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Training Program

Module 7: Project-Level GHG Baseline Determination for Energy Supply Facilities

Prepared for:
The United States Agency for International Development
under Contract LAG-I-00-98-00005-00, Task Order 16

Prepared by:
PA Government Services Inc.
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Washington, DC 200006-4506
USA
(202) 442-2000

September 2000
Updated September, 2002

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Module Contents

Overview

Background

This training module has been designed to help participants work through the various concepts associated with the development of project-level GHG baselines associated with investments in energy supply facilities in Ukraine. It is a new training course, developed specifically under the Climate Change Initiative's (CCI) near-term training program and represents the seventh in a series of nine training modules that focus on building awareness among a wide group of stakeholders on climate change issues.

Purpose of the Training

Experience gained from the pilot phase of Activities Implemented Jointly (AIJ) has demonstrated that the setting of GHG emission baselines is a difficult task. Several different approaches have been used, resulting in problems of credibility, transparency, and comparability. One of the greatest challenges in the development of baselines is to balance the need for high quality in analytical rigor and minimization of costs.

The purpose of this training package is to enable local analysts to estimate the GHG emission reductions resulting from investments in the following facility types:

- Electric power stations
- Industrial boilers
- District heating systems
- Coal mines

Quantitative exercises are built into the training with the purpose of providing practical guidance for estimating the amount of GHG emissions reduced compared to a baseline, as a result of an investment in a specific project that meets Joint Implementation criteria. The focus of these exercises is on quantifying GHG emission reductions that is likely to meet the criteria for Emission Reduction Units (ERUs), bearing in mind that these criteria have yet to be agreed upon by the Conference of Parties (COP). Several investment categories are included, as follows:

- Fuel switching at existing facilities (i.e., use of lower carbon emitting fuels such as natural gas in the place of coal),
- Improving thermal efficiency,
- Reducing losses in steam distribution,
- Capture, recovery, and utilization of methane from coal mines,
- Conversion to combined heat and power systems (CHP),
- Installation of new renewable energy facilities for electricity generation,

- Installation of new high-efficiency facilities for electric generation or heat production.

Objectives

The objectives of this module are to achieve an enhanced understanding of:

- What the context is for calculating GHG emission baselines (i.e., market-based environmental management, Kyoto Protocol, flexibility mechanisms)
- Why baselines are important and how they are calculated,
- What are the typical operational conditions in Ukraine for each of the four facility types targeted,
- How to make effective use of computer tools to calculate level GHG baselines and carbon reductions resulting from specific project investments.

Participation

The ideal audience for this module includes mid-level energy ministry officials and private organizations who need to estimate baselines and make judgments about the accuracy of baselines. Specifically, the course contents are targeted to the following audience categories:

- Those that are involved in and/or oversee operations at power stations, industrial boilers, district heating systems, and coal mines (i.e., those who would be putting the projects forward),
- Those within the Ukrainian government who would be involved in approving project baselines, and
- Those in the private and non-governmental communities who are interested.

Module Basics

- ***Duration***: 3 days
- ***Participants:*** 40-60 total; 10-15 per facility group
- ***Venue:*** Open
- ***Facilities (recommended):*** The module can be presented in any comfortable training facility with a large hall for plenary presentations (i.e., able to seat 60 people) and 4 small rooms for working group sessions for each of the facility types.
- ***Format:***

  - Day #1: Plenary sessions with combined group addressing core material relevant to each facility group;
  - Day #2: During morning, participants split up into 4 groups according to facility type. In the afternoon, participants remain in their separate groups and undertake working group exercises.
  - Day #3: During morning, participants remain in their separate groups and continue working group exercises. In the afternoon, participants reconvene in plenary session to make group presentations
- ***Instructors:*** 1 international specialist per facility type, 1 Ukrainian specialist per facility type
- ***Audio/Visual Needs:*** Overhead projector, overhead monitor, a sufficient number of computers to accommodate a maximum of three participants per computer.
- ***Contacts:*** Natalia Kulichenko and Natalya Parasyuk of CCI, Dan Thompson (USAID), Bill Dougherty and Michael Lazarus of Tellus Institute

Materials

The module provides several types of material for use during both the preparation of the workshop, and the workshop itself. This material is outlined below.

Session Overview: The session overviews are "blueprints" for each of the sessions. The overview of each session provides a summary of the session, listing basic information, such as the general objective, total time, and type of activities involved.

Presenters are encouraged to:

- review this guidance material carefully,
- note the time it takes to deliver each slide
- mark your comments and modifications in each page.

Overhead transparencies: OHTs are divided into sets according to sessions. Each set of OHTs is numbered consecutively and has titles based on their content. The precise order in which slides should be shown is presented in the corresponding Session Overview. Presenters are encouraged to give participants sufficient time to read and understand each OHT.

Analytical tools: Four computer models, developed for each of the four facility types considered, are included in this training package. The model was developed in Microsoft Excel Version 9.0. To be able to use these training tools, the computer must be loaded with Microsoft Excel Version 5.0 or higher.

Reading and Resources: The topic of GHG emission baseline estimation has a rapidly growing reference list. Citations for key reports are included for further reference. A large part of one report has been translated into Ukrainian and is provided in this package.

Evaluation Process

After delivery of the training, it is important to ask participants to evaluate the course in order to improve the workshop package for more effective subsequent use. The evaluation can be conducted using a simple questionnaire. Toward the close of the last day, the workshop organizer should ask the participants to take five to ten minutes to complete the evaluation form. Participants need to be asked to put down their names on the forms.

Module References

This is a new training package developed specifically for the Ukrainian Climate Change training program. Sources used in the development of the materials are based upon the citations in the Reading and Resources list cited above, and the experience of the international and local presenters.

Agenda

The agenda for Module Seven appears on the following pages.

Proposed Agenda for Module 7:

Baseline Determinations for Coal Mining Sector

DAY 1

09:00 – 9:30	REGISTRATION
09:30 – 9:45	WELCOME & COURSE OUTLINE
09:45 – 10:45	SESSION C-1: INTRODUCTION TO MARKET-BASED ENVIRONMENTAL MANAGEMENT
10:45 – 11:00	*BREAK*
11:00 – 12:00	SESSION C-2: KYOTO PROTOCOL MECHANISMS & ROLE OF PROJECT-LEVEL GHG BASELINES
12:00 – 13:00	*LUNCH*
13:00 – 14:00	SESSION C-3: UKRAINE'S TECHNOLOGY/POLICY CONTEXT FOR INVESTMENTS IN ENERGY SUPPLY TECHNOLOGIES
14:00 – 14:30	SESSION C-4: WHAT ARE THEY AND WHY DO THEY MATTER?
14:30 – 14:45	*BREAK*
14:45 – 15:45	SESSION C-5: HOW ARE THEY DETERMINED?
15:45 – 16:45	SESSION C-6: PANEL DISCUSSION (INTERNATIONAL EXPERTS)
16:45 – 17:00	DAY 1 SUMMARY

DAY 2

08:45 – 09:00	INTRODUCTION TO DAY 2 PROGRAM
09:00 – 9:40	SESSION CBM-1: OVERVIEW OF COAL MINING SECTOR IN UKRAINE (TRENDS, FEATURES, INVESTMENTS, ETC)
09:40 – 10:20	SESSION CBM-2: ESTIMATING BASELINES AND EFFECTIVENESS OF GEF COAL MINING METHANE PROJECT IN KUZBAS
10:20 – 10:30	*BREAK*
10:30 – 11:15	SESSION CBM-3: INVENTORY OF COAL-BED METHANE IN UKRAINE. SESSION CBM-4: COAL-BED METHANE OF UKRAINE: TECHNICAL AND INVESTMENT POTENTIAL OF COAL MINES IN UKRAINE
11:15 – 12:00	SESSION CBM-5: RESULTS OF COAL BED METHANE PROJECT IN UKRAINE
12:00 – 13:00	*LUNCH*
13:00 – 14:00	SESSION CBM-6: INTRODUCTION TO PROJECT-LEVEL BASELINE MODELING EXERCISE
14:00 – 14:15	*BREAK*
14:15 – 16:45	SESSION CBM-7: PROJECT MODELING WORKING GROUP EXERCISE • SMALL GROUPS
16:45 – 17:00	DAY 2 SUMMARY

DAY 3

08:45 – 09:00	INTRODUCTION TO DAY 3 PROGRAM
09:00 – 10:30	COAL BED METHANE PROJECTS: WORKING GROUP EXERCISE (CONTINUED) • SMALL GROUPS
10:30 – 11:00	*BREAK*
11:00 – 12:00	COAL BED METHANE PROJECTS: WORKING GROUP EXERCISE (CONTINUED) • SMALL GROUPS
12:00 – 13:00	*LUNCH*
13:00 – 14:30	SESSION C-7: PRESENTATION OF WORKING GROUP RESULTS
14: 30 – 15:00	*BREAK*
15:00 – 16:00	SESSION C-8: DISCUSSION OF RESULTS (INTERNATIONAL AND LOCAL EXPERTS)
16:00 – 16:30	SESSION C-9: COURSE SUMMARY & CONCLUSIONS

Proposed Agenda for Module 7:

Baseline Determinations for District Heating Sector

DAY 1

09:00 – 9:30	REGISTRATION
09:30 – 9:45	WELCOME & COURSE OUTLINE
09:45 – 10:45	SESSION C-1: INTRODUCTION TO MARKET-BASED ENVIRONMENTAL MANAGEMENT
10:45 – 11:00	*BREAK*
11:00 – 12:00	SESSION C-2: KYOTO PROTOCOL MECHANISMS & ROLE OF PROJECT-LEVEL GHG BASELINES
12:00 – 13:00	*LUNCH*
13:00 – 14:00	SESSION C-3: UKRAINE'S TECHNOLOGY/POLICY CONTEXT FOR INVESTMENTS IN ENERGY SUPPLY TECHNOLOGIES
14:00 – 14:30	SESSION C-4: WHAT ARE THEY AND WHY DO THEY MATTER?
14:30 – 14:45	*BREAK*
14:45 – 15:45	SESSION C-5: HOW ARE THEY DETERMINED?
15:45 – 16:45	SESSION C-6: PANEL DISCUSSION (INTERNATIONAL EXPERTS)
16:45 – 17:00	DAY 1 SUMMARY

DAY 2

08:45 – 09:00	INTRODUCTION TO DAY 2 PROGRAM
09:00 – 9:40	SESSION DH-1: OVERVIEW OF DISTRICT HEATING SECTOR IN UKRAINE (TRENDS, FEATURES, INVESTMENTS, ETC)
09:40 – 10:20	SESSION DH-2: COST AND PERFORMANCE CHARACTERIZATION OF EXISTING DHS TECHNOLOGY IN UKRAINE
10:20 – 10:30	*BREAK*
10:30 – 11:15	SESSION DH-3: GHG REDUCTIONS IN DISTRICT HEATING SYSTEMS (PART 1)
11:15 – 12:00	SESSION DH-4: GHG REDUCTIONS IN DISTRICT HEATING SYSTEMS (PART 2)
12:00 – 13:00	*LUNCH*
13:00 – 14:00	SESSION DH-5: INTRODUCTION TO PROJECT-LEVEL BASELINE MODELING EXERCISE
14:00 – 14:15	*BREAK*
14:15 – 16:45	SESSION DH-6: PROJECT MODELING WORKING GROUP EXERCISE • SMALL GROUPS
16:45 – 17:00	DAY 2 SUMMARY

DAY 3

08:45 – 09:00	INTRODUCTION TO DAY 3 PROGRAM
09:00 – 10:30	DHS PROJECTS : WORKING GROUP EXERCISE (CONTINUED) • SMALL GROUPS
10:30 – 11:00	*BREAK*
11:00 – 12:00	DHS PROJECTS : WORKING GROUP EXERCISE (CONTINUED) • SMALL GROUPS
12:00 – 13:00	*LUNCH*
13:00 – 14:30	SESSION C-7: PRESENTATION OF WORKING GROUP RESULTS
14: 30 – 15:00	*BREAK*
15:00 – 16:00	SESSION C-8: DISCUSSION OF RESULTS (INTERNATIONAL AND LOCAL EXPERTS)
16:00 – 16:30	SESSION C-9: COURSE SUMMARY & CONCLUSIONS.

Proposed Agenda for Module 7:

Baseline Determinations for Industrial Boilers

DAY 1

09:00 – 9:30	REGISTRATION
09:30 – 9:45	WELCOME & COURSE OUTLINE
09:45 – 10:45	SESSION C-1: INTRODUCTION TO MARKET-BASED ENVIRONMENTAL MANAGEMENT
10:45 – 11:00	*BREAK*
11:00 – 12:00	SESSION C-2: KYOTO PROTOCOL MECHANISMS & ROLE OF PROJECT-LEVEL GHG BASELINES
12:00 – 13:00	*LUNCH*
13:00 – 14:00	SESSION C-3: UKRAINE'S TECHNOLOGY/POLICY CONTEXT FOR INVESTMENTS IN ENERGY SUPPLY TECHNOLOGIES
14:00 – 14:30	SESSION C-4: WHAT ARE THEY AND WHY DO THEY MATTER?
14:30 – 14:45	*BREAK*
14:45 – 15:45	SESSION C-5: HOW ARE THEY DETERMINED?
15:45 – 16:45	SESSION C-6: PANEL DISCUSSION (INTERNATIONAL EXPERTS)
16:45 – 17:00	DAY 1 SUMMARY

DAY 2

08:45 – 09:00	INTRODUCTION TO DAY 2 PROGRAM
09:00 – 9:40	SESSION IB-1: EXPERIENCE IN DEVELOPING ENERGY EFFICIENCY MEASURES IN INDUSTRY OF UKRAINE (PART I)
09:40 – 10:20	SESSION IB-2: EXPERIENCE IN DEVELOPING ENERGY EFFICIENCY MEASURES IN INDUSTRY OF UKRAINE (PART II)
10:20 – 10:30	*BREAK*
10:30 – 11:15	GHG REDUCTIONS IN DISTRICT HEATING SYSTEMS (PART 1) *(JOINT SESSION WITH DISTRICT HEATING MODULE)*
11:15 – 12:00	GHG REDUCTIONS IN DISTRICT HEATING SYSTEMS (PART 2) *(JOINT SESSION WITH DISTRICT HEATING MODULE)*
12:00 – 13:00	*LUNCH*
13:00 – 14:00	SESSION IB-3: INTRODUCTION TO PROJECT-LEVEL BASELINE MODELING EXERCISE
14:00 – 14:15	*BREAK*
14:15 – 16:45	SESSION IB-4: PROJECT MODELING WORKING GROUP EXERCISE • SMALL GROUPS
16:45 – 17:00	DAY 2 SUMMARY

DAY 3

08:45 – 09:00	INTRODUCTION TO DAY 3 PROGRAM
09:00 – 10:30	INDUSTRIAL BOILER PROJECTS : WORKING GROUP EXERCISE (CONTINUED) • SMALL GROUPS
10:30 – 11:00	*BREAK*
11:00 – 12:00	INDUSTRIAL BOILER PROJECTS : WORKING GROUP EXERCISE (CONTINUED) • SMALL GROUPS
12:00 – 13:00	*LUNCH*
13:00 – 14:30	SESSION C-7: PRESENTATION OF WORKING GROUP RESULTS
14: 30 – 15:00	*BREAK*
15:00 – 16:00	SESSION C-8: DISCUSSION OF RESULTS (INTERNATIONAL AND LOCAL EXPERTS)
16:00 – 16:30	SESSION C-9: COURSE SUMMARY & CONCLUSIONS

Proposed Agenda for Module 7:

Baseline Determinations for Thermal Power Plants

DAY 1

09:00 – 9:30	REGISTRATION
09:30 – 9:45	WELCOME & COURSE OUTLINE
09:45 – 10:45	SESSION C-1: INTRODUCTION TO MARKET-BASED ENVIRONMENTAL MANAGEMENT
10:45 – 11:00	*BREAK*
11:00 – 12:00	SESSION C-2: KYOTO PROTOCOL MECHANISMS & ROLE OF PROJECT-LEVEL GHG BASELINES
12:00 – 13:00	*LUNCH*
13:00 – 14:00	SESSION C-3: UKRAINE'S TECHNOLOGY/POLICY CONTEXT FOR INVESTMENTS IN ENERGY SUPPLY TECHNOLOGIES
14:00 – 14:30	SESSION C-4: WHAT ARE THEY AND WHY DO THEY MATTER?
14:30 – 14:45	*BREAK*
14:45 – 15:45	SESSION C-5: HOW ARE THEY DETERMINED?
15:45 – 16:45	SESSION C-6: PANEL DISCUSSION (INTERNATIONAL EXPERTS)
16:45 – 17:00	DAY 1 SUMMARY

DAY 2

08:45 – 09:00	INTRODUCTION TO DAY 2 PROGRAM
09:00 – 9:40	SESSION PS-1: OVERVIEW OF COAL GENERATION IN UKRAINE (TRENDS, FEATURES, INVESTMENTS, ETC)
09:40 – 10:20	SESSION PS-2: GHG BASELINES: THERMAL POWER PLANTS OF UKRAINE
10:20 – 10:30	*BREAK*
10:30 – 11:15	SESSION PS-3: ESTIMATING BASELINES AND EFFECTIVENESS OF JOINT IMPLEMENTATION IN POWER PROJECTS IN EASTERN EUROPE
11:15 – 12:00	SESSION PS-4: GROUP DISCUSSION
12:00 – 13:00	*LUNCH*
13:00 – 14:00	SESSION PS-5: INTRODUCTION TO PROJECT-LEVEL BASELINE MODELING EXERCISE
14:00 – 14:15	*BREAK*
14:15 – 16:45	SESSION PS-6: PROJECT MODELING WORKING GROUP EXERCISE • SMALL GROUPS
16:45 – 17:00	DAY 2 SUMMARY

DAY 3

08:45 – 09:00	INTRODUCTION TO DAY 3 PROGRAM
09:00 – 10:30	COAL STATION PROJECTS: WORKING GROUP EXERCISE (CONTINUED) • SMALL GROUPS
10:30 – 11:00	*BREAK*
11:00 – 12:00	COAL STATION PROJECTS: WORKING GROUP EXERCISE (CONTINUED) • SMALL GROUPS
12:00 – 13:00	*LUNCH*
13:00 – 14:30	SESSION C-7: PRESENTATION OF WORKING GROUP RESULTS
14: 30 – 15:00	*BREAK*
15:00 – 16:00	SESSION C-8: DISCUSSION OF RESULTS (INTERNATIONAL AND LOCAL EXPERTS)
16:00 – 16:30	SESSION C-9: COURSE SUMMARY & CONCLUSIONS

MODULE 7: BASELINE DETERMINATIONS

Common Sessions

Session C-1: Introduction to Market-based Environmental Management

- **General Objectives:**

  Session C-1 is an introduction to market-oriented environmental management. It is intended to give a broad overview of the transition from command/control regulation towards a regulatory system that utilizes economic instruments. In this context, the Kyoto Protocol flexibility mechanisms can be seen as "quantity-based" (as opposed to price-based) instruments.

  This session will, of necessity, rely upon the experience and knowledge of the individual who makes the presentation. It would be helpful if that individual addresses the following topics, which were included in the initial training program offered in September, 2000:

  - The historical basis for command/control;
  - The engineering approach to pollution control;
  - The development of marginal cost and benefit curves;
  - Setting environmental goals using economics;
  - Utilizing price-based mechanisms to achieve these goals;
  - Utilizing quantity-based mechanisms to achieve these goals;
  - The historical development of U.S. quantity-based mechanisms and emissions trading:
    - The Emissions Trading Program
    - The Acid Rain Control Program
    - The NOx Budget Control Program
  - The Kyoto Protocol Flexibility Mechanisms as quantity-based mechanisms;
  - Summary of market-based environmental management.

  By the end of the session, participants should thus have a basic understanding of:

  - how market-oriented environmental management operates;

- recent experience in utilizing it; and
- the role of the Kyoto Protocol flexibility mechanisms as economic instruments.

- **Activities:** Presentation, followed by period of questions and answers
- **Total Time:** 60 minutes

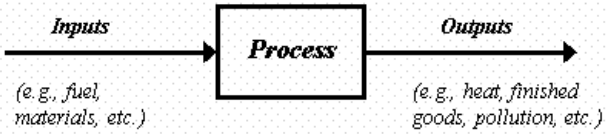
GHG Baselines:
Introduction to Market-Based Environmental Management

Session C-1

Module 7: Project-Level GHG Baseline Determination

Slide 1

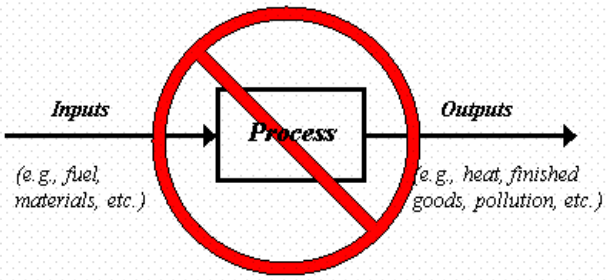
An Engineer's View



Slide 2

Pollution Control Options

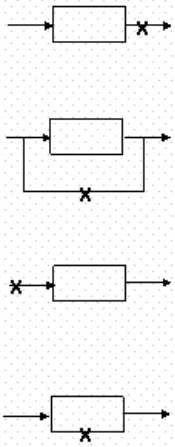
A. Prohibition



Slide 3

Pollution Control Options

B. Engineers' Approach



Emission standards
limit the amount of pollution being emitted (e.g., tons/year, pounds per day, etc.)

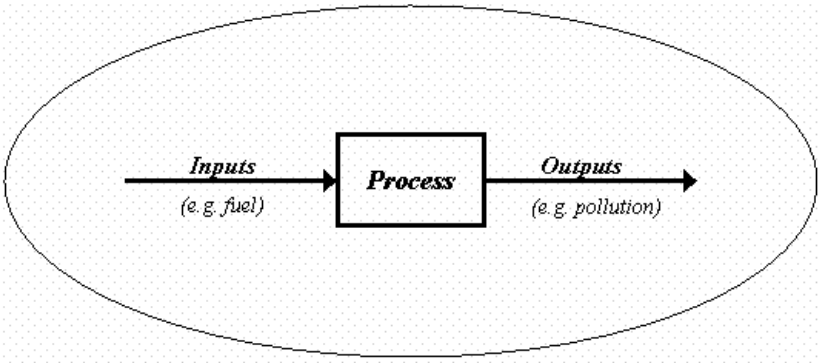
Performance standards
limit the amount of pollution being emitted based on the amount of material being processed (e.g., pounds of SO_2 per million BTUs of heat input from the fuel source).

Input/Product standards
limit the quality of materials, e.g. fuels, which can be used (e.g. limits on sulfur content of distillate and fuel oils).

Design standards
tell the polluter how the process must be designed (e.g., to minimize wastage of materials).

Slide 4

But Where is Environment?



Environment

Slide 5

Command/Control Regulation

Goals

physical modeling

Environmental Quality Standards

Regulatory Means

A. Prohibitions

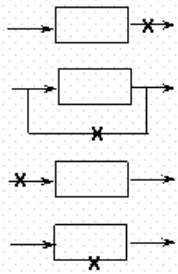
B. Technology-Based Standards

Emission Standards

Performance Standards

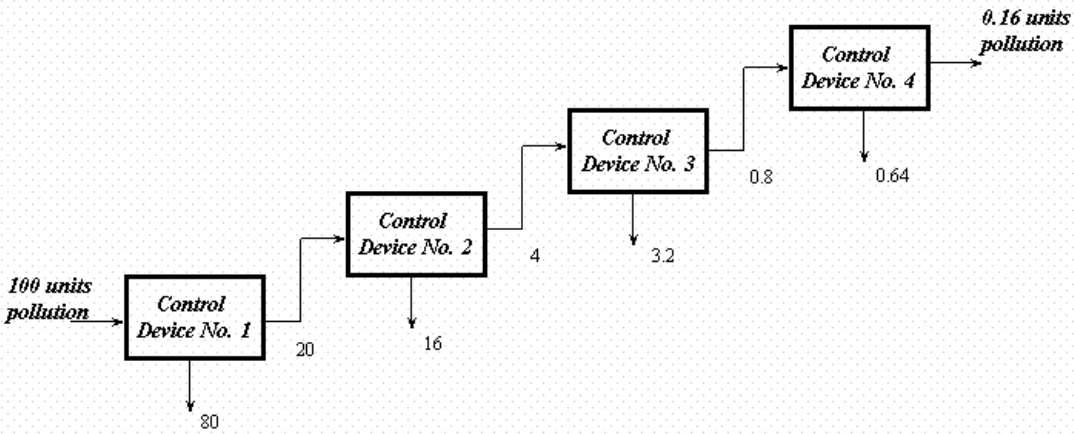
Input/Product Standards

Design Standards



Slide 6

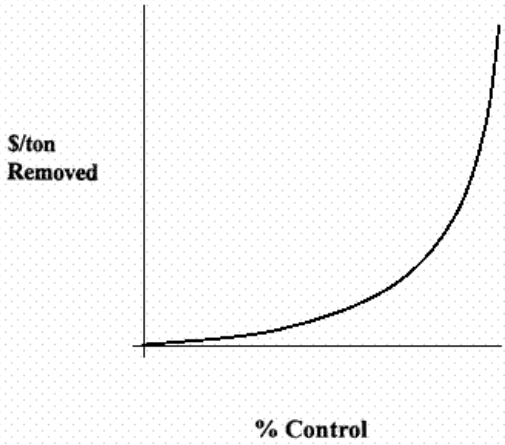
Incremental Pollution Control Improvements



Pollution Units Removed	80	16	3.2	0.64
% Control	80%	96%	99.2%	99.84%

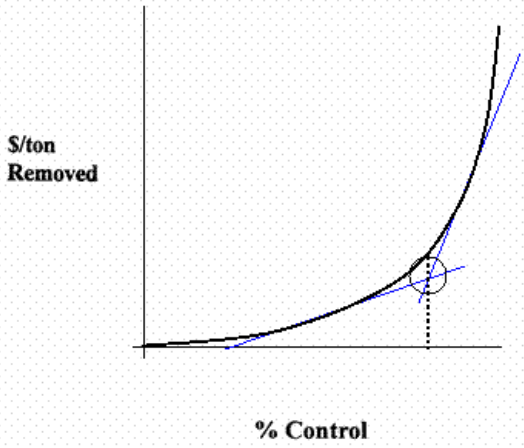
Slide 7

MC Curve



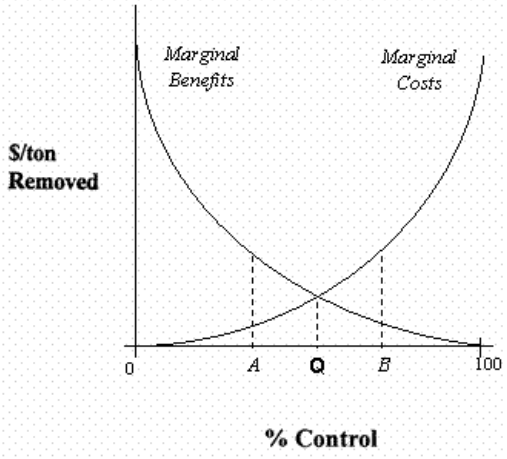
Slide 8

"Kink" in Curve



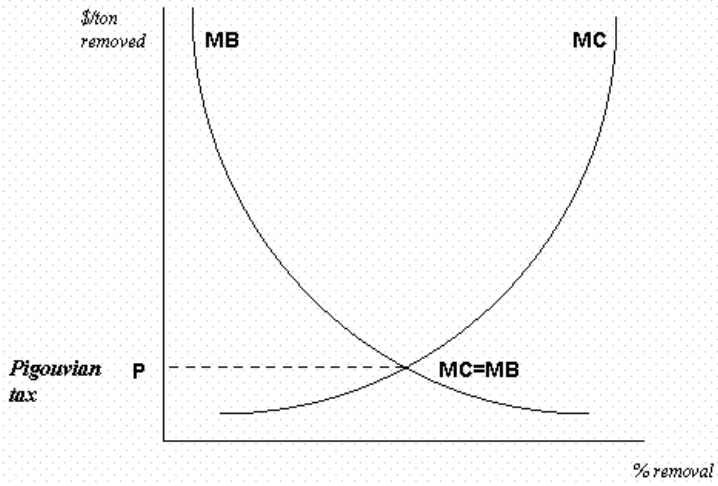
Slide 9

Marginal Costs and Benefits



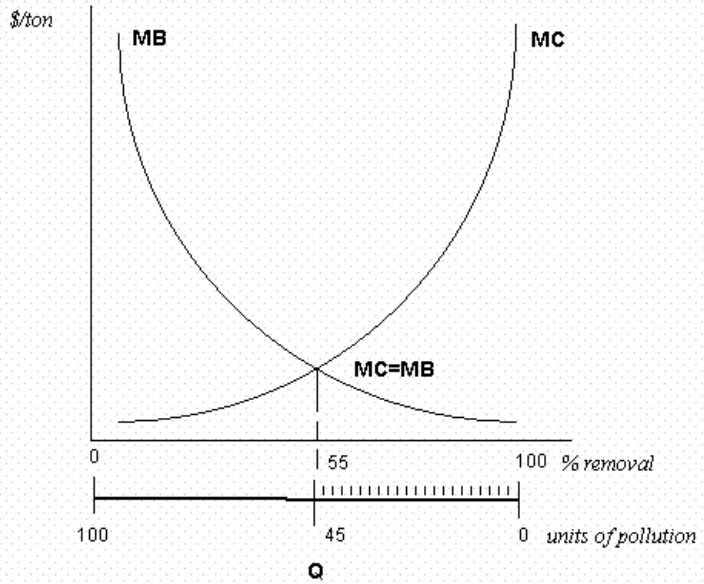
Slide 10

The Price-Based Approach: Pigouvian Taxation



Slide 11

The Quantity-Based Approach: Marketable Permits



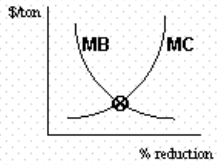
Quantity Emission Limitation

Slide 12

Economic Regulatory Approach

Goals

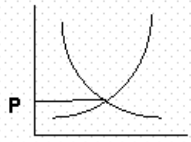
Marginal Costs (MC) = Marginal Benefits (MB)



Regulatory Means

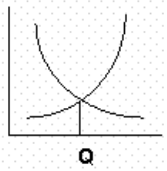
Pollution Taxes (Price-based)

Pigouvian taxation



Pollution Markets (Quantity-based)

Marketable Permits



Slide 13

Key Properties of Economic Mechanisms

- Governments focus on environmental goals, rather than stack-by-stack means.
- Economic efficiency gives comparable levels of environmental quality for lower costs.
- Efficiency can influence goal setting (i.e., savings targeted towards environment).
- Every ton of pollution has costs, giving facilities an incentive for reduction.

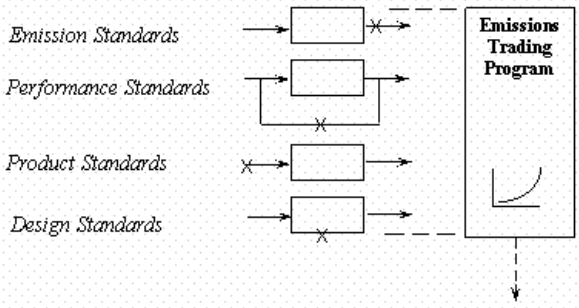
Slide 14

Emissions Trading Program

Goals — ***Environmental Quality Standards***

Regulatory Means

1. ***Prohibitions***
2. ***Technology-Based Standards***



Brokerage Opportunities

Emission Reduction Credits (ERCs)

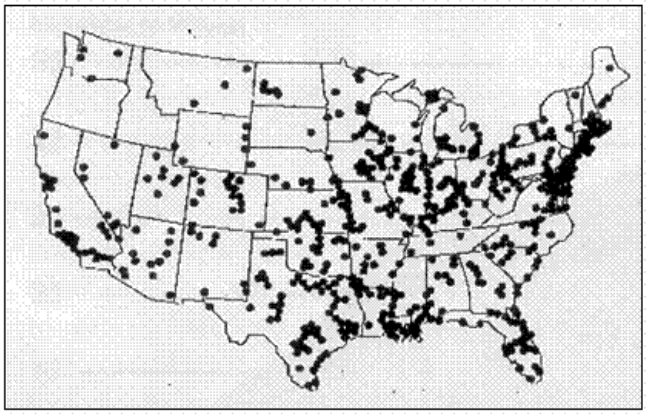
Slide 15

Acid Rain Control Program

Goals	*Localized SO_2 Levels*	*Total SO_2 Loading*
Regulatory Means	*1. Prohibitions* *2. Technology-based Standards* *Emission Stds.* *Performance Stds.* *Product Stds.* *Design Stds.*	*Pollution Markets (Q-based)* *Nation-wide Market (Allowance Tracking System)*
Brokerage Opportunities	***Emissions Trading Program*** → ***ERCs***	***Emission Allowances***

Slide 16

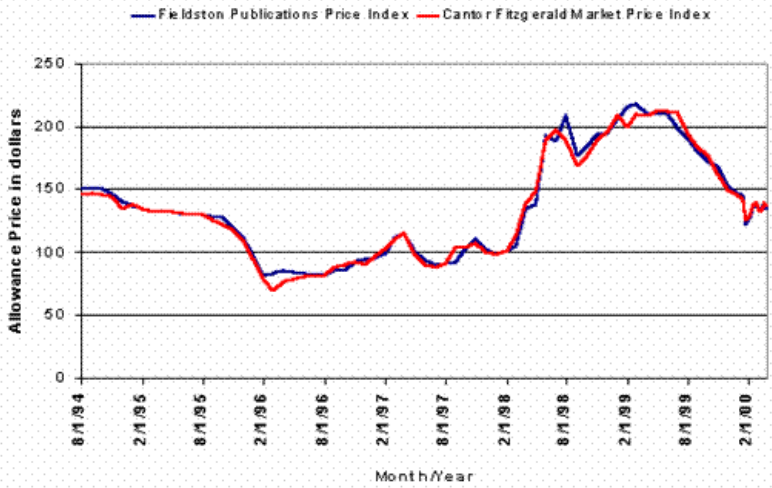
Acid Rain Control Affected Sources



2000+ Electric Utility Units

Slide 17

Monthly Average Price of Sulfur Dioxide Allowances



Slide 18

Ozone Control Program

Goals — ***Environmental Quality Standards***

Regulatory Means

1. *Prohibitions*
2. *Technology-based Standards*

Emission Stds.

Performance Stds.

Product Stds.

Design Stds.

Emissions Trading Program

Pollution Markets (Q-based)

City/Regional Markets

Examples:
Northeast U.S. "NOx Budget"

Los Angeles "RECLAIM" Program

Illinois "Clean Air Market"

Brokerage Opportunities

ERCs & Discrete Emissions Reductions (DERs)

NOx/VOC Emission Allowances

Slide 19

NOx Budget

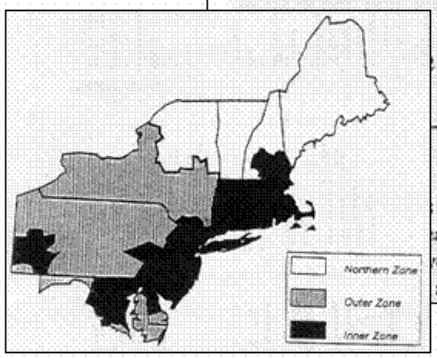
The NOx Budget: market-based control of tropospheric ozone in the northeastern United States

Alex Farrell [a,*], Robert Carter [b], Roger Raufer [b]

[a] Harvard University, Cambridge, MA, USA
University of Pennsylvania, Philadelphia, PA, USA

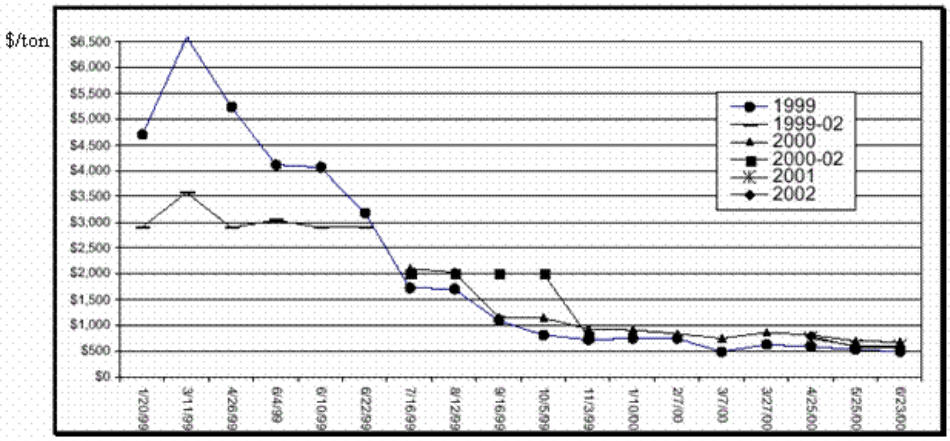
May 1998; revised 12 August 1998; accepted 21 August 1998

a marketable emissions allowance system currently being adopted
astern US to reduce tropospheric ozone concentrations to healthful
e manner. Oxides of nitrogen (NOx) are currently regulated within
and Control (CAC) framework. The introduction of a market-based



Slide 20

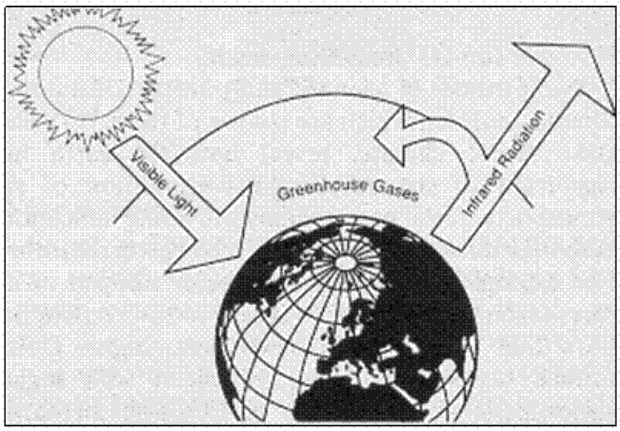
NOx Budget Allowance Prices



Source: Cantor Fitzgerald, June '00

Slide 21

The Greenhouse Effect



Source: GAO, '90

Slide 22

Global Warming P vs. Q Debate

FOREIGN AFFAIRS
Founded 1922

Toward a Real Global Warming Treaty

Richard N. Cooper

THE CHALLENGE AFTER KYOTO

IN DECEMBER 1997 the world's nations met in Kyoto to grapple with the problem of global warming. The Kyoto conference garnered a wide variety of assessments, ranging from "a notable success"

FOREIGN AFFAIRS · *March/April 1998*

Response

Stick with Kyoto

A Sound Start on Global Warming

Stuart Eizenstat

of the recent Kyoto accord, ooper notes that mitigating e will not be easy ("Toward Warming Treaty."

taxes. But his belief that ag a tax might be easier than se targets is out of touch with p Even if it could be arranged

FOREIGN AFFAIRS · *May/June*

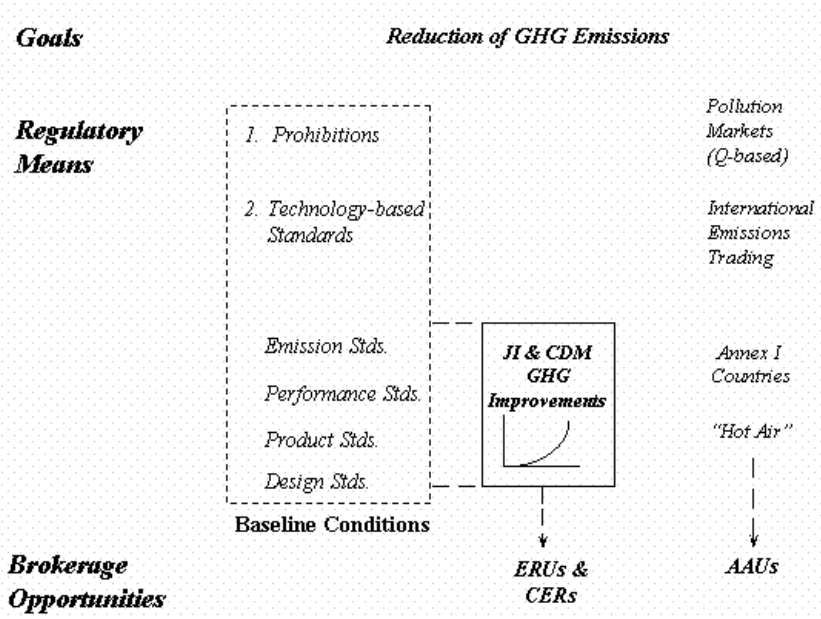
Slide 23

Q-Based Kyoto Flexibility Mechanisms

- Article 6: Joint Implementation
  - Transfer of "emission reduction units"
  - Project-based, effective 2008-2012
- Article 12: Clean Development Mechanism
  - Transfer of "certified emission reductions"
  - Banked after 2000, used during 2008-2012
- Article 17: International emissions trading
  - Transfer of "assigned amount"
  - Annex I countries, 2008-2012

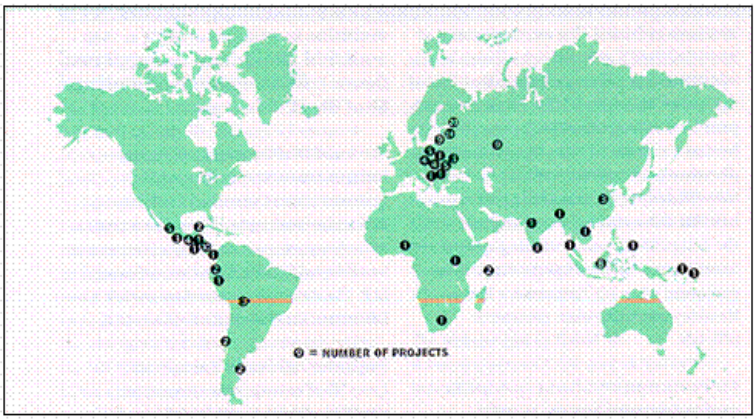
Slide 24

GHG Q-Based Program



Slide 25

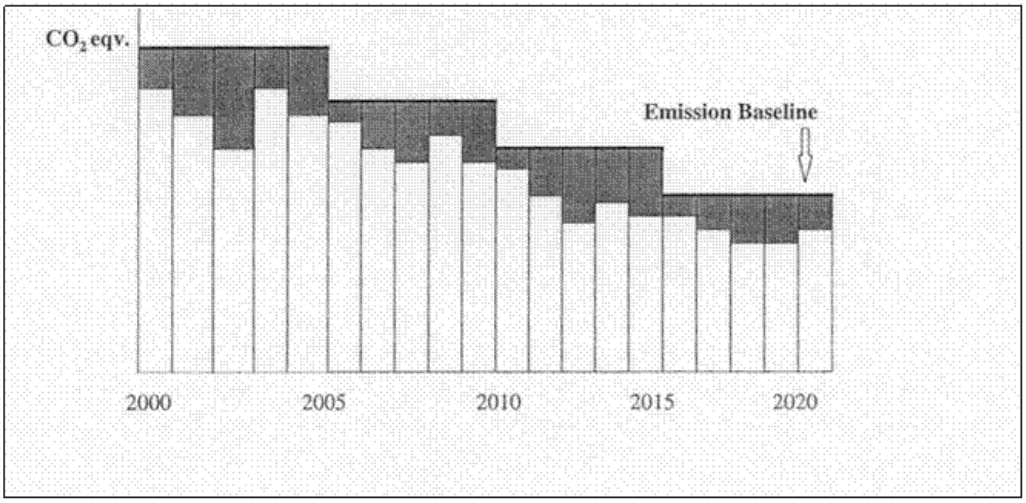
Planned and Ongoing AIJ & JI Projects



Source: JI Quarterly, Dec. '99

Slide 26

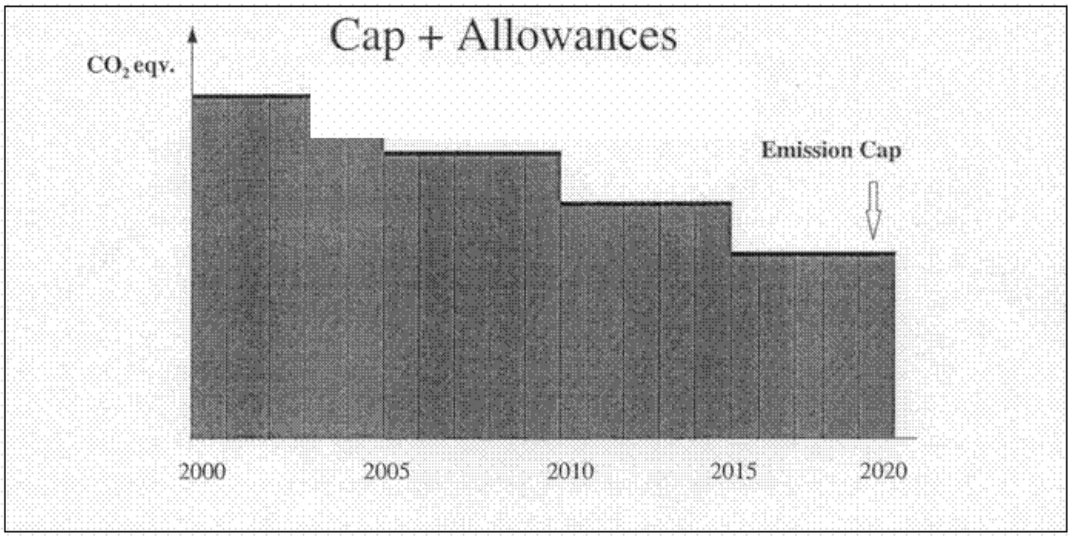
Baseline and Credits



Source: OECD 1997

Slide 27

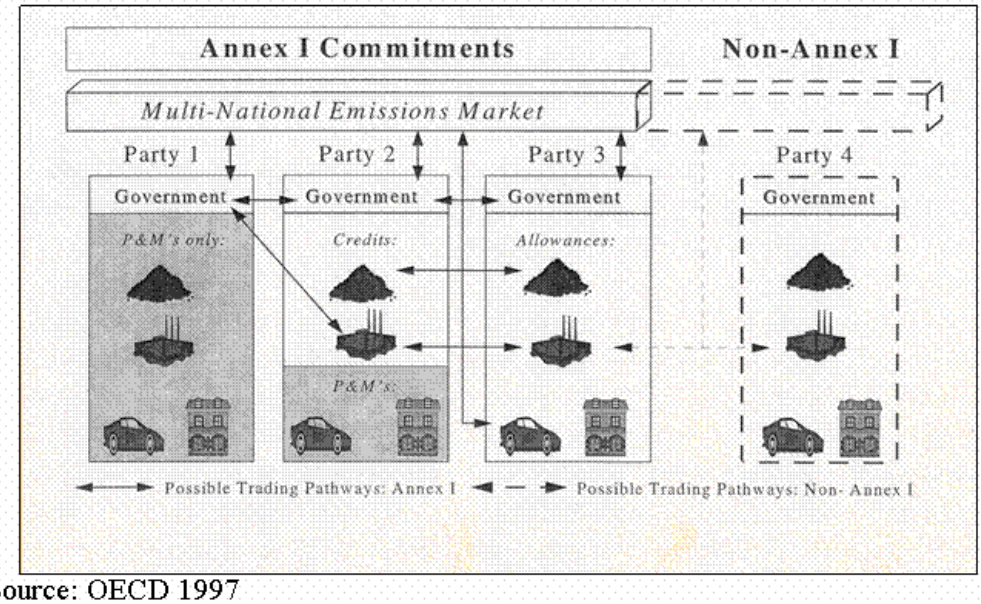
Cap + Allowances



Source: OECD 1997

Slide 28

Possible International GHG Emission Trades



Source: OECD 1997

Slide 29

Thirty-Five Years of EM Experience

- Command/control regulation won the early battles.
- Economics became increasingly important as societies climbed the marginal cost curve.
- A hybrid regulatory system has developed.

Slide 30

Thirty-Five Years of EM Experience

- Environmental goals set under the command/ control approach, but increasingly employing economic regulatory means.
- The U.S. tends to prefer quantity-based economic mechanisms.
- European and other countries tend to prefer price-based mechanisms.

Slide 31

Thirty-Five Years of EM Experience

- The transition has been gradual, with incremental improvements to increase economic efficiency.
- There has been an increased reliance on advanced technological systems (i.e., CEMs) to measure emissions.
- The economic mechanisms have relied on the regulatory infrastructure established under the command/control framework.

Slide 32

Thirty-Five Years of EM Experience

- The physical characteristics of the pollutant should influence the selection of the economic instrument.
- Broader pollutant markets work better.
- The future will increasingly rely on economic mechanisms.

Slide 33

MODULE 7: BASELINE DETERMINATIONS

Session C-2: Kyoto Protocol Mechanisms & Role of Project-Level Baselines

Overview

- **General Objectives:**

  Session C-2 is an introduction to the United Nations Framework Convention on Climate Change, the Kyoto Protocol, and the reasons for calculating project baselines. It seeks to provide participants with an overview of the international response to the challenges of climate change, and particularly the role of the flexibility mechanisms. It also presents on-going climate change actions at the company/firm level, taken even without any Protocol ratification.

  By the end of the session, participants should have a basic understanding of the following:

  a) Historical perspective on climate change actions;
  b) The role of the UNFCCC and Kyoto Protocol;
  c) The role of the Protocol's flexibility mechanisms;
  d) Difficulties in implementing the individual flexibility mechanisms;
  e) Actions of individual companies even before Protocol ratification.

- **Activities:** Presentation, followed by period of question and answer

- **Total Time:** 60 minutes

- **Materials:** Set of 36 OHTs

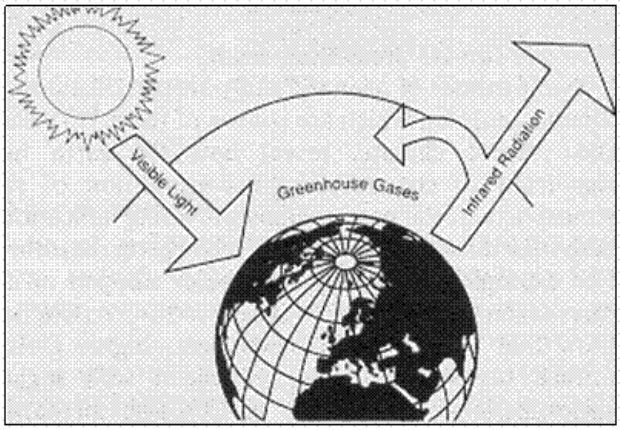
GHG Baselines: Kyoto Protocol Mechanisms and Role of Project Level GHG Baselines

Session C-2

Module 7: Project-Level GHG Baseline Determination

Slide 1

The Greenhouse Effect



Source: GAO, '90

Slide 2

Greenhouse Gas Mechanism

- Svante Arrhenius, 1903 winner of Nobel Prize in Chemistry
- Published paper in 1896 *Philosophical Magazine* identifying greenhouse gas effect
  - Trying to understand Ice Ages
  - Recognized that the "industrial development of our time" led to increased CO_2
  - Predicted that doubling CO_2 would lead to increases of several degrees in temperature

Slide 3

Earth Summit in Rio

- 1992 U.N. Conference on Environment and Development (UNCED), Rio de Janiero, Brazil
- Set up U.N. Framework Convention on Climate Change (UNFCCC)
- 175 countries signed, agreeing to reduce CO_2 emissions to 1990 levels by 2000
- Voluntary measures only

Slide 4

Kyoto Protocol to the UNFCCC

- This first Protocol to UNFCCC drafted in 1997
- Annex 1 (developed) countries committed to reduce emissions
- Introduced "flexibility mechanisms" to help achieve these reductions
- Must be ratified by legislative bodies in 55 countries, representing 55% of Annex I 1990 GHG emissions
- U.S. signed in 1997, but in 2001, the U.S. withdrew support for Protocol

Slide 5

Key Outcomes at COP-7

- **Compliance regime sets forth consequences for failing to meet targets**
- **Set criteria for a Party's eligibility to participate in flexibility mechanisms and set the operating rules for JI and CDM**
- **Allows full fungibility of credits under all flexibility mechanisms, but limits "over-selling" of assigned amounts (AAUs)**
- **Allows banking of credits, but puts limits on banking of JI and CDM credits**
- **Sets rules for use of sinks and creates new "Removal Unit" (RMU) for carbon sequestered through land use/forestry in Annex I countries**
- **Russia allowed much more credit for forest management activities**

Slide 6

Key Outcomes re JI at COP-7

- Established a JI Supervisory Committee
- Established second track for JI for Annex I countries with poor monitoring/reporting. This track will have tougher guidelines similar to CDM
- JI projects can begin generating credits in 2008, but a project can have started anytime after 2000

Slide 7

Issues for future COP's

- **Will the consequences called for in the compliance regime be "legally binding" (under international law) or merely "politically binding"?**
- **Will developing countries undertake voluntary emissions limitation commitments?**
- **Will financial assistance and technology transfer to developing countries be enhanced?**
- **Discussion on reduction targets and commitments for the post-2012 period will begin by 2005.**

Slide 8

GHG Market Is Emerging

- Despite uncertainties, an "unofficial" GHG market is emerging in anticipation of Kyoto or something like Kyoto being ratified in the future
- Market has companies participating from many countries, e.g., U.S., Canada, Europe, Japan, Australia
- Market has sophistication of trades, forward contracts, futures contracts
- Worldwide players involved, e.g., Price Waterhouse Coopers, Deloitte Touche, NatSource
- Allows early engagement and learning

Slide 9

Greenhouse Gases Covered Under Kyoto Protocol

- Carbon dioxide (CO_2)
- Methane (CH_4)
- Nitrous oxide (N_2O)
- Hydrofluorocarbons (HFCs)
- Perfluorocarbons (PFCs)
- Sulfur hexafluoride (SF_6)

Slide 10

Reduction Commitments

- Overall reduction: 5.2% from 1990 baseline
  - 8% reduction for EU, most Eastern Europe, & Switzerland
  - 7% reduction for U.S.
  - 6% reduction for Canada, Hungary, Poland & Japan
  - 5% reduction for Croatia
  - 0% (stabilization) for Russia, Ukraine & New Zealand
  - Increases for Norway, Iceland and Australia

Slide 11

Q-Based Kyoto Flexibility Mechanisms

- Article 6: Joint Implementation
  - Transfer of "emission reduction units"
  - Project-based, effective 2008-2012
- Article 12: Clean Development Mechanism
  - Transfer of "certified emission reductions"
  - Banked after 2000, used during 2008-2012
- Article 17: International emissions trading
  - Transfer of "assigned amount"
  - Annex I countries, 2008-2012

Slide 12

Joint Implementation

- Article 6.1
  - "For the purpose of meeting its commitments under Article 3, any Party included in Annex I may transfer to, or acquire from, any other such Party emission reduction units resulting from projects aimed at reducing anthropogenic emissions by source or enhancing anthropogenic removals by sinks of greenhouse gases in any sector of the economy"

Slide 13

Joint Implementation (JI)

- JI pilot program included in FCCC (1992)
  - Project oriented, voluntary
- Expanded in 1995 (to 2000)
  - Activities Implemented Jointly (AIJ)
- Kyoto Protocol creates
  - JI for projects within Annex I countries.
  - Clean Development Mechanism for developing countries.

Slide 14

Joint Implementation Under the Kyoto Protocol

- Project-based
- Annex I countries only
- Emission reduction units (ERUs) only effective in 2008-2012

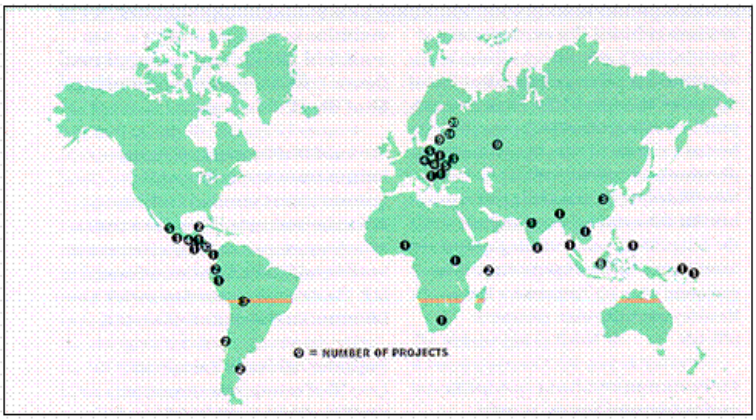
Slide 15

JI Concerns

- Transaction costs
- Project baselines
- Monitoring, evaluation, reporting & verification (MERV) requirements
- Meaning of: "a reduction…*additional* to any that would otherwise occur…" (Art. 6.1.a)

Slide 16

Planned and Ongoing AIJ & JI Projects



Source: JI Quarterly, Dec. '99

Slide 17

Clean Development Mechanism

- Article 12.2
  - "The purpose of the clean development mechanism shall be to assist Parties not included in Annex I in achieving sustainable development and in contributing to the ultimate objective of the Convention, and to assist Parties in Annex I in achieving compliance with their quantified emissions limitation and reduction commitments under Article 3."

Slide 18

CDM

- Adopted in 1997 Kyoto Protocol
- Both Annex I and non-Annex I countries can participate
- Voluntary, project-based
- Certified emissions reductions (CERs) banked after 2000

Slide 19

CDM Concerns

- Transaction costs
- Project baselines
- MERV requirements
- Same "additionality" requirements
- Must provide "real, measurable, long-term benefits"

Slide 20

International Emissions Trading

- Article 16 bis

  The Parties included in Annex B may participate in emissions trading for the purposes of fulfilling their commitments under Article 3 of this Protocol. Any such trading shall be supplemental to domestic actions for the purpose of meeting quantified emission limitation and reduction commitments under that Article.

Slide 21

IET

- Countries assigned an emissions budget, based on 1990 emissions
- Can sell their excess reductions, or purchase from others if exceeding their budget

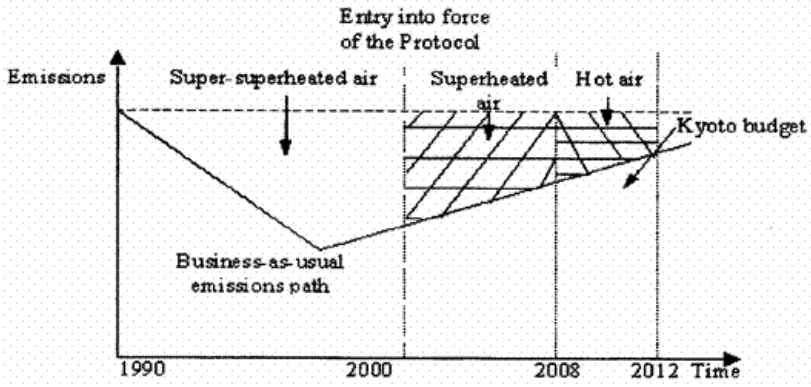
Slide 22

IET Concerns

- Development of rules, modalities, etc.
- MERV concerns
- Role of "Hot Air"
- Trading entity
  - government, firms, etc.

Slide 23

The "Hot Air" Debate



Source: www.hotair.org

Slide 24

Private Sector Transactions – A Sampling

- 150+ AIJ & JI projects
- SGS "CTOs" for 15+ M tonnes $C_{eq.}$ for Costa Rica
- APSCo. 25,000 SO2 EAs for 1.75 M tons CO_2 from Niagara Mohawk Power Corp.
- TransAlta & Hamburgische Electricitas-Werke AG. in 1st trans-Atlantic CO_2 trade

Slide 25

Private Sector Trading Systems

BP Amoco

Shell's Tradeable Emission Permit System

Slide 26

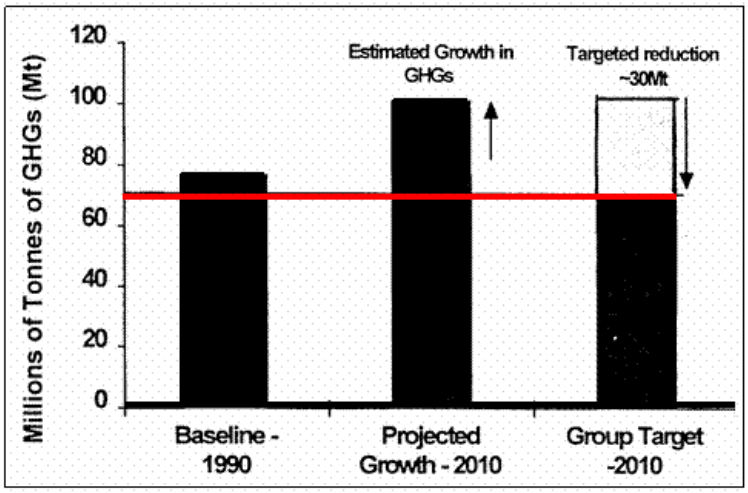
BP Amoco Emissions Trading

"Our goal is to reduce our emissions of greenhouse gases by 10% from a 1990 baseline over the period to 2010."

Sir John Browne,
September, 1998

Slide 27

BP Amoco Estimated Reduction Target Incorporating Growth



Source: BP Amoco

Slide 28

BP Amoco Emissions Trading

- Four business streams
  - Exploration and production
  - Refining and marketing
  - Chemicals
  - Natural gas and power
- 127 business units (BUs) in 100 countries
- 40 BUs account for ~80% of emissions
- All BUs receive "allowance" allocation (1998 baseline)

Slide 29

BP Amoco Emissions Trading

- Allowance = 1 metric tonne CO_2 equiv.
- CO_2 and CH_4 traded (GWP 1:21)
- Meet annual target, otherwise buy or sell
- Registry and brokerage in oil trading unit
- Began 1/1/00
- By April, 398,000 tonnes traded
- Average price ~ $11

Slide 30

BP Amoco Emissions Trading

- Lessons Learned
  - Raised awareness of climate change issue
  - Created innovative business strategies
  - Quantified financially GHG implications of investment decisions

Slide 31

Shell's Tradeable Emission Permit System (STEPS)

- Purpose
  - Demonstrate feasibility & merit of ET
  - Gain practical experience
  - Identify least cost opportunities for emissions reductions
- Target
  - Reduce 1990 GHG emissions by more than 10% in 2002

Slide 32

STEPS

- Five core businesses
  - Exploration and production
  - Oil products
  - Chemicals
  - Gas and power
  - Renewables
- Operating in more than 130 countries
- Company emits 140M tonnes/yr, approximately the same as Belgium

Slide 33

STEPS

- Voluntary for business units
- Restricted to units in Annex I countries
- Six business units in Exploration & Production, Oil Products, and Chemicals signed up:
  - Represent ~1/3 of emissions
  - Represent >1/2 of Annex I emissions

Slide 34

STEPS

- Business units receive "permits" (allocated using 1998 baseline)
- First year: 95% of allocation; 5% held for auction
- Permit = 100 metric tonne CO_2 equiv.
- CO_2 and CH_4 traded (GWP 1:21)
- Meet annual target, otherwise buy or sell
- Registry and brokerage in electricity/gas trading unit
- 1/1/00 – 12/31/02 duration

Slide 35

Market Prices

- IET: $20-50/tonne CO_2
- JI ERUs: $8-37/tonne CO_2
- CDM CERs: $6-9/tonne CO_2
- Market prices expected to harmonize, depending upon rules.
- Market actual: $0.5-4/tonne CO_2

Adapted from: Woerdman, 2000

Slide 36

The New Commodity Market?

Slide 37

MODULE 7: BASELINE DETERMINATIONS

Session C-3: Ukraine's Technology/Policy Context for Investments in Energy Supply Technologies

In compliance with the preliminary agenda we suggest that presentations should cover the review of Ukraine's technology/ policy context for investments in energy supply technologies.

Information should be updated depending on the development of new programs and strategies in this sphere of activity.

It is recommended to invite authors of programs and strategies for presentation of their developments.

MODULE 7: BASELINE DETERMINATIONS

Session C-4: Baselines: What are they and why do they matter?

Overview

General Objectives: By the end of the session, participants should have a clear understanding of importance of an accurate determination of baselines in the development of JI project ideas. Specifically:

- An adequate definition of baseline emissions is critical for the justification of the environmental benefits generated by a JI project,
- Various approaches are possible for determining. Many issues remain unresolved,
- Baseline approaches differ in costs, transparency, data, and monitoring.

Activities: An overhead slide presentation, followed by period of questions and answers

Total Time: 45 minutes

Materials: Set of 24 OHTs

GHG Baselines: What Are They and Why Do They Matter?

Session C-4

Module 7: Project-Level GHG Baseline Determination

Slide 1

Overview of Presentation:

- Background
- Approaches
- Issues
- Sharing of Carbon Credits
- Monitoring and Reporting

Slide 2

Joint Implementation:

- ✓ JI is a *project-based* instrument for reducing GHG emissions
- ✓ Investor provides capital, financing, access to technology & technical support, etc.
- ✓ This makes possible a project that reduces host entity emissions.
- ✓ The emissions reductions are quantified, and credit is transferable to investor.
- ✓ Time period for crediting emission reductions: 2008 - 2012

Slide 3

Joint Implementation: Who are the Players?

- ✓Host Country
- ✓Investor or Developer
- ✓National JI office
- ✓Operational Entities
- ✓Verification and validation entities

Slide 4

JI Energy Supply Investments: Some Examples

✓ Greenhouse Gas Emissions Reduction: (new facilities and retrofits)

- electricity production (renewables, plant efficiency, fuel switching)
- natural gas extraction and distribution
- oil extraction and refining
- coal mining and processing
- cogeneration of heat and power
- district heating

Slide 5

Sequence for JI Project Development

	Document/Activity	Responsible:
Project Design Phase	Project design documents	Project developer
	Baseline study	Project developer
	Monitoring Plan	Project developer
	Validation of project design, baseline study and monitoring plan	Validation/verification bodies
Selection and registration of projects		
Project implementation and Operation Phase	Project design documents	Project developer
	Project design documents	Project developer
	Validation of monitored project emissions	Validation/verification bodies

Source: ERUPT, 2000

Slide 6

What Are Baselines?

- ✓ Baselines are a quantitative reference by which to measure the "***environmental benefits***" of a JI project
- ✓ They are defined as the estimated project emissions ***in the absence of the JI project***
- ✓ They are the emissions that would have otherwise happened. They are not ***monitored***

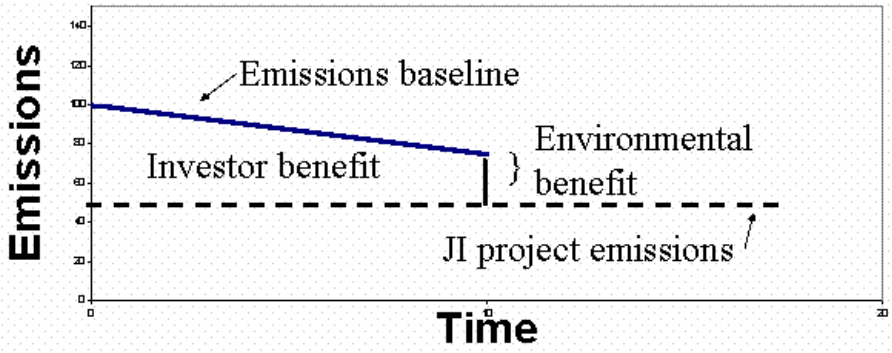
Slide 7

Why do We Need Baselines?

- ✓ JI projects must result in "*measurable" environmental benefits*
- ✓ Impossible to claim *that a project yields "measurable environmental benefits"* without a quantitative reference scenario
- ✓ Thus, baselines are extremely important because they are the basis for determining earned "***emission reduction units***" for a project

Slide 8

Baseline Terms



Slide 9

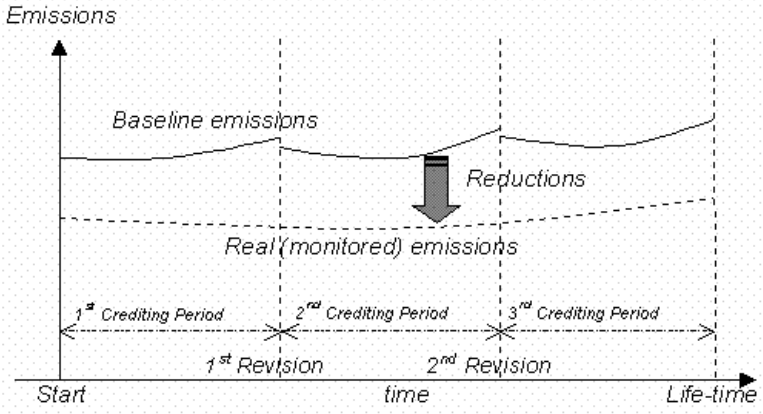
Emissions Additionality

"... and reductions of emissions that are additional to any that would occur in the absence of the certified project activity." [Kyoto Protocol]

- ✓ What would have occurred otherwise?
- ✓ What is the counter-factual "baseline" situation ?
- ✓ What are the project emissions?
- ✓ What no-regrets options are additional?
- ✓ Might there be significant leakage ?
- ✓ *JI* based on closed transfers

Slide 10

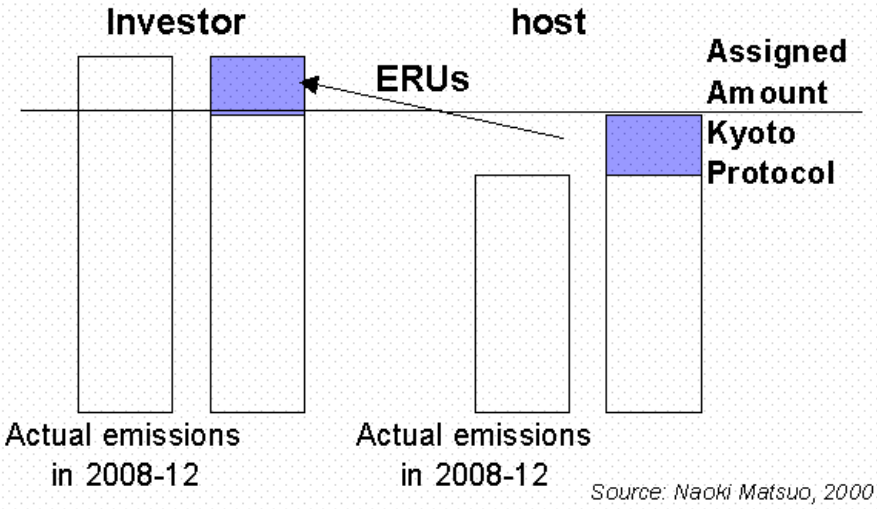
What Do We Mean by "Additionality" ?



Source: Naoki Matsuo, 2000

Slide 11

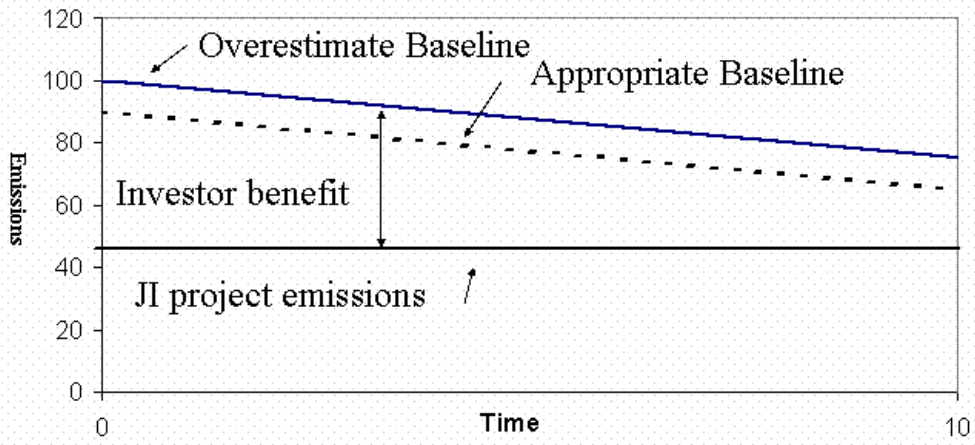
Earned Reduction Unit Transfer from Host to Investor



Source: Naoki Matsuo, 2000

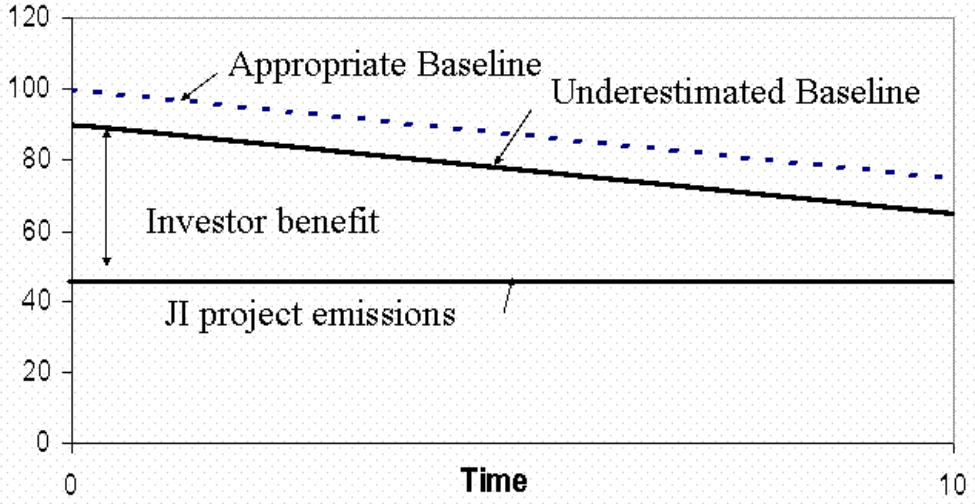
Slide 12

Impact of Overly Lax Baselines



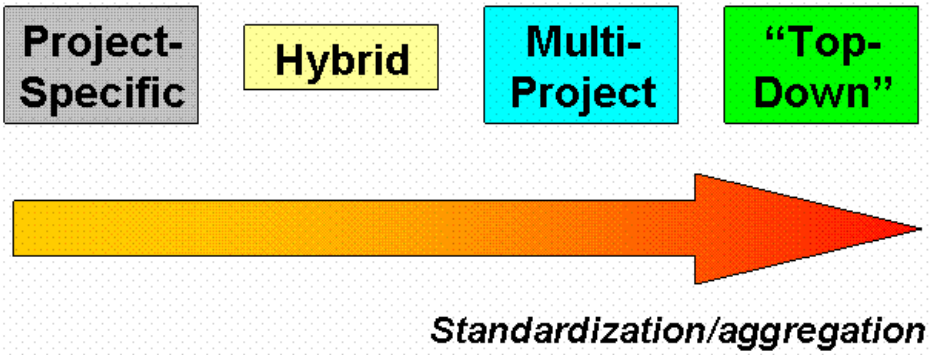
Slide 13

Impact of Overly Stringent Baselines



Slide 14

Baseline Approaches



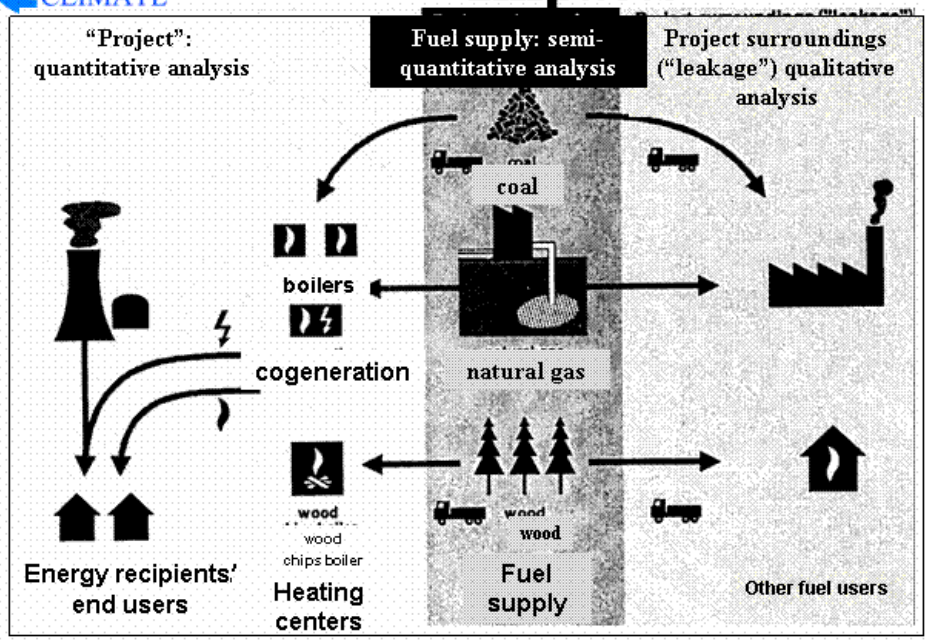
Slide 15

What Are the Major Approaches to Setting a Project Baseline?

- ✓ Method-based approaches
- ✓ Comparison-based approaches
- ✓ Simulation-based approaches
- ✓ Mixed-use approaches
- ✓ Existing approaches used by the international community

Slide 16

Range of GHG Emission Impacts



Slide 17

Major Issues in Setting Baselines

- ✓ Comparing Environmental vs. Economic Efficiency
- ✓ Establishing Evaluation Criteria
  - Credibility
  - Simplicity
  - Transparency
  - Crediting Certainty
  - Understanding the tradeoffs

Slide 18

Effect of Baseline Stringency & Complexity

	simple	complex
Stringent	**Lower transaction costs** Additionality ***Some Projects***	**Higher transaction costs** Additionality ***Few Projects***
	Lower transaction costs Additionality ***Some Projects***	**Higher transaction costs** Additionality ***Some Projects***
Lax	**Lower transaction costs** No Additionality ***Many Projects***	**Higher transaction costs** No Additionality ***Some Projects***

Source: Ellis, 1999

Slide 19

Other Major Issues in Setting Baselines

- ✓ Environmental credibility (i.e., "gaming")
- ✓ Free-riding
- ✓ Leakage
- ✓ Accounting: income and substitution effects
- ✓ Economic and commercial viability
- ✓ Timeline

Slide 20

Approaches to Sharing of Carbon Credits

- ✓Abatement approach
- ✓Investment approach
- ✓Incremental cost approach

Slide 21

Performance Monitoring, Reporting, and Evaluation

- ✓Measure GHG emissions from JI project
- ✓Explain differences
- ✓Determine secondary effects of project
- ✓Parameters and formula

Slide 22

Conclusions

- ✓ Determining baseline emissions is critical
- ✓ Many technical details remain unresolved
- ✓ Various approaches are possible
- ✓ Cross-cutting issues are relevant to all baselines
- ✓ Baseline approaches differ in costs, transparency, data, and monitoring
- ✓ COP-7 created JI Supervisory Committee to write final implementation rules

Slide 23

MODULE 7: BASELINE DETERMINATIONS

Session C-5: Baselines: How Are They Determined?

Overview

General Objectives: By the end of the session, participants should have a clear understanding of the principles, issues, and calculations involved in determining project-level baselines and carbon credits from JI projects. Specifically:

- The approach used for calculating the baseline must account for the current and expected situation
- Once determined, project baselines are fixed at the start of the JI project
- Carbon reduction credits are based on straightforward calculations on the basis of carbon intensity differences
- Analytical tools using spreadsheet models can provide a transparent framework for examining carbon reductions.

Activities: An overhead slide presentation, followed by period of questions and answers

Total Time: 45 minutes

Materials: Set of 23 OHTs

GHG Baselines: How Are They Determined?

Session C-5

Module 7: Project-Level GHG Baseline Determination

Slide 1

Overview of Presentation:

- Background
- Types of projects
- Principles
- Issues
- Major Calculations

Slide 2

Types of Projects Considered in this Training

- ✓ Power Supply
  - Replacement of an existing power station
  - Efficiency improvements to existing power station
  - Installation of a new Power Station
- ✓ District Heating Systems
  - Fuel switching at an existing facility
  - Efficiency improvements to existing facility
  - Conversion of an existing facility to CHP

Slide 3

Types of Projects Baselines Considered in this Training (cont'd)

- ✓ Industrial Boilers
  - Fuel switching to a lower intensity carbon fuel
  - Efficiency improvements to existing boiler
  - Conversion of an existing facility to CHP
- ✓ Coal Bed Methane
  - Capture of methane emissions from an existing mine

Slide 4

Basic Concern of Baselines

- ✓ *Would the project have proceeded even without the availability of emission credits?*
- ✓ Example: Diesel generator replacement
  - End of useful life?
  - Changes in supply conditions?
  - Changes in price
- ✓ Impact on national resource allocations

Slide 5

Principles in Defining Baselines

- ✓ First: Understand what recent experience tells us
- ✓ Second: Define the attributes needed for successful baseline methodologies
- ✓ Third: Decide on the baseline approach
- ✓ Fourth: Clarify conceptual issues
- ✓ Fifth: Understand the cost implications

Slide 6

Static and Dynamic Baselines

- ✓ Earlier presentation touched on this
- ✓ Static baseline : point of comparison constant over time
- ✓ Dynamic baseline: point of comparison projected to change over time

Slide 7

Sources of Uncertainty

- ✓ Future changes in fuel supply
- ✓ Future changes in dispatch and performance
- ✓ Example: Gas-fired power station
- ✓ Calculation:

$$(I_{ex} - I_{ji}) \times G_{ji} = Carbon\ reduction\ (t\ CO2)$$

Slide 8

Determinants of Baseline Emissions and Reduction Credits

- ✓ Project period and timing
- ✓ Equivalent energy services

Slide 9

Key Concepts in Baseline Emissions and reduction credits

- ✓ project baselines are ***fixed*** at the start of the JI project
- ✓ Carbon reduction credits are calculated on the basis of carbon intensity differences

Slide 10

Step by Step Approach to Baseline Development

- ✓ Describe the context of the project (i.e., current situation/problem)
- ✓ Characterize the JI project
- ✓ Verify the the project is "additional"
- ✓ Describe the baseline characteristics
- ✓ Quantify GHG baseline emissions
- ✓ Quantify JI project GHG emissions
- ✓ Estimate reduction impact

Slide 11

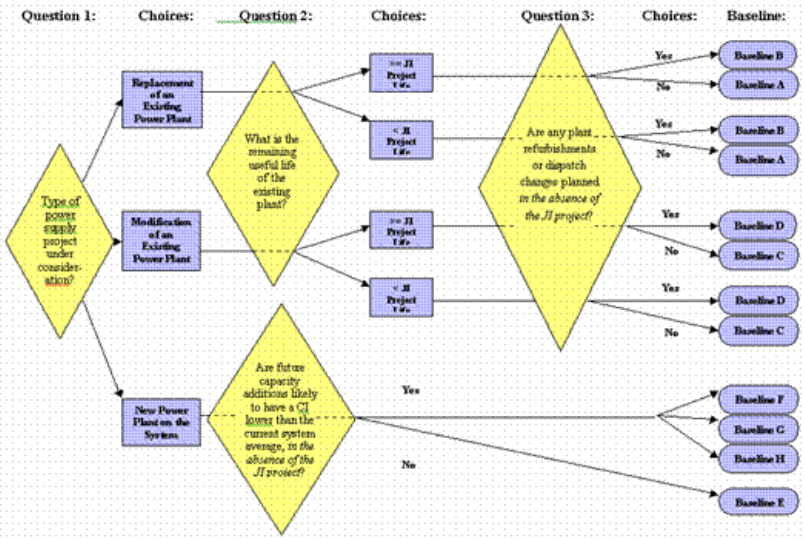
Step by Step Approach using a Decision Matrix

- ✓ *Decision matrix helps to identify*
  - What projects would qualify as a JI investment (from national perspective)
  - The key decisions made in development of the baseline (i.e., transparency)
  - What type of baseline approach is appropriate
  - Whether a static or dynamic approach should be used

Slide 12

Baseline Decision Protocols

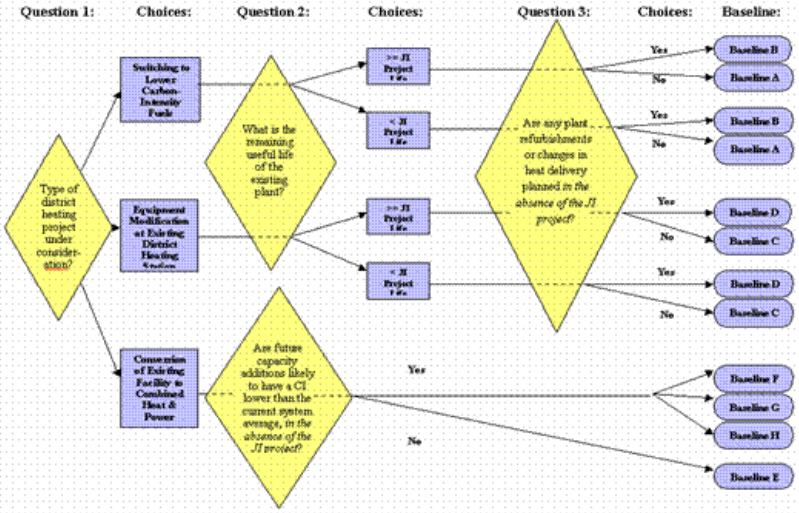
Flow Chart for Determination of Baseline in the JI Power Supply Training Module



Slide 13

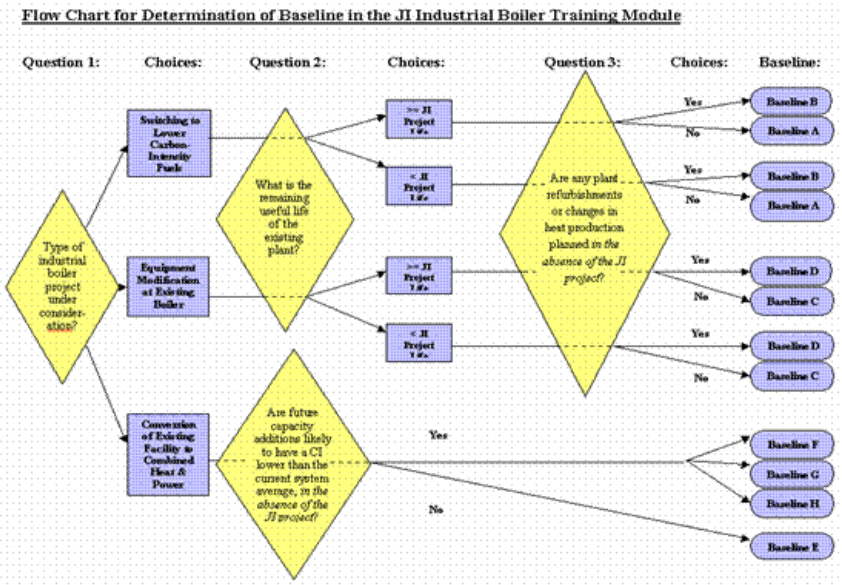
Baseline Decision Protocols

Flow Chart for Determination of Baseline in the JI District Heating Training Module



Slide 14

Baseline Decision Protocols



Slide 15

Major Calculations: CO2-equivalence

- ✓ Major Greenhouse gases:
  - Carbon dioxide (CO2)
  - Methane (CH4)
  - Nitrous Oxide (N2O)
- ✓ Global Warming Potential (GWP)
  - CO2= 1; CH4 = 21; N2O = 310
- ✓ Total CO2-equivalent emissions:

CO2-equiv = 1 x (mass of CO2) + 21 x (mass of CH4) + 310 x (mass of N2O)

Slide 16

Major Calculations (cont'd): CO2 from Fossil Fuel Combustion

- ✓ Premises:
  - Carbon content is known
  - Almost all of the carbon is converted to CO2
- ✓ Steps:
  - Estimate consumption of fuel (in mass or volume units)
  - Convert to energy units
  - Identify oxidation percentage
  - Multiply by adjusted CO2 emissions factor
- ✓ Total CO2 emissions:

  CO2 = (mass/volume of fuel) x (energy content of fuel) x (oxidation level) x (CO2 emission factor)

Slide 17

Major Calculations (cont'd): Energy from a Power Station

- ✓ Premises:
  - Energy lost converting combustion heat to steam
  - Energy lost converting steam energy to electric energy
  - Some electricity is used for auxiliary equipment on site
  - Some electricity produced is lost in the T&D system
- ✓ Steps:
  - Estimate total level of losses (in percent)
  - Identify level of electricity used on site
- ✓ Efficiency (%) of energy use ($3{,}600/(Gj_{in}/GWh_{out})$):

  Efficiency = 3,600 / ((total energy consumed at plant) / (total electricity produced at plant))

Slide 18

Major Calculations (cont'd): CO2 Intensity from a Power Grid

- ✓ Premises:
  - Network of power stations
  - Network of transmission and distribution lines
  - Large number of electricity consumers
  - Changes to the network take place over time
- ✓ Steps:
  - Calculate energy used and emissions for each station
  - Calculate emission intensity - electricity produced (gross)
  - Calculate emission intensity for electricity consumed (net)
- ✓ CO2 intensity :

  Gross intensity: CO2 emissions / total electricity produced

  Net intensity CO2 emissions / total electricity consumed

Slide 19

Major Calculations (cont'd): Energy from a Thermal Station

- ✓ Premises:
  - Energy lost converting combustion heat to steam
  - Energy lost in steam distribution system (if applicable)
- ✓ Steps:
  - Estimate total level of losses (in percent) in conversion of heat to steam (L_1)
  - Estimate total level of losses (in percent) in distribution of steam (if applicable) (L_2)
- ✓ Energy Losses (GJ)

$$= \textit{Energy use at site} \times (1 - L_1) \times (1 - L_2)$$

Slide 20

Major Calculations (cont'd): Energy from District Heating

- ✓ Premises:
  - Energy lost converting combustion heat to steam
  - Energy lost in steam distribution system
- ✓ Steps:
  - Estimate total level of losses (in percent) in conversion of heat to steam (L_1)
  - Estimate total level of losses (in percent) in distribution of steam (L_2)
- ✓ Energy Losses (GJ)

$$= \textit{Energy use at site} \times (1 - L_1) \times (1 - L_2)$$

Slide 21

Analytical Framework for Calculating Emissions

- ✓ Calculation described have been integrated into a tool for conducting case study work in working group exercises
- ✓ Several case study examples have been developed
- ✓ Cases analyzed are only a subset
- ✓ Results subject to evaluation and critique.

Slide 22

Conclusions

- ✓ Project baselines are ***fixed*** at the start of the JI project
- ✓ Carbon reduction credits are calculated on the basis of carbon intensity differences
- ✓ Baseline approach must take account of current and expected situation
- ✓ Major calculations are straightforward
- ✓ Analytical tool provides a framework for examining carbon reductions
- ✓ COP-7 created JI Supervisory Committee to write final implementation rules

Slide 23

MODULE 7: BASELINE DETERMINATIONS

Session C-6: Roundtable Panel Discussion

General Objectives: This session is a panel discussion of Ukrainian and international specialists (5 maximum), moderated by either an international or local specialist. The purpose is to explore the potential of investments in advanced technology in the Ukrainian energy supply sector to generate carbon credits that can be traded on the international market under the flexibility mechanisms of the Kyoto Protocol. The format is to pose three questions, one at a time to the collective panel, to stimulate discussion about the technical potential (i.e., efficiency improvement, process changes, etc) of advanced technologies for each facility to generate carbon reductions. Then, allow panel to respond, as they wish, after which audience participates in a short Q&A with assembled specialists. Possible questions:

- What are the major trends in technological development in high-efficiency thermal conversion facilities, renewable, methane recovery?
- What are the frontiers in efficiency improvements? (i.e., where are the goal posts? how are internal R&D efforts progressing towards this?)
- What barriers (policy, economic, technical) have the specialists found in their experience in project development to be the most important to address to facilitate investment?

Activities: Panel discussion on specific questions, followed by period of questions and answers

Total Time: 60 minutes

Materials: None

MODULE 7: BASELINE DETERMINATIONS

Session C-7: Presentation of Working Group Exercises

General Objectives: This session provides an opportunity for participants to present the results of their small group analyses using the computer tool. The objective is to provide a concise summary of the input parameters for the analysis, GHG baselines, and the resulting GHG emission reductions.

Activities: Each facility group is responsible to present the findings of their analysis, one per facility group. Insofar as possible, these summaries should be presented using a set of overheads. At the least, the results should be reported using the summary functions provided in the spreadsheet tools. A short period of questions and answers should be included.

Total Time: 1.5 hours

Materials: computer monitor for projecting slides

MODULE 7: BASELINE DETERMINATIONS

Session C-8: Panel Discussion of Results

General Objectives: This session is a panel discussion of the results of the GHG emission baseline analysis reported by the individual facility groups. The Ukrainian and international specialists who monitored the small group exercises should be involved in the panel, which is moderated by the lead international convener. The purpose of this session is to provide a constructive critique on the results, and suggest areas to refine or expand the analysis.

Activities: A series of issues, points, and/or questions to pursue should have been assembled by the specialists based upon the presentations in the previous session. The expert Panel will discuss these, while providing an opportunity for audience participation.

Total Time: 60 minutes

Materials: None

MODULE 7: BASELINE DETERMINATIONS

Session C-9: Course Summary and Conclusions

General Objectives: This is the closing session of the training event. The objective of this session is to summarize the accomplishments of the training event and set the context for practical applications of the material in the future.

Activities: Brief remarks by training event conveners

Total Time: 30 minutes

Materials: None

MODULE 7: BASELINE DETERMINATIONS

Coal Bed Methane sessions

Session CBM-1: Overview of Coal Mining Sector in Ukraine (Trends, Features, Investments)

In compliance with the preliminary agenda we suggest that presentations should cover the review of the current situation in the coal mining sector of Ukraine (trends, features, investments).

Information should be updated depending on the development of new programs and strategies regarding this sector.

It is recommended to invite authors of programs and strategies for presentation of their developments.

MODULE 7: BASELINE DETERMINATIONS

Session CBM-2: Estimating Baselines and Effectiveness of GEF Coal Mining Methane Project in Kuzbas

Overview

General Objectives: By the end of the session, the participants will be exposed to the baseline issues associated with the coal bed methane project at a mine in the Kuzbas region. Specifically, this session covers:

- Characteristics of the project,
- Baseline issues and assumptions that were addressed,
- Elements of the incremental cost analysis.

Activities: An overhead slide presentation, followed by period of questions and answers

Total Time: 45 minutes

Materials: Set of 11 OHTs

GHG Baseline: Estimating Baselines and Effectiveness of the GEF Coal Mine Methane Project in Kuzbas

Session CBM-2

Module 7: Project-Level GHG Baseline Determination

Slide 1

Overview

- UNDP/GEF feasibility study completed in August, 2000.
- Project Objectives
- Overall Project Design
- Baselines and GEF Alternative
- Incremental Cost Analysis

Slide 2

Project Objectives

- Achieve substantial (up to 50-70% of the baseline or up to 7 MMTCE over the project lifetime) GHG reductions at proposed project sites at a net unit cost less than $1 per TCE.
- Build institutional, technological, and financial capacity for reducing CMM emissions at other sites in the Kuzbas region and other NIS coal basins.

Slide 3

Overall Project Design: *Pilot Project Mines*

Association	*Mine*	*Coal Output (10^3x tonne)-1998*	*Total Methane Emission (10^6 m^3)-1998*	*Total Captured Methane (m^3)-1998*
Kuznetskugol	Abashevskaja	2016	65.59	2.36
Kuzbassugol	Komsomolets	830	45.10	24.70
Kuznetskugol	Lenina	1295	29.54	7.93
Kuznetskugol	Usinskaja	489	14.45	4.06
Total Pilot Project Mines		*4630*	*154.68*	*33.50*

Slide 4

Overall Project Design: *Technical Options*

- Underground degasification involving in-seam, gob-directional, and shield boreholes
- Utilization options include:
  - electricity generation
  - methane sales
  - combustion in boilers

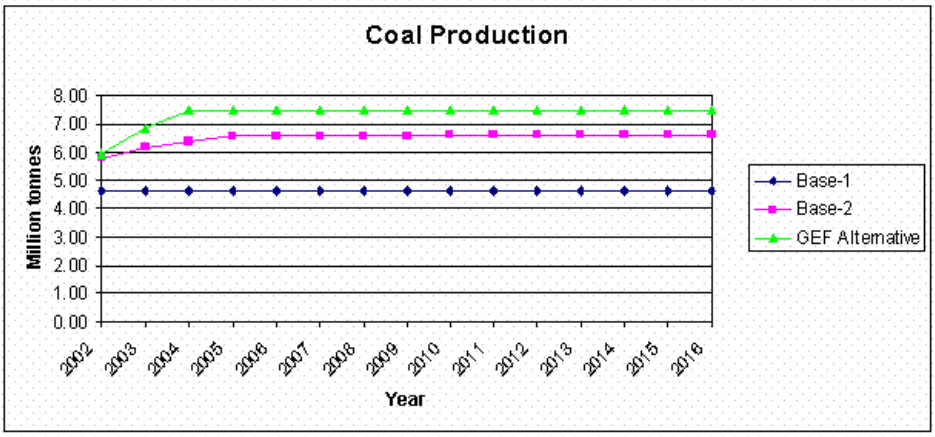
Slide 5

Baselines and GEF Alternative

- Two baseline and one GEF alternative scenarios
- Base-1: flat coal production
- Base-2: increase in coal production according to mining plans
- GEF Alternative: increase in coal production according to mining plans + underground methane drainage + utilization

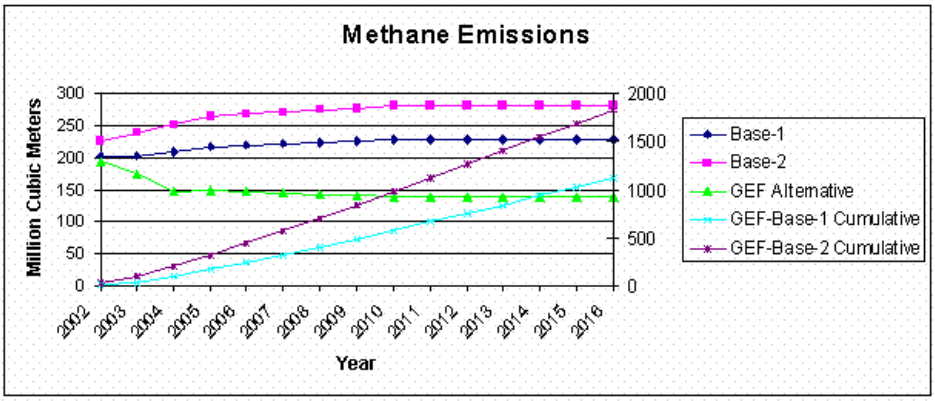
Slide 6

Baselines and GEF Alternative



Slide 7

Baselines and GEF Alternative



Slide 8

Baselines and GEF Alternative

Category of Mines	Additional Coal Production (10^6 ton)		Emission Reduction (10^9 m^3 CH_4)		Emission Reduction (MMTCE)	
	GEF-Base 1	GEF-Base 2	GEF-Base 1	GEF-Base 2	GEF-Base 1	GEF-Base 2
Komsomolets	NE	6.35	NE	1.83	NE	1.85
Abashevskaia	NE	4.30	NE	0.48	NE	2.71
Lenina& Usinskaia	NE	2.05	NE	0.70	NE	2.46
Pilot Mines Total	40.4	12.7	1.1	1.8	4.3	7.0

Slide 9

Incremental Cost Analysis

- Compared Base-2 and GEF Alternative Scenario
- "Incremental" variables:
  - Additional coal produced over and above the baseline
  - All the CMM drained according to the GEF project, assuming the complete utilization of this CMM and accounting for CMM losses during its transmission, processing, and consumption.
  - A reduction in baseline coal production costs on a per ton basis due to the use of modern degasification technology.

Slide 10

Incremental Cost Analysis

Mine	*Low Gas Price*	*High Gas Price*
Abashevskaia	CMM Sales	CMM Sales
Komsomolets	Boilers	Boilers
Lenina&Usinskaia	Electricity	CMM Sales w/PE
Total 5-yr cashflow ('000 $)	13,522	8,184
NPV ('000 $)	(18,186)	(20,124)
Unit cost based on 5-yr cashflow ($/TCE)	1.93	1.17

Slide 11

MODULE 7: BASELINE DETERMINATIONS

Session CBM-3: Inventory of Coal-Bed Methane in Ukraine

In compliance with the preliminary agenda we suggest the inclusion of the following theme:

- Inventory of Coal-Bed Methane in Ukraine

  Information is updated depending on the development of new programs and strategies regarding the inventory of coal-bed methane in Ukraine.

As an example we give presentation of the inventory of coal-bed methane in Ukraine (See Ukrainian deliverables).

It is recommended to invite authors of programs and strategies for presentation of their developments.

MODULE 7: BASELINE DETERMINATIONS

Session CBM-4: Coal-Bed Methane of Ukraine: Technical and Investment Potential of Coal Mines

In compliance with the preliminary agenda we suggest the inclusion of the following theme:

- Coal-Bed Methane of Ukraine: Technical and Investment Potential of Coal Mines

  Information is updated depending on the development of new programs and strategies regarding the technical and investment potential of coal mines in Ukraine.

As an example we give the presentation of technical and investment potential of coal mines (See Ukrainian deliverables).

It is recommended to invite authors of programs and strategies for presentation of their developments.

MODULE 7: BASELINE DETERMINATIONS

Session CBM-5: Results of Coal-Bed Methane Project in Ukraine

In compliance with the preliminary agenda we suggest the inclusion of the following theme:

- Results of Coal-Bed Methane Project in Ukraine

As an example we give the presentation of the coal-bed methane project in Ukraine.

CM DEVELOPMENT PROJECT

TWO BUSINESS PLANS BEING DEVELOPED:

Komsomolets Donbassa Mine

Skochinsky Mine

Slide 2

CM DEVELOPMENT PROJECT

Basic Assumptions:

Utilization of Western designed equipment

Utilization of Western technologies

Utilization of Western experience

All legal and tax issues successfully negotiated

The Project will receive cash for the product produced.

Slide 3

CM DEVELOPMENT PROJECT

Program Development:

Pilot Project Phase

Evaluation Phase

Full-Scale Production Phase

Slide 4

KOMSOMOLETS DONBASSA CMM DEVELOPMENT PROJECT

KOMSOMOLETS DONBASSA
PILOT PROJECT
DRILLING AND COMPLETION COST ESTIMATE

	Well Type	Standard	Job
	Number of Wells	5	1
	Total Depth - ft. (M)	3300 (1000)	2460 (750)
Drilling	Survey	$1 000	$1 000
	Location & Road	$13 000	$13 000
	Water	$5 000	$5 000
	Fuel	$30 000	$23 000
	Mob / De-mob	$72 000	$72 000
	Rig Cost	$117 500	$95 000
	Cementing	$25 000	$25 000
	Cementing Overhead	$11 000	$11 000
	Transportation	$5 000	$5 000
	Welding	$1 000	$1 000
	Logging	$20 000	
	Conductor Casing - Cost	$1 500	$1 500
	Surface Casing - Cost	$5 520	$5 520
	Production Casing - Cost	$15 000	$10 000
	Mud	$7 500	$7 500
	Bits	$12 000	$12 000
	Drilling Cost per Well	$305 120	$292 520
	Contingency (10%)	$30 512	$29 252
	Total Drilling Cost Per Well	$372 632	$321 772
Completion	CEMENT PRODUCTION CASING		
	Cementing Overhead	$5 500	
	Equipment	$15 000	
	Materials	$3 700	
	Personnel	$6 600	
	Sub-Total	$33 500	$0
	CEMENT BOND LOGS		
	Mob / De-Mob - Prorated: 5 Wells	$200	
	Service	$6 550	
	Sub-Total	$6 750	$0
	FRACTURE STIMULATION		
	Mob / De-mob - Prorated: 5 Wells	$50 000	
	Equipment	$260 000	
	Materials	$205 000	
	Personnel	$45 000	
	Bridge Plugs	$15 000	
	Perforating	$22 000	
	Sub-Total	$597 000	$0
	WELL CLEANOUT		
	Rig Time	$20 400	
	Tools	$3 000	
	Sub-Total	$23 400	$0
	TANGIBLES		
	2-7/8" Production Tubing	$7 500	$5 000
	Rods & Pump	$10 000	$7 500
	Pumping Unit	$30 000	$30 000
	Surface Equipment	$10 000	$10 000
	Sub-Total	$57 500	$52 500
	Total Completion Cost (Per Well)	$715 450	$52 500
Summary	Total Cost Per Well	$1 095 082	$374 272
	Total Project Costs	$6 490 410	$374 272
	GRAND TOTAL	$6 864 682	

Slide 5

KOMSOMOLETS DONBASSA CMM DEVELOPMENT PROJECT

DRILLING PROGRAM SCHEDULE

	YEAR 1		YEAR 2		YEAR 3		
	Standard Wells	Gob Wells	Standard Wells	Gob Wells	Standard Wells	Gob Wells	
Month 1	3	1	4	0	3	1	
Month 2	4	0	3	1	4	0	
Month 3	3	1	3	1	3	1	
Month 4	3	1	3	1	4	0	
Month 5	3	1	4	0	4	0	
Month 6	3	1	3	1	3	1	
Month 7	4	0	3	1	3	1	
Month 8	3	1	3	1	3	1	
Month 9	3	1	4	0	3	1	
Month 10	4	0	4	0	4	0	
Month 11	4	0	4	0	4	0	
Month 12	4	0	4	0	4	0	
Category Total	**41**	**7**	**42**	**6**	**42**	**6**	
Year Total		**48**		**48**		**48**	
					Grand Total		**144**

Slide 6

KOMSOMOLETS DONBASSA CMM DEVELOPMENT PROJECT

DEVELOPMENT PROJECT WELL COST ESTIMATES

Standard Well Specifications	**Gob Well Specifications**
Depth: 3300ft (1000m)	Depth: 2500ft (750m)
cased, cemented to surface, logged & perforated	slotted production casing insert,
multiple zone hydraulic fracture stimulation	progressive cavity pump with electric motor
progressive cavity pump with electric motor	

Intangibles	**Standard Well**	**Gob Well**
Permits	$500	$500
Road & drill site construction	$5,000	$5,000
Survey	$500	$500
Drilling	$35,000	$30,000
Cementing	$12,000	$8,000
Logging	$5,000	$0
Perforating	$12,000	$0
Hydraulic frac	$75,000	$0
Workovers and cleanout	$10,000	$10,000
Miscellaneous services	$10,000	$10,000
subtotal	**$165,000**	**$64,000**
Tangibles		
Casing (conductor, surface & production)	$14,000	$10,000
Tubing	$4,000	$4,000
Wellhead	$10,000	$10,000
Pump & rods	$15,000	$15,000
Surface facilities & equipment	$13,000	$13,000
Flow line & meters	$20,000	$20,000
Separator	$5,000	$5,000
subtotal	**$81,000**	**$77,000**
Total Drilling & Completion Costs	**$246,000**	**$141,000**
Other Costs		
Pro rata portion of gas & water gathering system	$30,000	$30,000
Contingency	$20,000	$20,000
Overhead	$20,000	$20,000
subtotal	**$70,000**	**$70,000**
Total Well Cost	**$316,000**	**$211,000**

Slide 7

KOMSOMOLETS DONBASSA CMM DEVELOPMENT PROJECT

Production Profile for One Standard Well

Reserves (kcm* 154,000

Year of Operation	Production, kcm per day	Production, kcm per year	Cumulative Production, kcm	Cumulative Production, % of Reserves	Decline Rate % of Prior Yr
1	12.948	4,726	4,726	3.07%	
2	15.693	5,728	10,454	6.79%	21.20%
3	11.364	4,148	14,602	9.48%	-27.58%
4	8.975	3,276	17,878	11.61%	-21.02%
5	7.414	2,706	20,584	13.37%	-17.40%
6	6.288	2,295	22,879	14.86%	-15.19%
7	5.433	1,983	24,862	16.14%	-13.59%
8	4.764	1,739	26,601	17.27%	-12.30%
9	4.227	1,543	28,144	18.28%	-11.27%
10	3.784	1,381	29,525	19.17%	-10.50%

*1000 cubic meters

Slide 8

KOMSOMOLETS DONBASSA CMM DEVELOPMENT PROJECT

Production Profile for One Gob Well

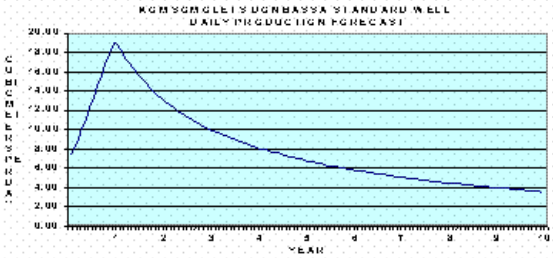
Reserves (kcm* 27,000

Year of Operation	Production, kcm per day	Production, kcm per year	Cumulative Production, kcm	Cumulative Production, % of Reserves	Decline Rate % of Prior Yr
1	5.364	1,958	1,958	7.25%	
2	6.501	2,373	4,331	16.04%	21.20%
3	4.708	1,718	6,049	22.41%	-27.58%
4	3.719	1,357	7,407	27.43%	-21.01%
5	3.072	1,121	8,528	31.59%	-17.40%
6	2.605	951	9,479	35.11%	-15.20%
7	2.251	821	10,300	38.15%	-13.60%
8	1.974	720	11,021	40.82%	-12.30%
9	1.751	639	11,660	43.18%	-11.29%
10	1.568	572	12,232	45.30%	-10.47%

*1000 Cubic Meters

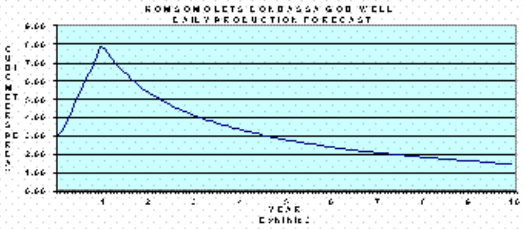
Slide 9

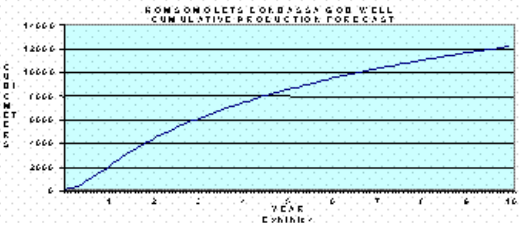
KOMSOMOLETS DONBASSA CMM DEVELOPMENT PROJECT



Slide 10

KOMSOMOLETS DONBASSA CMM DEVELOPMENT PROJECT





Slide 11

KOMSOMOLETS DONBASSA CMM DEVELOPMENT

With Special Economic Zone Income Tax Benefits

Assumptions:

Capital Cost per well	$316 000.00
Gas Price ($/kcm)	$60.00
Gathering Costs ($/kcm)	$11.20
Pipeline Tariff ($/kcm)	$3.50
Misc. Op/g Costs ($/kcm)	$5.25
G & A ($/kcm)	$1.75
Depreciation	14%
Income Tax:	
First Three Years	0.0%
Next Three Years	15.0%
Thereafter	30.0%

Production Profile for One Standard Well

Reserves (kcm*) 154 000

Year of Operation	Production, kcm per day	Production, kcm per year	Cumulative Production, kcm	Cumulative Production, % of Reserves	Decline Rate % of Prior Yr
1	12 948	4 726	4 726	3.07%	
2	15 693	5 728	10 454	6.79%	21.20%
3	11 364	4 148	14 602	9.48%	-27.58%
4	8 975	3 276	17 878	11.61%	-21.02%
5	7 414	2 706	20 584	13.37%	-17.40%
6	6 288	2 295	22 879	14.86%	-15.19%
7	5 433	1 983	24 862	16.14%	-13.59%
8	4 764	1 739	26 601	17.27%	-12.30%
9	4 227	1 543	28 144	18.28%	-11.27%
10	3 784	1 381	29 525	19.17%	-10.50%

Results:(Year)	1	2	3	4	5	6	7	8	9	10
Gas Production (kcm/yr)	4 726	5 728	4 148	3 276	2 706	2 295	1 983	1 739	1 543	1 381
Gross Revenue	$283 560	$343 680	$248 880	$196 560	$162 360	$137 700	$118 980	$104 340	$92 580	$82 860
Gathering Costs	($52 931)	($64 154)	($46 458)	($36 691)	($30 307)	($25 704)	($22 210)	($19 477)	($17 282)	($15 467)
Pipeline Tariff	($16 541)	($20 048)	($14 518)	($11 466)	($9 471)	($8 033)	($6 941)	($6 087)	($5 401)	($4 834)
Misc. Op/g Costs	($24 812)	($30 072)	($21 777)	($17 199)	($14 207)	($12 049)	($10 411)	($9 130)	($8 101)	($7 250)
G & A	($8 271)	($10 024)	($7 259)	($5 733)	($4 736)	($4 016)	($3 470)	($3 043)	($2 700)	($2 417)
Net Production Revenue	$181 006	$219 382	$158 868	$125 471	$103 640	$87 899	$75 949	$66 604	$59 097	$52 892
Depreciation	($44 240)	($44 240)	($44 240)	($44 240)	($44 240)	($44 240)	($44 240)	($6 320)	$0	$0
Taxable Income	$136 766	$175 142	$114 628	$81 231	$59 400	$43 659	$31 709	$60 284	$59 097	$52 892
Income Tax	$0	$0	$0	($12 185)	($8 910)	($6 549)	($9 513)	($18 085)	($17 729)	($15 868)
IncomeAfter Taxes	$136 766	$175 142	$114 628	$69 046	$50 490	$37 110	$22 196	$42 199	$41 368	$37 025
Net Cash Flow From Oper	$181 006	$219 382	$158 868	$113 286	$94 730	$81 350	$66 436	$48 519	$41 368	$37 025
Initial Investment	($316 000)									
Cumulative Net Cash Flow	($134 994)	$84 388	$243 257	$356 543	$451 273	$532 622	$599 059	$647 577	$688 945	$725 970

Economic Indicators:

Discount Rate	**49.73%**
Discounted Net Cash Flow	**$316 023**
Internal Rate of Return	**49.73%**

Slide 12

KOMSOMOLETS DONBASSA CMM DEVELOPMENT PROJECT

Economic Evaluation For One Geb Well

With Special Economic Zone Income Tax Benefits

Assumptions:

Capital Cost per well	$211 000.00
Gas Price ($/kcm)	$60.00
Gathering Costs ($/kcm)	$11.20
Pipeline Tariff ($/kcm)	$3.50
Misc. Op/g Costs ($/kcm)	$5.25
G & A ($/kcm)	$1.75
Depreciation	14%
Income Tax:	
First Three Years	0.0%
Next Three Years	15.0%
Thereafter	30.0%

Production Profile for One Geb Well

Reserves (kcm*) 27 000

Year of Operation	Production, cm per day	Production, cm per year	Cumulative Production, kcm	Cumulative Production, % of Reserves	Decline Rate % of Prior Yr
1	5 364	1 958	1 958	7.25%	
2	6 501	2 373	4 331	16.04%	21.20%
3	4 708	1 718	6 049	22.41%	-27.58%
4	3 719	1 357	7 407	27.43%	-21.01%
5	3 072	1 121	8 528	31.59%	-17.40%
6	2 605	951	9 479	35.11%	-15.20%
7	2 251	821	10 300	38.15%	-13.60%
8	1 974	720	11 021	40.82%	-12.30%
9	1 751	639	11 660	43.18%	-11.29%
10	1 568	572	12 232	45.30%	-10.47%

Results:(Year)	1	2	3	4	5	6	7	8	9	10
Gas Production (kcm/yr)	1 958	2 373	1 718	1 357	1 121	951	821	720	639	572
Gross Revenue	$117 478	$142 382	$103 109	$81 442	$67 273	$57 048	$49 290	$43 227	$38 346	$34 331
Gathering Costs	($21 929)	($26 578)	($19 247)	($15 202)	($12 558)	($10 649)	($9 201)	($8 069)	($7 158)	($6 409)
Pipeline Tariff	($6 853)	($8 306)	($6 015)	($4 751)	($3 924)	($3 328)	($2 875)	($2 522)	($2 237)	($2 003)
Misc. Operating Costs	($10 279)	($12 458)	($9 022)	($7 126)	($5 886)	($4 992)	($4 313)	($3 782)	($3 355)	($3 004)
G & A	($3 426)	($4 153)	($3 007)	($2 375)	($1 962)	($1 664)	($1 438)	($1 261)	($1 118)	($1 001)
Net Production Revenue	$74 990	$90 887	$65 818	$51 987	$42 943	$36 416	$31 463	$27 593	$24 477	$21 915
Depreciation	($29 540)	($29 540)	($29 540)	($29 540)	($29 540)	($29 540)	($29 540)	($4 220)	$0	$0
Taxable Income	$45 450	$61 347	$36 278	$22 447	$13 403	$6 876	$1 923	$23 373	$24 477	$21 915
Income Tax	$0	$0	$0	($3 367)	($2 010)	($1 031)	($577)	($7 012)	($7 343)	($6 574)
IncomeAfter Taxes	$45 450	$61 347	$36 278	$19 080	$11 392	$5 844	$1 346	$16 361	$17 134	$15 340
Net Cash Flow From Oper	$74 990	$90 887	$65 818	$48 620	$40 932	$35 384	$30 886	$20 581	$17 134	$15 340
Initial Investment	($211 000)									
Cumulative Net Cash Flow	($136 010)	($45 122)	$20 695	$69 315	$110 247	$145 632	$176 518	$197 099	$214 233	$229 574

Economic Indicators:

Discount Rate	**24.44%**
Discounted Net Cash Flow	**$211 013**
Internal Rate of Return	**24.44%**

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KOMSOMOLETS DONBASSA CMM DEVELOPMENT PROJECT

Wells Started: — **TOTAL PROJECT GAS PROJECTION**

Project Year:	1	2	3
Gob Wells Started	7	6	6
Pilot Gob Well	1	1	1
Standard Well Started	41	42	42
Pilot Standard Well	5	5	5

Well Production Year:	1	2	3	4	5	6	7	8	9	10
Gob Well Flow	1 958	2 373	1 718	1 357	1 121	951	821	720	639	572
Pilot Gob Well Flow	1 958	2 373	1 718	1 357	1 121	951	821	720	639	572
Standard Well Flow	4 726	5 728	4 148	3 276	2 706	2 295	1 983	1 739	1 543	1 381
Pilot 5 Standard Wells Flow	21 596	26 175	18 955	14 972	12 367	10 487	9 061	7 947	7 049	6 311

Project Year:	0	1	2	3	4	5	6	7	8	9	10	11	12
Gob Well Started Year 1		13 706	16 611	12 026	9 499	7 847	6 657	5 747	5 040	4 473	4 004	-	-
Gob Well Started Year 2			11 748	14 238	10 308	8 142	6 726	5 706	4 926	4 320	3 834	3 432	-
Gob Well Started Year 3				11 748	14 238	10 308	8 142	6 726	5 706	4 926	4 320	3 834	3 432
Pilot Gob Well		2 373	1 718	1 357	1 121	951	821	720	639	572	-	-	-
Standard Well Started Year 1		193 766	234 848	170 068	134 316	110 946	94 095	81 303	71 299	63 263	56 621	-	-
Standard Well Started Year 2			198 492	240 576	174 216	137 592	113 652	96 390	83 286	73 038	64 806	58 002	-
Standard Well Started Year 3				198 492	240 576	174 216	137 592	113 652	96 390	83 286	73 038	64 806	58 002
Pilot 5 Standard Wells		26 175	18 955	14 972	12 367	10 487	9 061	7 947	7 049	6 311	-	-	-
Annual Total:		236 020	482 372	663 477	596 641	460 489	376 746	318 191	274 335	240 189	206 623	130 074	61 434
Adjusted Annual Total:		132 284	377 252	558 357									
Project Total:		3 732 615											

Note: all volumes in kcm

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KOMSOMOLETS DONBASSA CMM DEVELOPMENT PROJECT

TOTAL PROJECT

	Year 1	Year 2	Year 3	Year 4	Year 5
Gob Wells Started	7	6	6	0	0
Investment Per Well	$211,000	$211,000	$211,000	$211,000	$211,000
Net Wells in Production	1	1	1	1	1
Total Gob Wells in Production	8	14	20	20	20
Standard Wells Started	41	42	42	0	0
Investment Per Well	$316,000	$316,000	$316,000	$316,000	$316,000
Net Wells in Production	5	5	5	5	5
Total Standard Wells in Production	46	88	130	130	130

Gob Well Cash Flow - (each)	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10	Total
Net Production Revenue	$ 74,990	$ 90,887	$ 65,818	$ 51,957	$ 42,943	$ 36,416	$ 31,453	$ 27,593	$ 24,497	$ 21,915	$ 468,489
Depreciation	$ (29,540)	$ (29,540)	$ (29,540)	$ (29,540)	$ (29,540)	$ (29,540)	$ (29,540)	$ (4,220)	$ -	$ -	$ (211,000)
Taxable Income	$ 45,450	$ 61,347	$ 36,278	$ 22,447	$ 13,403	$ 6,876	$ 1,923	$ 23,373	$ 24,497	$ 21,915	$ 257,489

Standard Well Cash Flow - (each)	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10	Total
Net Production Revenue	$ 181,006	$ 219,382	$ 158,868	$ 125,471	$ 103,640	$ 87,899	$ 75,949	$ 66,604	$ 59,097	$ 52,892	$ 1,130,808
Depreciation	$ (44,240)	$ (44,240)	$ (44,240)	$ (44,240)	$ (44,240)	$ (44,240)	$ (44,240)	$ (6,320)	$ -	$ -	$ (316,000)
Taxable Income	$ 136,765	$ 175,142	$ 114,628	$ 81,231	$ 59,400	$ 43,659	$ 31,709	$ 60,284	$ 59,097	$ 52,892	$ 814,808

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KOMSOMOLETS DONBASSA CMM DEVELOPMENT PROJECT

All Numbers are in US$

TOTAL PROJECT

Taxable Income	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10	Year 11	Year 12	Total
Gob Wells Started in Year 1		318,151	429,452	253,943	157,128	93,818	48,130	13,463	163,613	171,341	153,404			1,802,424
Gob Wells Started in Year 2			272,701	368,084	217,666	134,681	80,416	41,255	11,539	140,240	146,863	131,489		1,544,935
Gob Wells Started in Year 3				272,701	368,084	217,666	134,681	80,416	41,255	11,539	140,240	146,863	131,489	1,544,935
Gob Well Pilot Project		38,489	13,420	(411)	(9,455)	(15,982)	(20,935)	(24,805)	16,992	21,915				19,227
Std Wells Started in Year 1		5,607,396	7,180,838	4,699,764	3,330,463	2,435,392	1,789,999	1,300,065	2,471,632	2,422,973	2,168,584			33,407,108
Std Wells Started in Year 2			5,744,164	7,355,981	4,814,393	3,411,694	2,494,792	1,833,657	1,331,774	2,531,915	2,482,070	2,221,477		34,221,915
Std Wells Started in Year 3				5,744,164	7,355,981	4,814,393	3,411,694	2,494,792	1,833,657	1,331,774	2,531,915	2,482,070	2,221,477	34,221,915
Std Wells Pilot Project		233,834	(42,693)	(195,240)	(294,998)	(366,990)	(421,617)	(464,302)	160,185	241,722				(1,150,099)
Total Taxable Income		6,197,873	13,597,861	18,436,366	15,939,261	10,724,671	7,517,159	5,274,540	6,030,646	6,873,419	7,623,077	4,981,899	2,352,966	105,612,359
Income Tax Rate		0.00%	0.00%	0.00%	15.00%	15.00%	15.00%	30.00%	30.00%	30.00%	30.00%	30.00%	30.00%	
Income Tax		0	0	0	(2,390,889)	(1,608,701)	(1,127,574)	(1,582,362)	(1,809,194)	(2,062,026)	(2,286,923)	(1,494,570)	(705,890)	(15,068,128)
Income After Taxes		6,197,873	13,597,861	18,436,366	13,548,372	9,115,970	6,389,585	3,692,178	4,221,452	4,811,394	5,336,154	3,487,329	1,647,076	90,544,231
Add non cash items:														
Depreciation		2,841,675	4,876,995	6,912,315	6,912,315	6,912,315	6,912,315	6,912,315	4,476,594	2,326,080	290,760	0	0	49,373,682
Net Cash Flow From Oper		9,039,548	18,474,857	25,411,302	20,460,687	16,028,286	13,301,901	10,604,493	8,698,046	7,137,474	5,626,914	3,487,329	1,647,076	139,917,913
Investment in Gob Wells	(374,272)	(1,477,000)	(1,266,000)	(1,266,000)	0	0								(4,383,272)
Investment in Std Wells	(5,490,410)	(12,956,000)	(13,272,000)	(13,272,000)	0	0								(44,990,410)
Cash Flow After Invest	(5,864,682)	(5,393,452)	3,936,857	10,873,302	20,460,687	16,028,286	13,301,901	10,604,493	8,698,046	7,137,474	5,626,914	3,487,329	1,647,076	90,544,231
Cumulative Cash Flow	(5,864,682)	(11,258,134)	(7,321,277)	3,552,025	24,012,712	40,040,997	53,342,898	63,947,392	72,645,438	79,782,911	85,409,825	88,897,155	90,544,231	

Discount Rate 36.18%

PV of Cash Flows in 30,059,720 Assumes flows come in at end of period

PV of Cash Flows Out (30,059,720) Assumes flows go out at beginning of period

Internal Rate of Return 36.18%

* Pilot Project Evaluation Year

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MODULE 7: BASELINE DETERMINATIONS

Session CBM-6: Introduction to Working Group Exercise for Coal Bed Methane Recovery and Utilization Projects

General Objectives: This session introduces the computer tool for calculating project GHG emission baselines and carbon offsets for projects that recover and use methane emitted from coal mines. This session should provide an overview of each of the project investment types built into the tool, namely coal bed methane recovery projects that involve: a) feeding methane into the natural gas grid, b) use of methane in internal combustion engines; and c) use of methane to produce electric power.

Activities: The presenter should lead this session by using the computer. After the plenary session as been split into facility groups, participants should be further split into small working of no more than 3 per computer. The presenter should ask each small working group to open the spreadsheet file, and while it is open, explain the tool, worksheet by worksheet.

Total Time: 60 minutes

Materials: Computers, coal bed methane recovery and use spreadsheet training tool

MODULE 7: BASELINE DETERMINATIONS

Session CBM-7: Working Group Exercise for Coal Bed Methane Recovery and Utilization Projects

General Objectives: This session provides an opportunity for participants to use the computer tool to calculate project GHG emission baselines and carbon offsets for projects that recover and use methane emitted from coalmines. The objective is to work in small teams and become familiar with the key techniques and approaches used to calculate GHG baselines.

Activities: The training tool is loaded with a set of default data for the existing mine and for the three project investments. The instructor should provide each working group with a set of specific exercises based as much as possible on local conditions for the existing mine, and realistic project investments. The instructor is free to design these exercises within the bounds of the tool itself. Given time, sensitivity analyses can also be conducted. During the early stages of the working group exercise, one spokesperson should be chosen (or nominated) to represent the results of the working groups in plenary session.

Total Time: 5.5 hours

Materials: Computers, coal bed methane recovery and use spreadsheet training tool

MODULE 7: BASELINE DETERMINATIONS

District Heating Sessions

Session DH-1: Overview of District Heating Sector in Ukraine (Trends, Features, Investments)

In compliance with the preliminary agenda we suggest that presentations should cover the review of the current situation in the district heating sector of Ukraine (trends, features, investments).

Information should be updated depending on the development of new programs and strategies regarding the district heating.

It is recommended to invite authors of programs and strategies for presentation of their developments.

MODULE 7: BASELINE DETERMINATIONS

Session DH-2: Cost and Performance Characterization of Existing DH-S Technology in Ukraine

In compliance with the preliminary agenda we suggest the inclusion of the following theme:

- Cost and Performance Characterization of Existing DH-S Technology in Ukraine

  Information is updated depending on the development of new programs and strategies regarding the district heating.

As an example we give presentation of Cost and Performance Characterization of Existing DH-S Technology in Ukraine (see Ukrainian deliverables).

It is recommended to invite authors of programs and strategies for presentation of their developments.

MODULE 7: BASELINE DETERMINATIONS

Session DH-3: GHG Reductions in District Heating Systems (Part I)

General Objectives: This session is a designed as a presentation by an international specialist on district heating. The purpose of this session is twofold: 1) provide an overview of district heating systems - technology, distribution of systems, and growth patterns; and 2) to review the reasons why district heating systems are important - local/global environmental benefits and reductions is energy costs due to increased efficiency. It is highly recommended that this session only be provided by an international specialist who is able to address the following

- Major trends in global technological development in high-efficiency district heating systems,
- Major technological bases for efficiency improvements and the trends in R&D,
- Major barriers (policy, economic, technical) that are most important to address to facilitate investment.

Activities: An overhead slide presentation, followed by period of questions and answers

Total Time: 45 minutes

Materials: Overhead slides

MODULE 7: BASELINE DETERMINATIONS

Session DH-4: GHG Reductions in District Heating Systems (Part II)

General Objectives: This session is a designed as a continuation of the preceding presentation by an international specialist on district heating. The purpose of this second session is twofold: 1) provide an overview of district heating technology; and 2) to review in detail the greenhouse gas reduction potential of district heating systems. It is highly recommended that this session only be provided by an international specialist who is able to address the following:

- Technological details in high-efficiency district heating systems, including system hydraulics, efficiency improvements, friction reduction measures, gas turbine compression and cost aspects.
- Greenhouse gas reductions achieved by district heating projects in Eastern Europe.

Activities: An overhead slide presentation, followed by period of questions and answers

Total Time: 45 minutes

Materials: Overhead slides

GHG Reduction in District Heating Systems

Module 7: Session DH-4

CCI - Ukraine Workshop Package

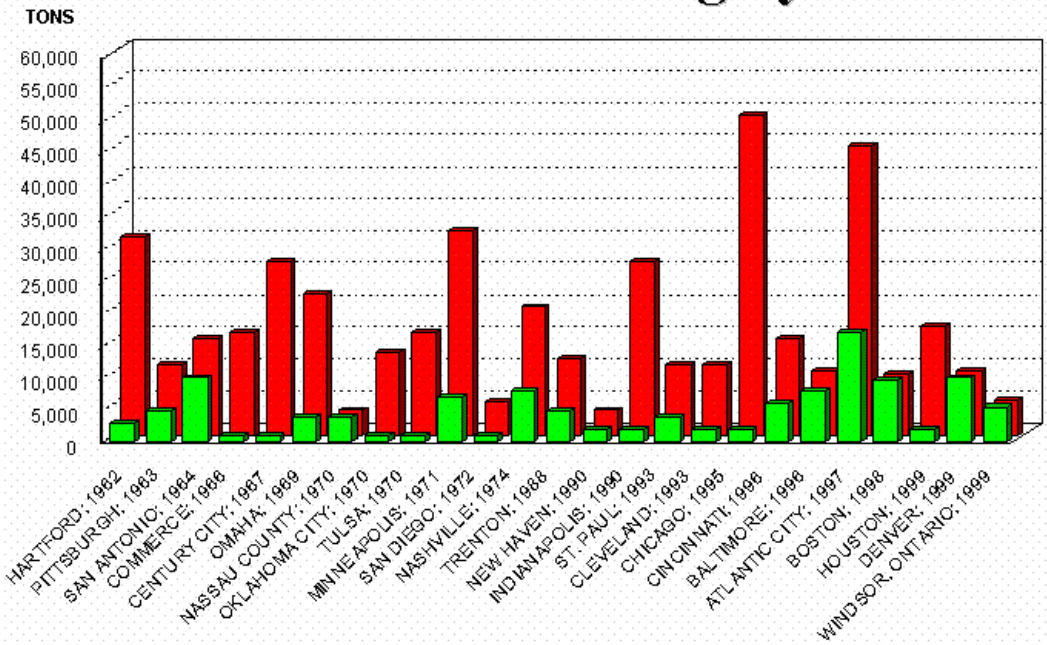
AGENDA

- Overview of District Energy worldwide
- Why District Heating systems are important
- District Energy technology
- Greenhouse Gas (GHG) reduction in District Heating systems

OVERVIEW OF DISTRICT ENERGY WORLDWIDE

- Europe
  - Mature hot water district heating
  - Strong growth in district cooling, particularly in Sweden
  - Increasing use of CHP, waste heat, biomass
  - Sophisticated operations and maintenance
- North America
  - New investments in older steam systems
  - Very strong growth in district cooling
  - Progress in policies to support Combined Heat and Power (CHP)

Significant Growth in US District Cooling Systems



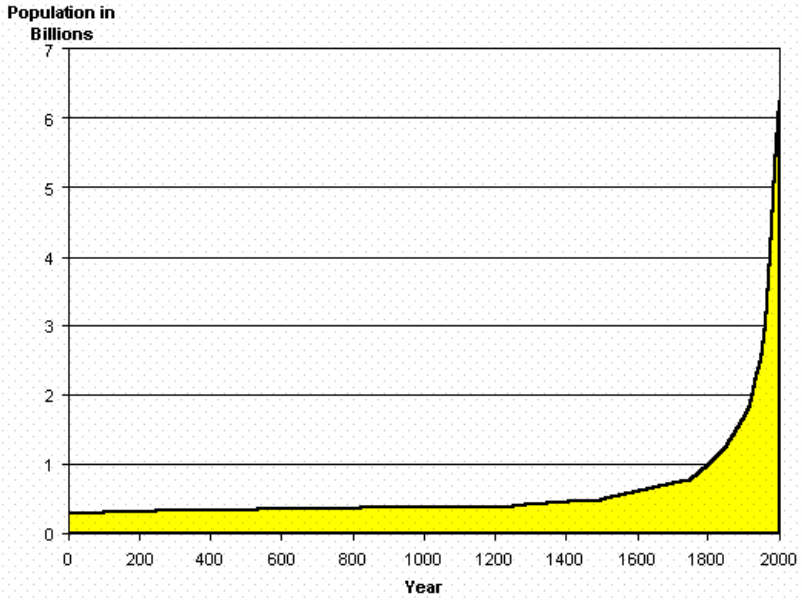
OVERVIEW OF DISTRICT ENERGY WORLDWIDE

- Asia
  - Japan: growing use of district heating and cooling
  - Korea: hot water district heating with dispersed absorption cooling
  - Malaysia: growing district cooling
  - Singapore, Philippines and elsewhere: growing interest in district cooling
- Middle East
  - New district cooling systems in United Arab Emirates
  - Growing interest in other Middle East countries, including Saudi Arabia, Egypt

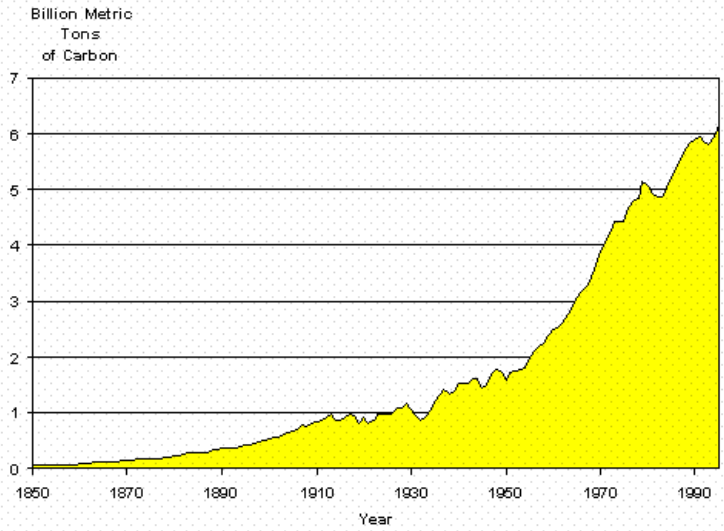
WHY DISTRICT ENERGY SYSTEMS ARE IMPORTANT

- Climate change due to Greenhouse Gas (GHG) emissions is real
- District energy systems help:
  - Increase energy efficiency
  - Decrease emissions of pollution and GHG
  - Promote national and local economic development

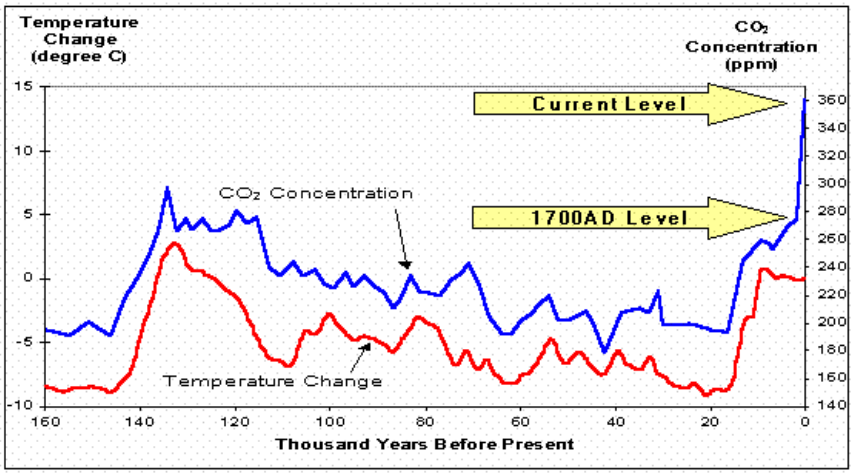
World Population Growth



World Carbon Dioxide Emissions from Fossil Fuels



Atmospheric CO_2 Concentration and Associated Temperature Changes



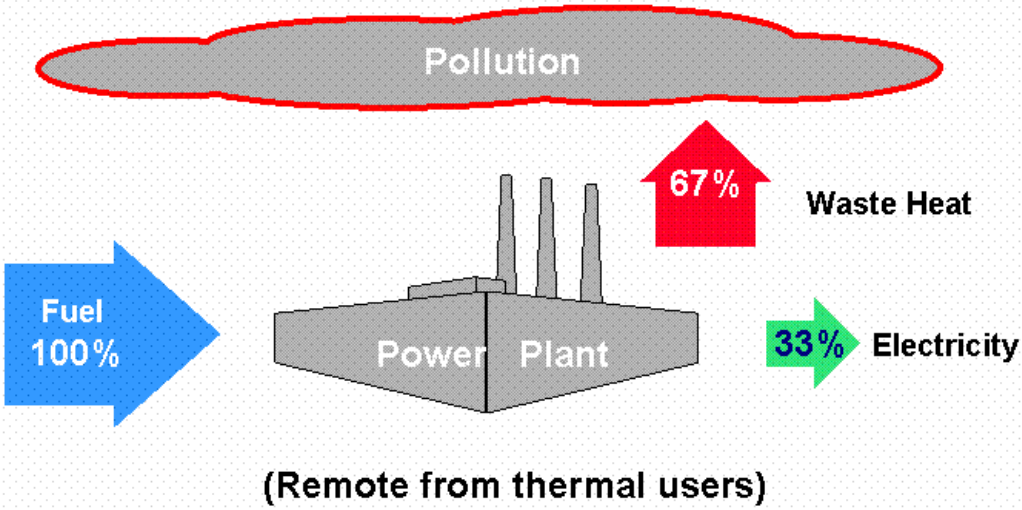
Energy Efficiency

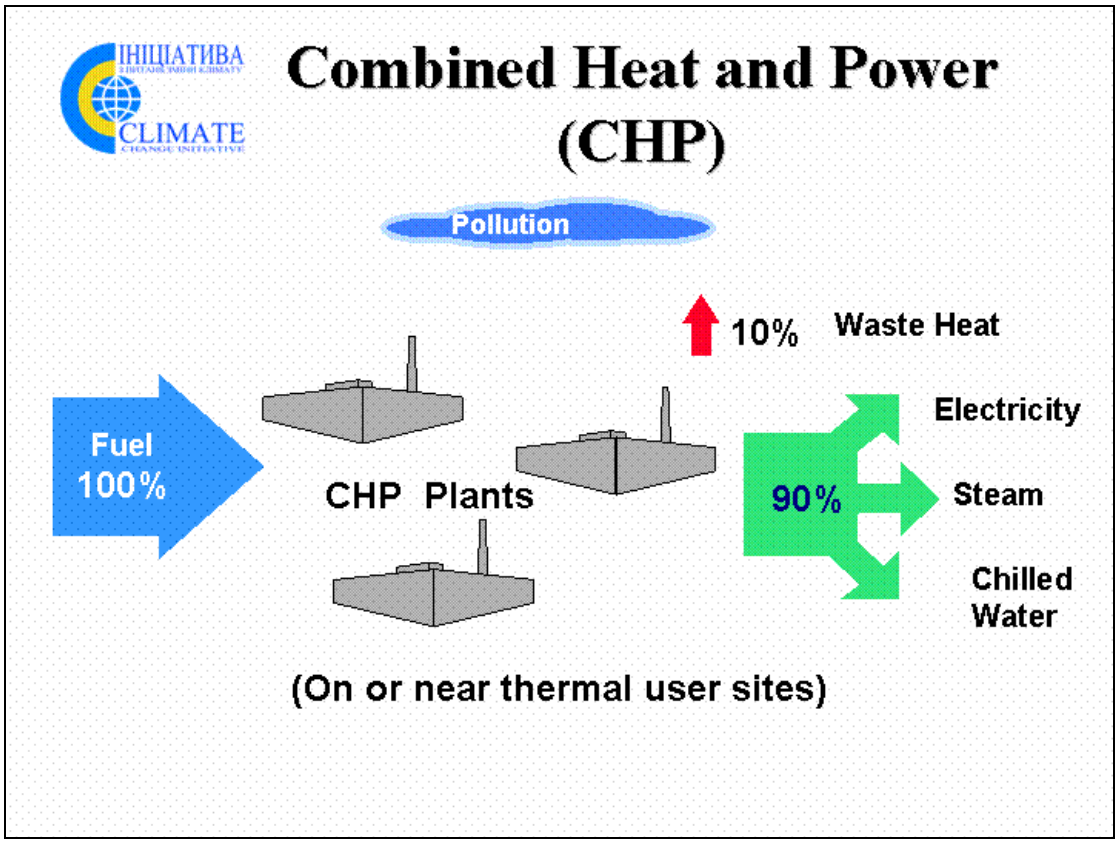
- Tap waste energy
  - Power plant waste heat
  - Industrial waste heat
  - Biomass waste fuels
  - Environmental sources of heat or cool
- Energy-efficiency equipment
  - High-efficiency equipment
  - Better equipment loading
  - Sophisticated controls and professional staff

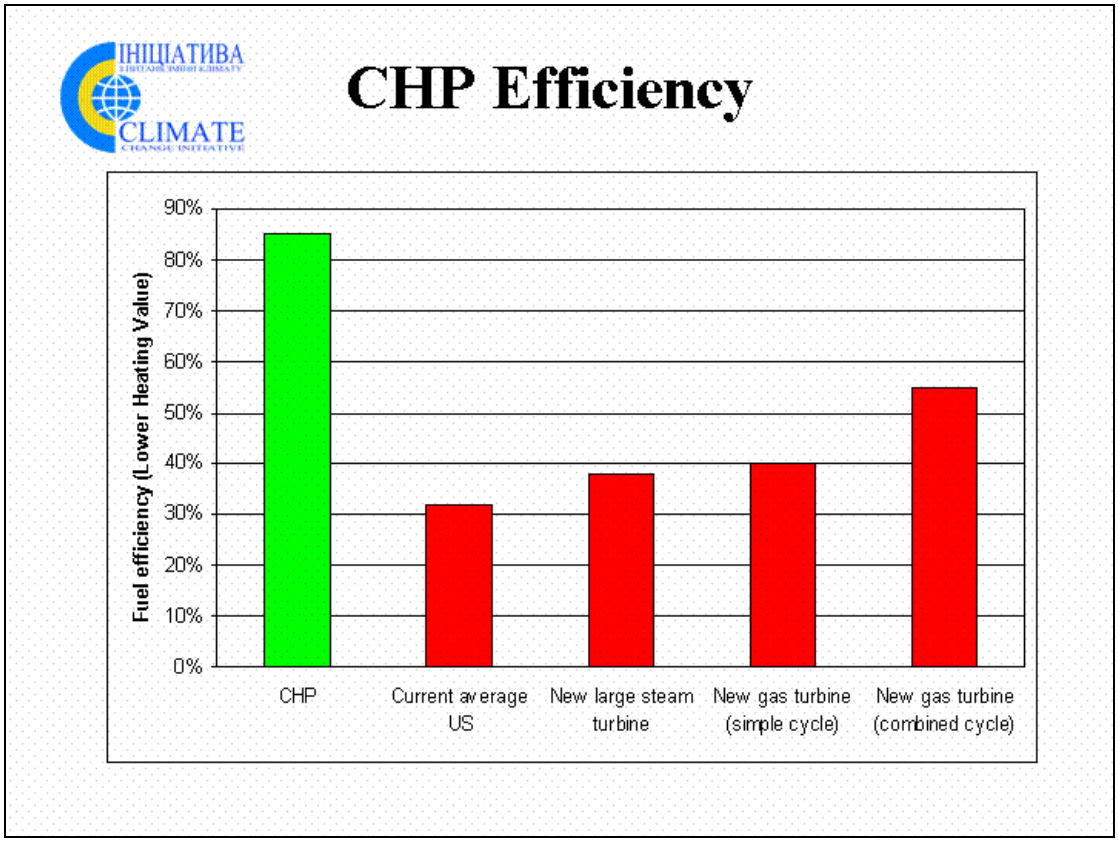
District Heating System

Linking energy users to sources of waste heat and renewable energy

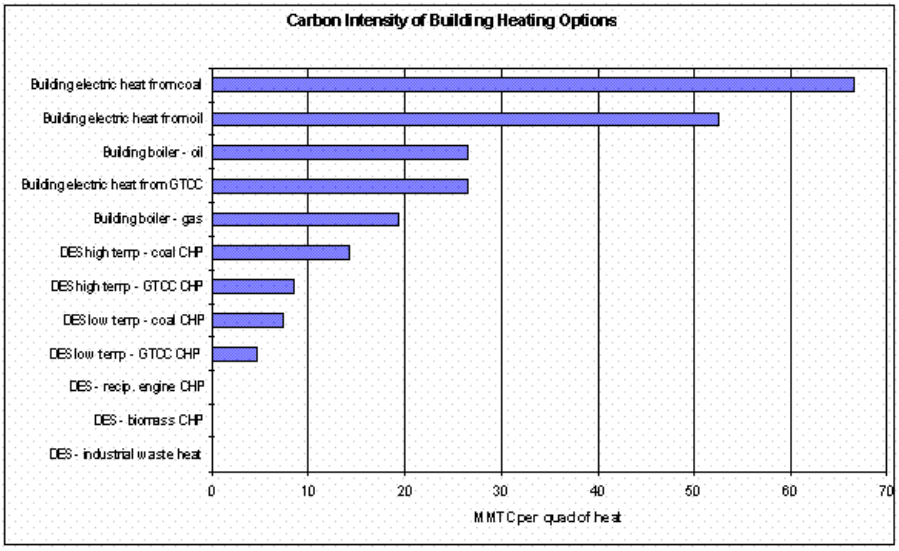
Conventional Generation




Combined Heat and Power (CHP)
Pollution
10%
Waste Heat
Fuel 100%
CHP Plants
90%
Electricity
Steam
Chilled Water
(On or near thermal user sites)


CHP Efficiency
Fuel efficiency (Lower Heating Value)
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
CHP
Current average US
New large steam turbine
New gas turbine (simple cycle)
New gas turbine (combined cycle)

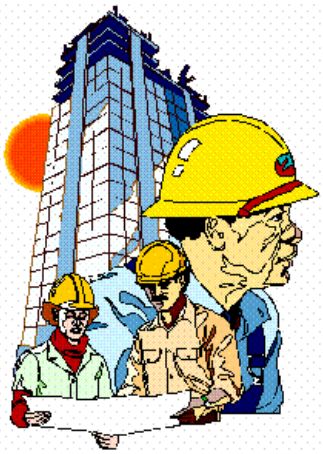
Carbon emissions from heating alternatives



Environment

- Energy Efficiency
- Air Pollution
  - Nitrogen oxides --> smog
  - Sulfur dioxide
  - Particulates
- Carbon dioxide
- Ozone-depleting refrigerants

Economy



- Economic Growth
  - Labor-intensive development
  - Economic multiplier
- Urban Revitalization
  - Energy-efficient infrastructure
  - Lower cost for building development
  - Stable, cost-competitive operating costs
  - Better air quality
- Energy security
  - Flexibility helps price and supply stability
  - Local energy sources

Customer Benefits

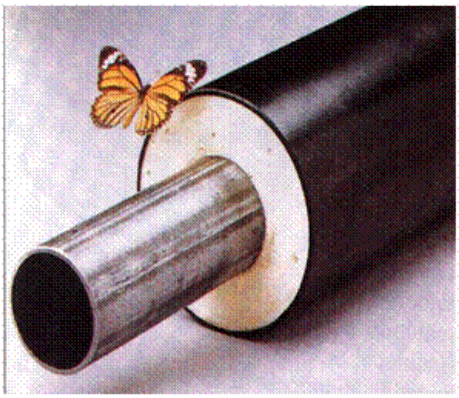
- Elimination of capital costs for boiler and chiller systems
- Improved reliability
- Reduced risk
- Improved flexibility and convenience
- Compares favorably with costs for equipment, fuels, electricity, operation and maintenance

DISTRICT ENERGY TECHNOLOGY

- Combined Heat and Power
  - Gas turbine
  - Reciprocating engine
  - Fuel cell
  - Steam turbine
- Thermal storage
  - Ice
  - Water

Technical Developments

- Distribution
  - Pre-insulated pipe
  - Plastic pipes
  - Ice slurries and freeze point depressants
  - Friction reduction additives
- Cooling
  - Advanced steam absorption
  - Hot water absorption
  - Gas turbine compression with heat recovery

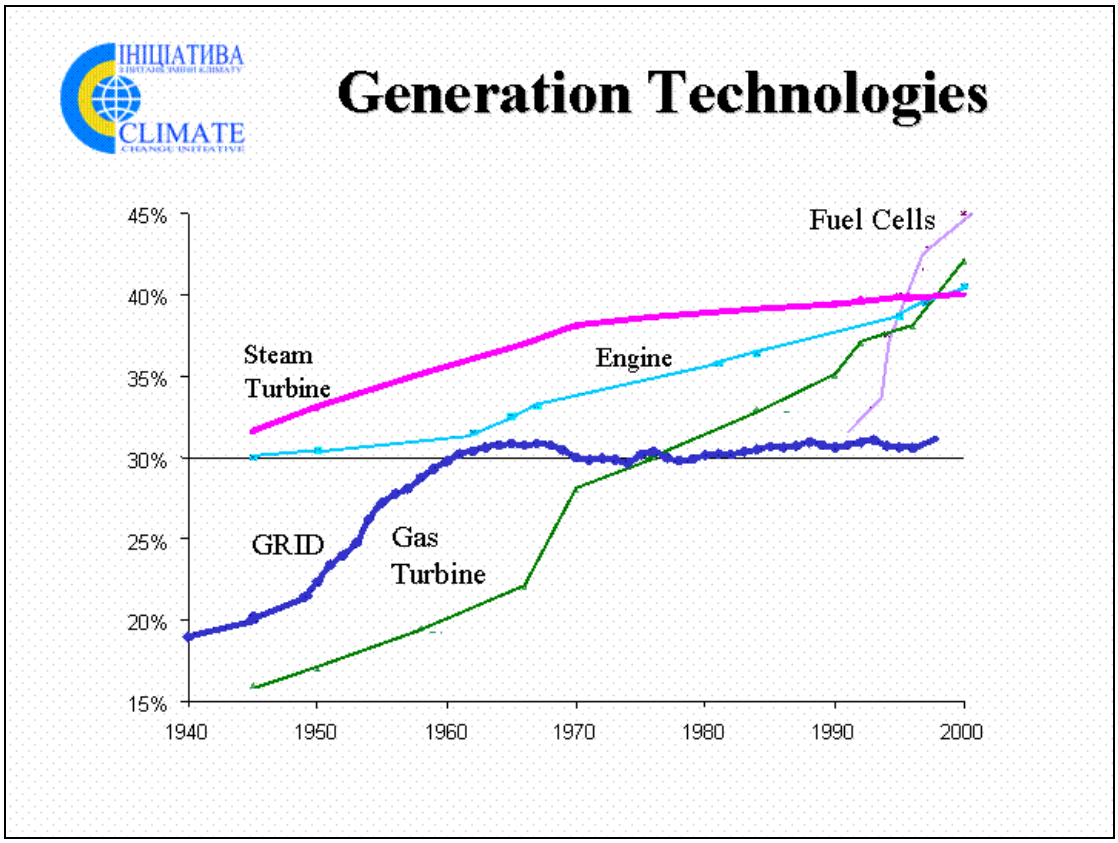


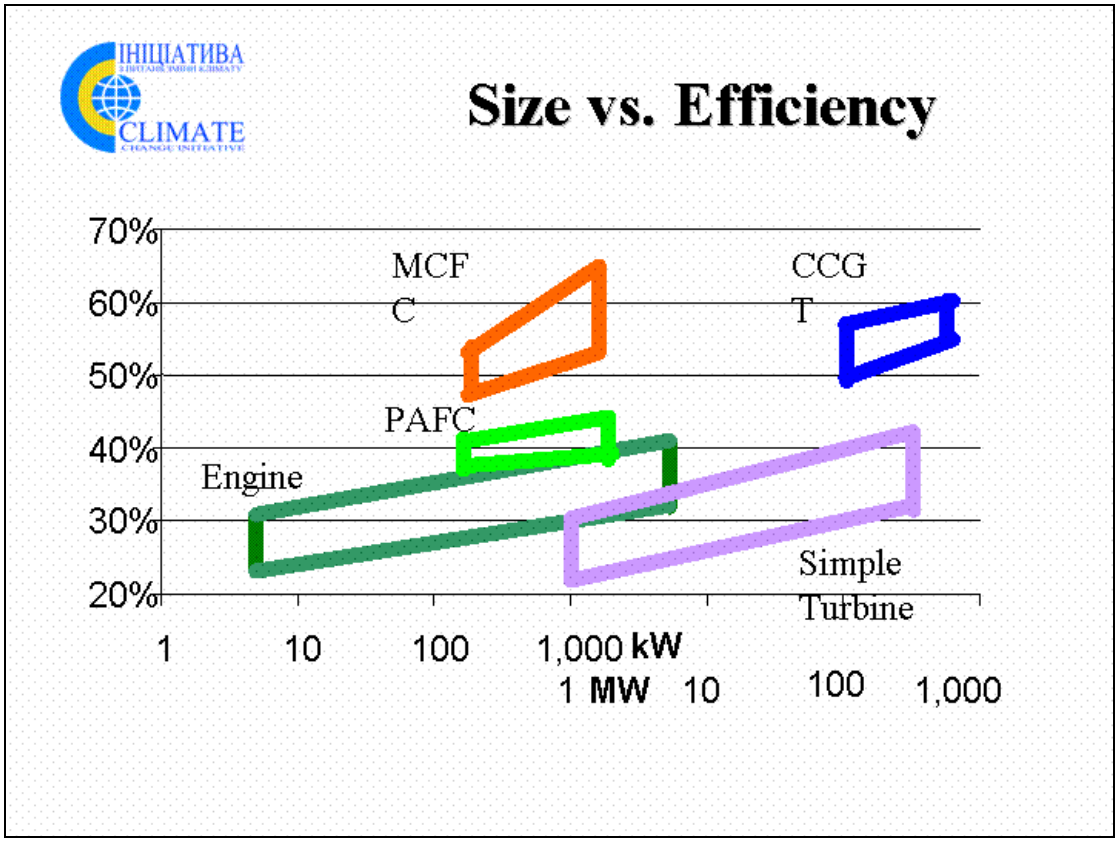
International Energy Agency Implementing Agreement on District Heating and Cooling including Integration with CHP

- Management of system hydraulics
- Integration of District Cooling with District Heating and CHP
- Detection and quantification of heat losses through infrared thermography
- Execution of connection of pipelines in operation
- Water treatment strategies
- Friction reducing additives

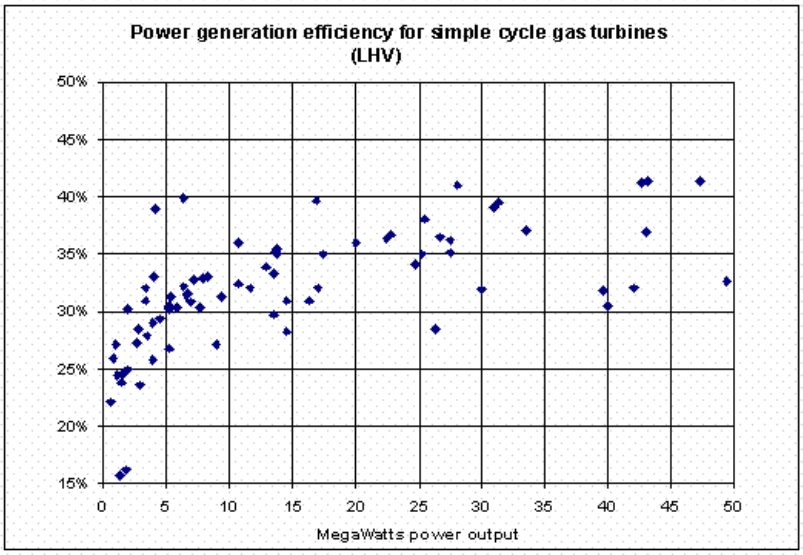
International Energy Agency Implementing Agreement on District Heating and Cooling including Integration with CHP

- Reducing cost of new piping
  - Cold installation of bonded pre-
  - insulated pipe
  - Re-use of excavated material for backfilling
- Plastic piping system design and installation
- Performance of different types of small heat meters
- Efficient building substation design

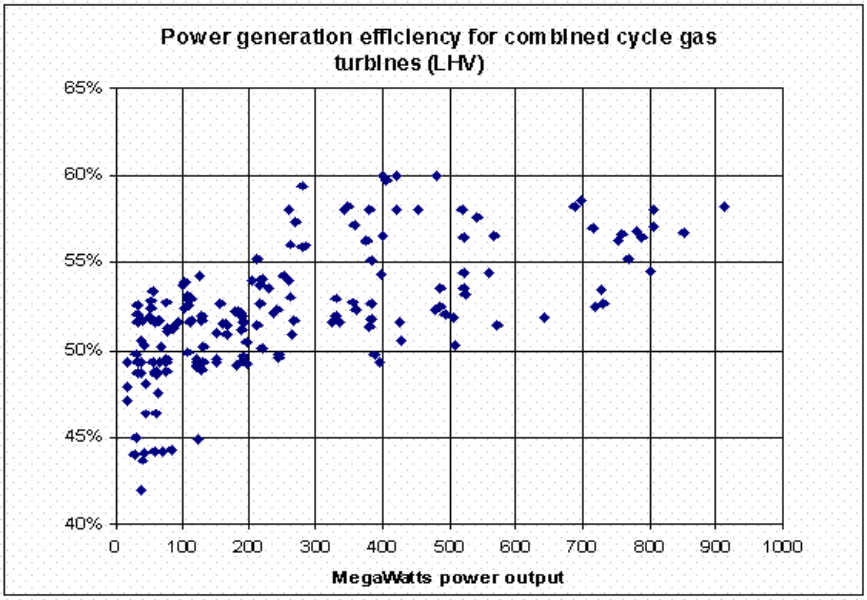

Generation Technologies
45%
40%
35%
30%
25%
20%
15%
1940
1950
1960
1970
1980
1990
2000
Fuel Cells
Steam Turbine
Engine
GRID
Gas Turbine


Size vs. Efficiency
70%
60%
50%
40%
30%
20%
MCFC
CCGT
PAFC
Engine
Simple Turbine
1
10
100
1,000 kW
1 MW
10
100
1,000

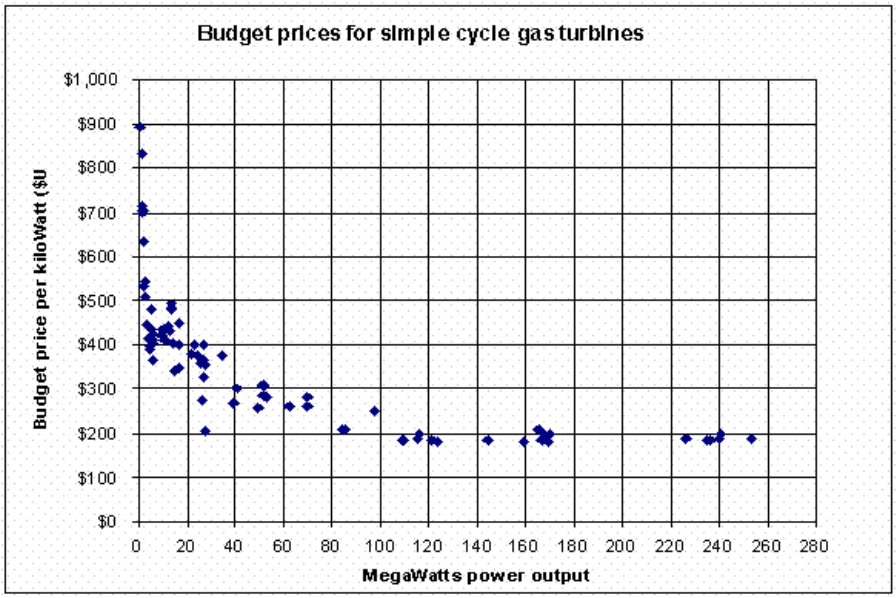
Simple Cycle Gas Turbine Power Generation



Combined Cycle Gas Turbine Power Generation



Costs for Gas Turbines



GREENHOUSE GAS REDUCTION IN DISTRICT HEATING SYSTEMS

- Projects performed by FVB District Energy
- Key strategies for GHG reduction in District Heating systems

Regional projects performed by FVB District Energy Inc.

- Tartu, Estonia
  - Rehabilitation of 7 district heating systems including plants, distribution and customer substations
  - Total production capacity 490 MWth
  - Implementation funded by World Bank
  - Boiler conversions to fluidized bed combustion
  - Replacement of portions of distribution system
  - Upgrade of building substations
  - FVB role in study, detailed design, tendering of equipment and construction contracts, and construction supervision

Regional projects performed by FVB District Energy Inc.

- Jelgava, Latvia
  - Rehabilitation of one of two district heating systems serving the city
  - Annual energy consumption 85,000 MWH
  - Implementation funded by World Bank
  - Replacement of 19 km of distribution system
  - Upgrade of 150 building substations
  - Installation of new control system and distribution pumps
  - FVB role in detailed design, preparation of tender documents, evaluation of bids, and procurement

Regional projects performed by FVB District Energy Inc.

- Tomsk, Russia
  - Rehabilitation of district heating system
  - Five production plants
  - Peak heating load 2,450 MWth
  - Annual energy production over 7,500,000 MWH
  - FVB role in evaluation of system condition
- Zheleznogorsk, Russia
  - Rehabilitation of district heating system
  - Two production plants

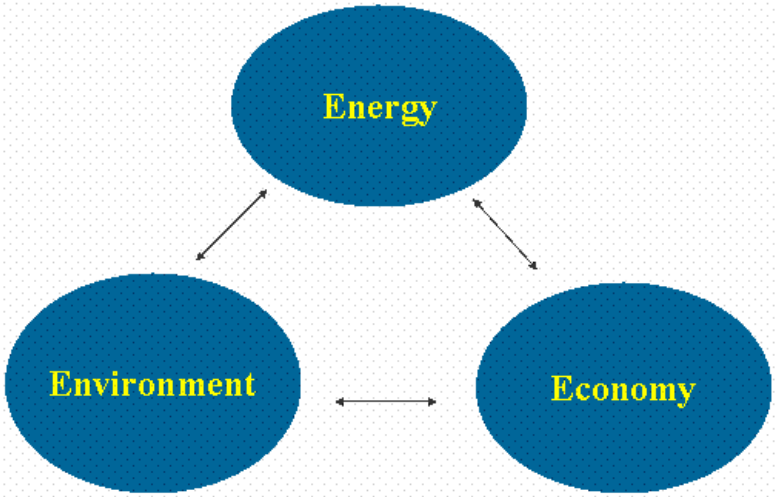
Regional projects performed by FVB District Energy Inc.

  - Peak heating load 640 MWth
  - Annual energy production over 1,740,000 MWH
  - FVB role in evaluation of system condition
- Lviv, Ukraine
  - Peak heating load 1,300 MWth
  - Annual energy production over 2,650,000 MWH
  - FVB role in evaluation of system condition

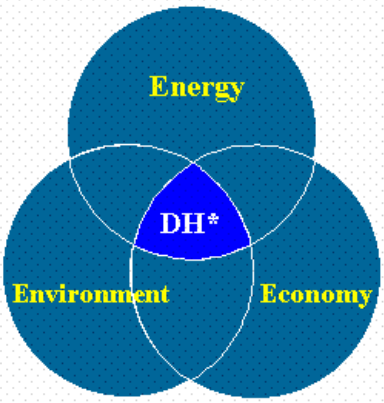
Key Strategies for GHG Reduction in District Heating Systems

- Distribution system upgrade/replacement
- Improved plant and distribution system controls so that the least cost, most efficient production can be delivered
- Improved building substation and metering
- Fuel switching to natural gas or non-fossil fuels
- Conversion to Combined Heat and Power (CHP)
- Cost-based pricing to consumers
- Appropriate allocation of CHP costs

Historic conflicts



Optimizing Energy, Environment and Economy with District Heating



* DH = District Heating

Thank you for your attention!

Questions?

MODULE 7: BASELINE DETERMINATIONS

Session DH-5: Introduction to Working Group Exercise for District Heating Projects

General Objectives: This session introduces the computer tool for calculating project GHG emission baselines and carbon offsets for district heating systems. This session should provide an overview of each of the project investment types built into the tool, namely district heating projects that involve: a) fuel switching, b) energy efficiency projects that save fossil fuel consumption at the heating station; and c) combined heat and power projects that save fossil fuel consumption at the heating station and reduce the need for electric generation from the electric system.

Activities: The presenter should lead this session by using the computer. After the plenary session as been split into facility groups, participants should be further split into small working of no more than 3 per computer. The presenter should ask each small working group to open the spreadsheet file, and while it is open, explain the tool, worksheet by worksheet.

Total Time: 60 minutes

Materials: Computers, district heating system spreadsheet training tool

MODULE 7: BASELINE DETERMINATIONS

Session DH-6: Working Group Exercise for District Heating Projects

General Objectives: This session provides an opportunity for participants to use the computer tool to calculate project GHG emission baselines and carbon offsets for project investments in district heating systems. The objective is to work in small teams and become familiar with the key techniques and approaches used to calculate GHG baselines.

Activities: The training tool is loaded with a set of default data for the existing system and for the three project investments. The instructor should provide each working group with a set of specific exercises based as much as possible on local conditions for existing facilities, and realistic project investments. The instructor is free to design these exercises within the bounds of the tool itself. Given time, sensitivity analyses can also be conducted. During the early stages of the working group exercise, one spokesperson should be chosen (or nominated) to represent the results of the working groups in plenary session.

Total Time: 5.5 hours

Materials: Computers, district heating system spreadsheet training tool

MODULE 7: BASELINE DETERMINATIONS

Industrial Boiler Sessions

Session IB-1: Experience in Developing Energy Efficiency Measures in Industry in Ukraine (Part I)

In compliance with the preliminary agenda we suggest the inclusion of the following theme:

- Experience in Developing Energy Efficiency Measures in Industry in Ukraine

  Information is updated depending on the development of new programs and strategies regarding these issues.

As an example we give two parts of presentation concerning the experience in developing energy efficiency measures in industry in Ukraine (see Ukrainian deliverables).

It is recommended to invite authors of programs and strategies for presentation of their developments.

MODULE 7: BASELINE DETERMINATIONS

Session IB-2: Experience in Developing Energy Efficiency Measures in Industry in Ukraine (Part II)

In compliance with the preliminary agenda we suggest the inclusion of the following theme:

- Experience in Developing Energy Efficiency Measures in Industry in Ukraine

  Information is updated depending on the development of new programs and strategies regarding these issues.

As an example we give two parts of presentation concerning the experience in developing energy efficiency measures in industry in Ukraine (see Ukrainian deliverables).

It is recommended to invite authors of programs and strategies for presentation of their developments.

MODULE 7: BASELINE DETERMINATIONS

Session IB-3: Introduction to Working Group Exercise for Industrial Boiler Projects

General Objectives: This session introduces the computer tool for calculating project GHG emission baselines and carbon offsets for industrial boilers. This session should provide an overview of each of the project investment types built into the tool, namely industrial boiler projects that involve: a) fuel switching, b) energy efficiency projects that save fossil fuel consumption at the boiler; and c) combined heat and power projects that save fossil fuel consumption at the boiler and reduce the need for electric generation from the electric system.

Activities: The presenter should lead this session by using the computer. After the plenary session as been split into facility groups, participants should be further split into small working of no more than 3 per computer. The presenter should ask each small working group to open the spreadsheet file, and while it is open, explain the tool, worksheet by worksheet.

Total Time: 60 minutes

Materials: Computers, industrial boiler spreadsheet training tool

MODULE 7: BASELINE DETERMINATIONS

Session IB-4: Working Group Exercise for Industrial Boiler Projects

General Objectives: This session provides an opportunity for participants to use the computer tool to calculate project GHG emission baselines and carbon offsets for project investments in industrial boilers. The objective is to work in small teams and become familiar with the key techniques and approaches used to calculate GHG baselines.

Activities: The training tool is loaded with a set of default data for the existing boiler and for the three project investments. The instructor should provide each working group with a set of specific exercises based as much as possible on local conditions for existing boiler facilities, and realistic project investments. The instructor is free to design these exercises within the bounds of the tool itself. Given time, sensitivity analyses can also be conducted. During the early stages of the working group exercise, one spokesperson should be chosen (or nominated) to represent the results of the working groups in plenary session.

Total Time: 5.5 hours

Materials: Computers, industrial boiler spreadsheet training tool

MODULE 7: BASELINE DETERMINATIONS

Power Supply Sessions

Session PS-1: Overview of Power Generation in Ukraine (Trends, Features, Investments)

In compliance with the preliminary agenda we suggest the inclusion of the following theme:

Overview of Power Generation in Ukraine (Trends, Features, Investments)

Information is updated depending on the development of new programs and strategies regarding the power generation.

As an example we give presentation of Overview of Power Generation in Ukraine (see Ukrainian deliverables).

It is recommended to invite authors of programs and strategies for presentation of their developments.

MODULE 7: BASELINE DETERMINATIONS

Session PS-2: GHG Baselines: Thermal Power Plants of Ukraine

In compliance with the preliminary agenda we suggest the inclusion of the following theme:

Overview of Power Generation in Ukraine (Trends, Features, Investments)

Information is updated depending on the development of new programs and strategies regarding the power generation.

As an example we give presentation of Overview of Power Generation in Ukraine (see Ukrainian deliverables).

It is recommended to invite authors of programs and strategies for presentation of their developments.

MODULE 7: BASELINE DETERMINATIONS

Session PS-3: Estimating Baselines and Effectiveness of Joint Implementation in Power Projects in Eastern Europe

Overview

General Objectives: By the end of the session, participants should have a clear understanding of the issues and concepts associated with determining baselines in the power supply sector. Specifically, this session covers:

- Characteristics and types of baselines in the power supply sector,
- Case studies of baselines calculated for several projects in Eastern Europe,
- Typology for baselines
- Policy recommendations for determining baselines in power supply.

Activities: An overhead slide presentation, followed by period of questions and answers

Total Time: 45 minutes

Materials: Set of 16 OHTs

Estimating Baselines and Effectiveness of Joint Implementation Power Projects in Eastern Europe

Session PS-3

Module 7: Project-Level GHG Baseline Determination

Slide 1

Overview

- General Characteristics of Baselines
- Types of Baselines in Power Generation Projects (based on Axel Michaelowa, 1998)
- Case Studies of Energy-Related JI Projects in Eastern Europe

Slide 2

General Characteristics of Baselines

- Are prerequisite in JI and CDM projects
- Objective: Provide a verifiable evidence of GHG reductions
- Inclusion of "No-Regrets" options -- remains unclear
- Multiple baselines -- a solution for an inherent uncertainty of the future development

Slide 3

Baseline Selection: General Methods

- Each project can be examined using several alternative baselines
- Baselines depend on:
  - existing business practices within the particular sector of industry;
  - trends and changes in these standards and practices.
  - indirect effects such as activity shifting, price effects and lifecycle effects in products.

Slide 4

Types of Power Project Baselines: *Improving efficiency levels of existing power stations or replacing old power plant with new plant using the same fuel*

Baseline	Emission reduction	Project lifetime	Case in which baseline applies
Efficiency level of plant before improvement	E(old)-E(new)	Commercial life of old plant (approximate value: depreciation period)	Plant still operating economically
Average level of efficiency in new plant built in the last 5 years	E(mean)-E(new)	Commercial life of new plant (approximate value: depreciation period)	Commercial life of old plant has run out
Efficiency level of plant before improvement	E(old)-E(new)	10 years	Transitional solution for out-dated power stations

Slide 5

Types of Power Project Baselines:

Fuel substitution, same level of efficiency

Baseline	Emission reduction	Project lifetime	Case in which baseline applies
Fuel actually used previously	E(old)-E(new)	Commercial life of old plant (approximate value: depreciation period)	Plant still operating economically
Average level of efficiency in new plant operating on previous fuel built in the last 5 years	E(mean)-E(new)	Commercial life of new plant (approximate value: depreciation period)	Commercial life of old plant has run out, reference is previous fuel since autonomous fuel substitution cannot be assumed
Fuel actually used previously	E(old)-E(new)	10 years	Transitional solution for out-dated power stations

Slide 6

Types of Power Project Baselines:

Additional Power Plant

Baseline	Emission reduction	Project lifetime	Case in which baseline applies
Average level of efficiency in new plant operating on same fuel built in the last 5 years	E(mean)-E(new)	Commercial life of new plant (approximate value: depreciation period)	Reference fuel used in additional power plant

Slide 7

Types of Power Project Baselines:

Replacing old power plant with new plant using renewable energies

Baseline	Emission reduction	Project lifetime	Case in which baseline applies
Efficiency level of the old plant	E(old)	Commercial life of old plant (approximate value: depreciation period)	Plant still operating economically
Average level of efficiency in new plant operating on old fuel built in the last 5 years	E(mean)	Commercial life of new plant (approximate value: depreciation period)	Commercial life of old plant has run out, reference is previous fuel since autonomous fuel substitution cannot be assumed
Efficiency level of the old plant	E(old)	10 years	Transitional solution for out-dated power stations

Slide 8

Types of Power Project Baselines:

Training and information for the operators of existing power plants

Baseline	Emission reduction	Project lifetime	Case in which baseline applies
Actual level of efficiency before training	E(old)-E(T1)	As long as E(T1)<E(old), regular measurements	Problem: recognising temporary effects

Slide 9

Case Studies

- Based on a study by the EC Environment and Climate Research Programme (1999) Countries: Czech Republic and Estonia
- Projects:
  - conversion of heating boilers from heavy fuel oil or coal to biomass or natural gas
  - wind electricity supply projects
  - gas-fired co-generation project
  - demand-side efficiency project in the heat sector.

Slide 10

Project Feasibility Indicators

- Total emissions reduction achieved by the project over its lifetime;
- Specific emissions reduction achieved by the project per unit of energy output;
- Incremental cost of the abatement option over and above the cost of the baseline;
- Specific incremental cost of the abatement (per unit of emissions reduction).

Slide 11

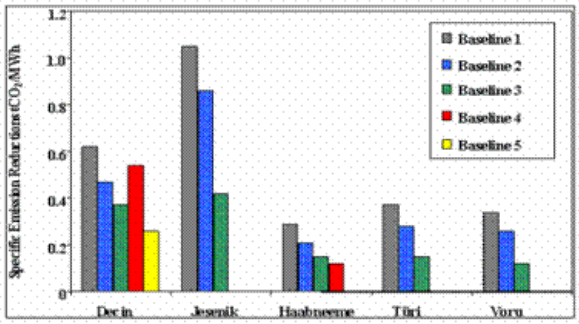
Project Types and Locations

- Five boiler conversion projects in Estonia (Aardla-Tartu,Haabneeme, Türi, Valga and Võru),
- Four boiler conversion projects in the Czech Republic (Kardašova Recice, Mratokin, Staré Mesto and Velesin),
- Two combined building energy efficiency projects in Estonia (at Mustamäe),
- A cogeneration project in the Czech Republic (Decín)
- Two electricity supply projects, one in the Czech Republic (Jeseník) and the other in Latvia (Lettland).

Slide 12

Results of Case Studies

- Calculated values for emission reductions and specific emission reductions from the case study projects varied considerably (up to 50%) according to the different baseline assumptions



Slide 13

Types of Project Baselines

- **Type 1:** simple assumptions about the plant which has been replaced and the separability of the JI project from the rest of the energy system; but compensates for these simplistic assumptions by using a short crediting life.
- **Type 2:** assume separability but include more complex assumptions about the timing of replacement plant over a longer crediting life.

Slide 14

Types of Project Baselines

- **Type 3:** adopt an average mix for situations where the replaced plant is difficult to define explicitly, and again incorporate the possibility of revising this mix to account for unforeseen changes in technology over time.
- **Type 4:** baselines are an average of other baseline types.

Slide 15

Policy Recommendations

- Uncertainty of actual GHG is inevitable. It is necessary to weigh up the costs of developing a baseline against the informational benefit it can be expected to produce.
- Project-specific baseline scenarios appear less uncertain than country-specific baselines
- Different approaches for defining project-related baselines should be encouraged

Slide 16

MODULE 7: BASELINE DETERMINATIONS

Session PS-4: Group Discussion

General Objectives:	This session is a discussion of the first three presentations. It provides an opportunity for questions and answers between the Ukrainian and international specialists assembled. The purpose is to identify key baseline issues in the power supply sector that may prove difficult or challenging to assess. The session should be moderated by one of the local specialists. The format is to pose several questions, based on issues presented during the presentations, and to stimulate discussion
Activities:	Panel discussion on specific questions, followed by period of questions and answers
Total Time:	45 minutes
Materials:	None

MODULE 7: BASELINE DETERMINATIONS

Session PS-5: Introduction to Working Group Exercise for Power Supply Projects

General Objectives: This session introduces the computer tool for calculating project GHG emission baselines and carbon offsets for power supply projects. This session should provide an overview of each of the project investment types built into the tool, namely power supply projects that involve: a) replacement of an existing power station, b) modification of equipment at an existing electric power generation station to improve supply-side efficiency; and c) addition of new electric power generation station on the electric grid.

Activities: The presenter should lead this session by using the computer. After the plenary session as been split into facility groups, participants should be further split into small working of no more than 3 per computer. The presenter should ask each small working group to open the spreadsheet file, and while it is open, explain the tool, worksheet by worksheet.

Total Time: 60 minutes

Materials: Computers, power supply spreadsheet training tool

MODULE 7: BASELINE DETERMINATIONS

Session PS-6: Working Group Exercise for Power Supply Projects

General Objectives: This session provides an opportunity for participants to use the computer tool to calculate project GHG emission baselines and carbon offsets for project investments in power supply facilities. The objective is to work in small teams and become familiar with the key techniques and approaches used to calculate GHG baselines.

Activities: The training tool is loaded with a set of default data for the existing plant and for the three project investments. The instructor should provide each working group with a set of specific exercises based as much as possible on local conditions for existing power plants, and realistic project investments. The instructor is free to design these exercises within the bounds of the tool itself. Given time, sensitivity analyses can also be conducted. During the early stages of the working group exercise, one spokesperson should be chosen (or nominated) to represent the results of the working groups in plenary session.

Total Time: 5.5 hours

Materials: Computers, power supply spreadsheet training tool

MODULE 7: BASELINE DETERMINATIONS

EXPERIENCE WITH EMISSION BASELINES UNDER THE AIJ PILOT PHASE

OECD Information Paper, Contact details: Jane Ellis, Administrator, Climate Change, OECD Environment Directorate, Organization for Economic Co-operation and Development, 2 rue André Pascal, 75775 Paris Cedex 16, FRANCE, email: jane.ellis@oecd.org; Tel: (33 1) 45 24 15 98; Fax: (33 1) 45 24 78 76,

INTRODUCTION

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1.1 Objective and approach

The objective of this paper is to analyse and assess emission baselines used in Activities Implemented Jointly (AIJ) projects. The paper then draws lessons from these baselines that can be used when determining emission baselines for JI and CDM projects. This paper is based on information in the AIJ reports as submitted by participating countries to the UNFCCC, and on supporting information. Almost half of the 95 certified AIJ pilot project reports were examined in detail. The paper also draws on general analysis of baseline issues found in recent literature.

1.2 Terminology

This paper examines the emissions baseline used in AIJ projects, defined as the estimated project emissions in the absence of AIJ. The time over which this baseline continues is called the emissions timeline. Other issues that are important, although not treated in great depth in this paper are the:

- project emissions (i.e. GHG emissions from the AIJ project);
- project's environmental benefit in the host country (defined as the difference between baseline and project emissions); and
- investor benefit (defined as some proportion of the host country's environmental benefit).

1.3 Why do we need AIJ baselines?

AIJ projects are projects where investors fund all or part of a project that aims to mitigate greenhouse gas emissions in another country. AIJ projects are required to *bring about real, measurable and long-term environmental benefits related to the mitigation of climate change that would have not occurred in the absence of such activities* (UNFCCC 1995). AIJ projects therefore have to be additional, i.e. to have an environmental benefit over and above any climate mitigation activities that would

have happened anyway.[1] "What would have happened anyway" therefore represents the project's emissions baseline.

The decision of the first Conference of the Parties that established the pilot phase for AIJ (5/CP.1) does not include the word "baseline". However, the fact that AIJ projects have to result in *measurable* environmental benefits implies that there needs to be some sort of quantitative reference scenario against which to measure the environmental performance of an AIJ project.[2] It is also possible to allocate emission benefits from a project without the use of project-specific emission baselines. The advantages and disadvantages of one way of doing this are explored in section 5 of this paper.

Emission baselines are highly project-specific, and are difficult to validate as, by definition, they never happen. However, they are extremely important as they form the basis for determining emission reductions from the AIJ project.

...

The emissions baseline influences the total projected emissions benefits from a project. It is therefore a crucial component in determining the projected greenhouse gas (GHG) mitigation cost of a project (e.g. in $/t CO2). To the extent that potential investors make their final investment decisions in potential projects based on the projected GHG mitigation cost of those projects, the baseline used may influence which projects are ultimately pursued.

2. BACKGROUND

Emission baselines are needed in order to determine the environmental benefits from AIJ, JI and CDM projects. In the AIJ pilot phase, project-specific emission baselines have been used to determine the environmental benefits from individual AIJ projects. Some of the difficulties in setting emission baselines will be the same for all three mechanisms. Thus, some lessons from the AIJ pilot phase should be applicable to JI and the CDM. However, not all questions relating to emission baselines for JI and the CDM can be answered by looking at AIJ experience to date because not all aspects of baselines have been thoroughly explored under the AIJ pilot phase.

2.1 Challenges involved in determining emission baselines

There may be many feasible options from which to choose when determining an emissions baseline. This is particularly true when considering sector-wide baselines, which aggregate several different emission levels and/or trends, and for emission baselines for "greenfield" (new) projects, where no direct comparison is available with pre-AIJ project parameters such as fuel type, technology type, and amount of heat produced.

[1] This paper focuses on environmental additionality, and does not explore issues surrounding financial additionality

[2] However, the Uniform Reporting Format, which was subsequently agreed upon as the means of reporting AIJ projects, includes reference to a baseline.

An emission baseline for greenfield projects is not what emissions were *before* the project (zero), but what emissions *would become* in the absence of that project. Greenhouse gas mitigation from greenfield AIJ projects in the energy sector may therefore be lower than that of replacement AIJ projects since these projects actually increase emissions (although by less than they would have increased in the absence of the project). The importance of this uncertainty is limited in an AIJ context because of the small number of projects involved. However, it will potentially be much more important in future, especially under the CDM, because the growing demand for goods and energy in developing countries is likely to lead to a demand for new, rather than replacement, plant.

However, even emission baselines for projects where existing equipment is replaced or rehabilitated ("replacement" projects) are subject to significant uncertainties, although the range of feasible baseline possibilities is limited. The emissions baseline for all projects is by definition hypothetical and so cannot be accurately determined. This *ex ante* nature of baselines has been estimated by some analysts (Begg et. al. 1998) to be the largest potential source of errors in determining emission reductions from AIJ projects.

Although it is impossible to avoid all uncertainties in baseline determination, it is possible to reduce these uncertainties through a rigorous baseline-setting procedure. Such a procedure is likely to involve an extensive monitoring exercise in order to determine the pre-project emissions (if the proposed AIJ project involves replacing or upgrading an installation already in place). Further background information may also be needed, such as the availability or not of alternative fuel sources, the distance between the proposed project and gas/electricity grids, strength of transport communication with the proposed project site. It is likely that little of this type of information is readily available, so it would have to be specifically researched for the AIJ project proposal.

Obtaining information needed to determine the emissions baseline for a project has time and cost implications. The more information is required, the greater the cost. The costs of determining baseline emissions are sunk, i.e. disbursed whether or not a proposed project is agreed to, or its impact assessed. This cost barrier may have been one of the reasons for the limited participation of the private sector in the AIJ pilot phase. Moreover, high costs for baseline determination can disproportionately penalise smaller scale projects, as these costs often represent a relatively high proportion of the expected benefits of these projects. One of the major challenges involved in setting up criteria for determining emission baselines (and emission benefits/credits) from AIJ, JI or CDM projects is therefore balancing the need for thorough, rigorous baselines with the need for relatively low costs in baseline determination (and emission monitoring).

3. CURRENT EXPERIENCE WITH SETTING EMISSION BASELINES

Emission baselines have been set within the context of the Activities Implemented Jointly (AIJ) under the UNFCCC. This section outlines the presentation of baselines used in different AIJ projects, and examines the approaches used to estimate and report these emission baselines.

There is currently no internationally agreed methodology on how to calculate emission baselines for AIJ projects, although some countries have set up or are preparing national guidelines that include guidelines for emission baseline determination. It is therefore unsurprising that the choice of method to determine the baseline varies substantially between AIJ projects - even between those taking place in the same sector.

…

The majority of AIJ projects are "replacement" projects in the energy sector, i.e. where one technology or system is replaced with another that has lower emissions. There are also a number of AIJ projects in the industrial sector (e.g. cement production in the Czech Republic) which aim to reduce the greenhouse gas emissions per unit output, although emissions may actually increase due to increased production. In addition to these two project types, there are also a number of "greenfield" (new) AIJ projects in the energy and forestry sectors.

…

3.2 How have AIJ projects calculated and reported baselines?

Different AIJ projects show a large variation in the detail of reporting emission baselines in AIJ pilot phase projects, as well as a large variation in the different types of emission baselines used. Most AIJ reports outlined one quantified emissions baseline. A few reported more than one baseline, and some did not report any emissions baseline, or only reported total projected emission benefits over the project's life (rather than by year of project operation).

…

A summary of different issues found when comparing emission baselines in different AIJ projects is presented below. These issues are explored further in the remainder of this section.

- The methodology by which emission baselines were calculated was not always clear. **…**

- Justification of the methodology used to calculate the emission baseline not presented**….**

- The calculation of many emission baselines was not transparent**…**

- Data presented in emission baselines were not always justified or referenced**…**

- There was a wide variation in the time over which an AIJ project generated emission benefits for the investing party (the "timeline"), both within and between sectors**….**

- The choice of system boundary for AIJ projects greatly affects project baselines, but was not always presented or explained**….**

3.2.1 Emission baselines used in AIJ projects

Different AIJ project reports used different emission baselines. There is no general rule for the shape of an emissions baseline: some go down; others go up; many stay constant, and a few are a combination of all three. While some diversity is to be expected because of the wide variation in different AIJ project types, the variation seen is significant even within similar projects.

Just because projects of a similar type have different shapes of baselines does not mean that one baseline shape is “wrong” and another is “right”: the different situation of host countries, and the location of the different plants, all affect the choice of baseline. For example, the location of a heating plant relative to the natural gas grid is an important determinant of whether or not a coal or oil-fired plant could feasibly be connected to the gas grid in future, but this information is rarely given in AIJ project reports. Other assumptions also have a strong influence on the baseline shape. For example, the relative output of goods and/or energy before and during the AIJ project; whether or not the pre-AIJ equipment would have been rehabilitated; and whether any demand-side energy-efficiency measures are undertaken. This potential validity of different baseline shapes does not facilitate inter-project comparisons, but is unavoidable if project-specific baselines are used.

…

3.2.2 Categorising AIJ emission baselines

The AIJ projects described in submissions to the UNFCCC contain many different baseline types. Some of the project descriptions specifically label the emission baseline scenario chosen, e.g. as “status quo”. Other reports refer to model simulation results. Most reports examined present a short description of the expected baseline scenario without labelling it in a particular manner.

The literature surrounding emission baselines includes many labels for different project types. Recent OECD analysis (Puhl 1998) distinguishes these into four types:

- **method-base**d, i.e. generally-applicable guidelines independent from the specific conditions of an individual project, e.g. benchmarking or top-down baselines;

- **comparison-base**d, i.e. based on a “real world” reference project or control group;

- **simulation-base**d, i.e. assessing what would have happened in the absence of the proposed activity;

- **mixe**d, i.e. a mixture of the above.

These types could be further sub-divided, e.g. into static or dynamic baselines. Most AIJ projects to date are in the energy or forestry sectors, and so have a larger impact on CO2 than on other gases. The emphasis on CO2 is therefore not surprising.

Descriptions of AIJ emission baselines do not always fall neatly into the first three categories. For example, a common means of determining the baseline for energy

supply type AIJ projects was to estimate the current emissions from that particular system (which could be categorised as a method-based approach) and then to modify this slightly to take into account expected efficiency gains and/or fuel switches. This modification falls into the “simulation” category.

…

One area on which most project reports were consistent was on possible revisions to an emissions baseline during the project’s lifetime. Almost all AIJ emission baselines were fixed at or near the project start date to cover the whole emissions timeline of the project. Only one of the AIJ project reports examined (Czech/France cement production) indicated that the emissions baseline would be revised during the project’s lifetime.

…

3.2.5 Timelines

The number of years over which an AIJ project (or potential JI or CDM projects) generates emission benefits for the investor is of crucial importance. Emission benefits for the investor will generally be greater if they can accrue over a longer period of time. Greater projected emission reductions from a proposed project will reduce the projected per unit emission mitigation cost for that project, and may increase the likelihood of that project attracting funds.

There are currently no commonly-agreed international guidelines that can be used by project developers when deciding the timeline over which their project is valid

…

The timelines used to calculate emission baselines in current AIJ projects varies significantly, both between and within different project types. The shortest AIJ baseline presented was for two years (for a German-financed gas transmission network upgrade). This seemed to correspond to the length of time needed to upgrade the network, although the lifetime of the transmission network (and therefore of the emission reductions brought about by the project) is substantially longer. The longest AIJ baseline presented was for 99 years for a Dutch-financed forest preservation project, even though the project description suggested that there would be no net changes in carbon stocks of the preserved forest after year 60. However, the majority (76 out of 95) of AIJ projects outlined in the UNFCCC’s second synthesis report had baselines between 10 and 30 years (UNFCCC 1998b). Almost all renewable energy and energy efficiency projects fell into this category.

…

3.2.6 System boundary

The system boundary chosen for a project will affect emission reduction baseline for that project. Determining the system boundary is therefore an important part of the

baseline determination. However, there is no international guidance on where exactly the boundaries should be set.

Most AIJ projects examined assumed that the system boundary stopped at the project edges. **…** The choice of the physical project boundary as the system boundary is probably because most of the AIJ reports examined had estimated a baseline specific to the project, rather than to a sector (or country). In addition, the project boundary is easily defined, while setting limits on the system in which a project operates is more difficult. Using a coal to gas fuel switch as an example, should the system boundary be drawn in such a way as to include any or all of: reduced methane emissions from coal mining, reduced emissions from coal transportation, the (one-off) emissions associated with producing any new equipment installed under the AIJ project, the (one-off) emissions associated with transport and disposal of the old equipment, and increased emissions from the extraction, transport and distribution of natural gas? While emissions associated with most of these activities would be included in national inventories, the effect on global emissions would be different if the countries involved had emission commitments or not.

…

3.2.7 Other issues

Risk: AIJ projects include some element of risk, as do other investments. However, the risk in an AIJ project has both a financial and an environmental component. The environmental risk is twofold: firstly that the project may not deliver the emission reductions initially anticipated. Secondly, if emission reductions are lower than anticipated, this may result in global GHG emissions being higher than expected.

Reduced emission reductions from a project may occur for a number of political, economic, technical or other reasons. For example, natural disasters such as hurricanes may uproot trees and thereby reduce the amount and timeline over which a reforestation/afforestation AIJ project generates GHG emission benefits. Natural climate variations, e.g. in rainfall or wind patterns, will affect the amount of electricity produced by renewable energy AIJ projects, and will thereby affect the GHG benefits from these projects if the renewable electricity generated was assumed to displace fossil-fuelled electricity. Changes in land ownership may result in altered land-use (and carbon sequestration) patterns. Changes in a country's energy prices either through subsidy or other policy reform can alter the pattern or level of energy demand. An economic recession may lower demand for goods or energy produced under an AIJ project, and reduce the projected emission reductions from this project. Technical failures that require an AIJ project to be temporarily halted for repair or maintenance can also reduce the projected emission benefits from this project.

…

Environmental conservatism: Some AIJ project reports infer explicitly or implicitly that they err on the side of environmental caution. For example, … [T]he French project of improving energy efficiency at a cement manufacturer in the Czech Republic implicitly errs on the side of environmental caution, when assessed per unit output,

by only taking into account CO2 reductions from improved efficiency of the heat exchanger used in the project, not of the gains associated with reduced electricity consumption. However, the figures given in the report are on the basis of per unit output, even though the stated aim of the plant owner is to increase production (which would therefore increase absolute emissions from the plant).

Validation and verification of URF reports: There are other issues that may need to be addressed as the quantification of emission baselines takes on greater importance. For example, who will check reports for inconsistencies, mistakes (or even for bias)? At present, there is no international verification or validation on the content of reports, and some AIJ reports are internally inconsistent (e.g. report different project lifetimes in different parts of the URF), contain arithmetical errors (e.g. in the estimated emission reductions from the AIJ project) or contain other possible inconsistencies. There may also be inconsistencies in general policy/data information in the reports of two different projects carried out with the same investor and host parties.

3.3 Sensitivity of emission baselines

The variation noted above in the different assumptions used in different emission baselines illustrates the difficulties of drawing up an emissions baseline. However, the emissions baseline is often either directly proportional or extremely sensitive to these different assumptions.

This is illustrated in an example below, where the emission baseline of an actual AIJ project is compared with the emission baseline that would have applied if this project baseline had applied assumptions similar to those found in other AIJ projects.

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4. LESSONS AND RECOMMENDATIONS

Although COP4 did agree to continue the pilot phase, the future of AIJ is likely to be limited. Even in the event of the pilot phase continuing to the first commitment period (2008-2012), the Kyoto Protocol's JI and CDM are likely to be the focus of many investors, as both these mechanisms can generate emissions benefits. However, since project-specific emission baselines may be needed under JI and CDM, it is important to see where lessons can be drawn from the AIJ pilot phase, and if these lessons can help in setting up recommendations or FCCC-agreed guidelines for calculating such baselines under JI and the CDM.

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4.1 Methodological lessons and recommendations

There are many methodological issues that need to be resolved if project-specific emission baselines are to be used in determining emission benefits for project-based co-operative mechanisms. This section focuses on measures that could improve the consistency and transparency of project-specific emission baseline calculations. However, it does not suggest whether or not these measures should be mandatory or just encouraged as part of "good practice". Some of these recommendations will only be applicable to projects if a project-specific emissions baseline is required.

1) **Emission baselines for AIJ projects are highly project-specific**, so detailed project-specific baselines are likely to vary from one another in shape and length, even for projects of a similar nature. Expert judgment has played an important role in setting emission baselines to date, and is an important source of the variation noted in them: baselines are often directly proportional, or

This Swedish-financed project converted a heat-producing boiler from gas/diesel oil to biomass. Two reports have been submitted to the UNFCCC for this project, with total emission mitigation of the project estimated at 130 kt CO2 (1st report) and 195 kt CO2 (2nd report). **This difference of 50% in emission mitigation potential of the project was solely due to a different time horizon** used in the two projects: the first estimated a 10-year emissions timeline, and the second estimated a 15-year timeline.

The assumptions included in the most recent Daugavriva report include: output from the plant to remain constant, a lifetime of the AIJ project of 15 years, and no fuel switching to take place. Other AIJ projects of a comparable nature present different assumptions in their baseline calculation, e.g.:

- fuel switch to from original fuel to gas (between 2-10 years after the project start),
- project lifetime of 30 years,
- energy demand growing, with the increased demand being met by the AIJ project and with the AIJ project mitigation benefits increasing in line with increased energy production.

Applying these assumptions to the Daugavriva project gives a range of projected GHG mitigation of the project between 130 kt C_{O2} and 477 kt CO2.

The factor to which the calculated mitigation effect is most sensitive is the projected timeline of the project. However, other *ex ante* assumptions could be plausible, and could increase the variation in expected emissions benefits of projects even more. For example, if the plant owners were to switch to biomass in the absence of an AIJ project 7 years after the AIJ project started, the emissions benefit of the project would be reduced to 91 kt C_{O2} as the emissions benefit of the project drops to zero in year 8.

Actual and projected emission benefits of a project could also be substantially different, for example in the case of technical failure. This outlines the need for *ex post* verification/validation of the emission mitigation of projects.

highly sensitive, to underlying assumptions.

Box: Sensitivity analysis: Daugavriva boiler conversion

⇒ Detailed, project-specific technical and policy data are needed to reduce the uncertainties inherent in determining emission baselines, if these emission baselines are to be drawn up at the project level. However, expert judgment is likely to remain an important component of baseline determination even if detailed data are available to the project developers.

2) **Environmental conservatism** in drawing up baselines would help to improve the global greenhouse gas mitigation potential of project-based co-operative mechanisms, although it also has a cost implication for the investor. A few AIJ reports examined indicated that some of the assumptions presented in the report were environmentally conservative, i.e. that the total emission benefits estimated were at the low end of a possible range. This could be interpreted as a tacit acknowledgement of:

- the uncertainty that surrounds an individual emissions estimate, or

- the wish of the investor/host party to maximise the chances that the project will be "environmentally effective" (i.e. that leakage is minimised from the project).

Increasing the environmental effectiveness of projects could also be achieved by periodically revising the emissions baseline (downward) once the project is in place in order to take e.g. unexpected technical improvements into account. However, such adjustments would increase the uncertainty of investor benefits, and is therefore likely to reduce investor interest in AIJ projects significantly.

⇒ Emission baseline calculations may need to include a "safety margin". For example, recommendations could be made that the calculations of the emissions baseline and emission benefits should err on the side of environmental caution (e.g. by taking a low estimate for the emissions timeline or the low end of a range when calculating the emission mitigation potential of a project). This would be particularly important when the uncertainty in emission reductions from that project is large, for example in biotic projects, and/or where *ex post* emission monitoring is limited.

3) **The rationale behind choosing the emissions timeline is rarely explaine**d, although the timeline is a crucial component of the emissions baseline and in determining the environmental benefits from (and potentially, credits for) a project. Possible methodological guidelines for setting timelines are explored in e.g. Michelowa 1998.

Erring on the side of environmental conservatism may require long baselines for biotic projects, but shorter baselines for other projects. Long baselines for biotic projects will help e.g. to ensure that carbon sequestration from that project continues far into the future, although this would need to be complemented by assurances from the host country that the sink created by the project would not be lost. Long baselines may also be justifiable for projects that improve transmission/distribution

infrastructure, e.g. for the transport of gas or heat, as such networks have long lifetimes.

However, long baselines are not necessarily most appropriate for projects introducing new technology, even if this has a long lifetime. In this case, a long emissions baseline may result in substantially over-estimated emission reductions if independent technological advances reduce the emission mitigation potential of the project equipment before the end of its useful life.

⇒ Recommendations on how to determine the emissions timeline would help improve consistency in emission baselines between different projects of a similar nature.

4) **Host country policies that might affect emission baselines are rarely presente**d, although policies e.g. of improving the efficiency of power generation, facilitating a switch to renewables, or to introduce large-scale gas use would all have significant impacts on the choice of shape and timeline for emission baselines. Third party validation of emission baseline choices would be facilitated if sources of such policy information was referenced. This should be neither difficult nor time-consuming since the host country government have to approve the AIJ project, and are best placed to state their policy goals.

⇒ Key methodological assumptions should be reported to make transparent the validity of the emission baseline scenario. (This sort of information could be presented in the current URF section on "compatibility with economic development and socioeconomic and environmental priorities": current reporting in this section is extremely brief in many AIJ projects).

5) **Little experience has been gained from "greenfield" AIJ project**s, especially for non-renewable energy sector projects. However, it is likely that greenfield projects will form a large proportion of proposed CDM projects and that some of these projects in the energy sector will use fossil fuels as an energy source. Determining emission baselines for "greenfield" projects may be subject to greater uncertainties than determining emission baselines for "replacement" projects, because there is no direct reference in a greenfield project to major factors that determine its greenhouse gas emissions (such as the fuel and technology used). More experience of, and information exchange on, determining the emission baseline for greenfield projects would be useful before any guidelines are agreed on calculating emission baselines for such projects.

In addition, the environmental effectiveness of greenfield and replacement projects may be different. Similar project types may therefore have very different environmental impacts if they were replacement or greenfield, and the investor benefit from greenfield projects may need to be calculated in such a way as to reflect this, e.g. via guidelines on the length of emissions timeline.

⇒ Methodological work is needed on how to calculate baselines from greenfield projects.

6) **Learning effects may lower expected emission reductions at the start of a project,** especially when this project involves introducing a new, lower-emitting technology. The limited data available on expected versus actual benefits for AIJ projects shows that this is indeed frequently the case in the first few years of a project. Thus, while the technology users are learning how to use or manage the new, the performance of the project is likely to be sub-optimal and the emission reductions lower than anticipated. This means that if emission reductions from project-based co-operative mechanisms are allocated on an *ex ante* basis and not subsequently verified, emission reductions could be over-estimated.

...

⇒ Learning effects should be factored into emission baseline calculations for JI and CDM projects if emission crediting for these projects is allocated on an *ex ante* basis and are not subsequently verified.

7) **Calculating emission benefits from energy efficiency measures is difficult for grid-connected electricity systems.**

...

⇒ Recommendations are needed on how to calculate emission benefits from energy efficiency measures in project-specific emission baselines. Alternatively, other means of calculating emission benefits from a project, e.g. via technology-based emissions credits, may make the need for such guidelines redundant.

8) **There is no agreement on the system boundary** for GHG mitigation from AIJ projects, with little attention currently placed on reporting what the system boundary actually is.

⇒ Guidelines may be needed on where to set boundaries for emission baselines. Countries may also like to consider whether any such boundaries should be the same for each of these Kyoto mechanisms, or whether the fact that the system boundary for calculating CDM project baselines should be different, reflecting the fact that CDM projects effectively increase Annex I Parties' allowed emissions in the first commitment period.

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5. CONCLUSIONS

Information on the methodology and assumptions used in calculating emission baselines for AIJ projects is neither complete nor transparent in many of the AIJ project reports submitted to the UNFCCC. In fact, many reports contain surprisingly little information on the emission baseline assumed in that project, and on the means by which this baseline was arrived at.

There are inherent uncertainties involved in estimating counter-factual emission baselines. Moreover, valid baseline assumptions can vary significantly at different sites, with different technologies, and under different climatic conditions. Project-

specific measurements are therefore needed to set up project-specific baselines, although even baselines based on detailed, project-specific data are likely to contain a significant component of expert judgement.

Determining how emission baselines are calculated and reported, and how any emission credits are allocated, will have a significant impact on the total costs involved in setting up an AIJ, JI or CDM project. Rules surrounding emission baseline calculation and reporting, and emission crediting will also influence the cost and environmental effectiveness of such projects.

Guidelines on calculating and reporting project-specific emission baselines could help to increase the transparency of, and consistency between, emission baseline calculations in different AIJ projects. Many of these guidelines would also be applicable to setting out project-specific emission baselines for JI and CDM projects.

Any future methodological guidance on estimating project-specific emission baselines could address:

- the length of time over which different project types should generate emissions benefits;
- the issue of uncertainty (possibly by requiring some sort of “safety margin” or environmental conservatism in baseline estimation);
- whether emission baselines should be calculated in the same manner for greenfield and replacement projects;
- how baseline assumptions could be validated (e.g. by referencing relevant host countrypolicies);
- how to deal with learning issues; and
- how to calculate the environmental benefits of energy efficiency measures.

Other site-specific information that impacts the assumptions underlying the baseline estimation methodology should also be included, such as vegetation types for biotic projects, and distance of the project site from alternative fuel sources (e.g. electricity/gas grids) for energy projects.

Simple reporting measures, if taken, could improve the transparency and comparability of different project-specific emission baselines. These recommendations are applicable to future reports of AIJ, JI and CDM projects, and include modifying the current Uniform Reporting Format for AIJ projects so that it provides:

- greater disaggregation of current project classifications;
- separate reporting of sub-projects;
- references to the availability of more detailed information elsewhere (if applicable);

- an agreed convention to account for emission benefits from projects; and

In addition, reports should distinguish between projects actually operating from those at the planning stage.

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Fundamental questions need to be answered about the issues given priority in setting up rules, modalities and guidelines for project-based co-operative mechanisms. Should maximum environmental effectiveness per project be emphasised, and rules set up for emission baseline determination and/or emission crediting that err on the side of environmental caution? Should strict criteria be applied that limit the project types eligible to be included as one of the project-based co-operative mechanisms? Should any environmental benefits be credited only following *ex post* verification and validation of emission mitigation? Should any rules and guidelines distinguish between greenfield and replacement projects; uncertain and more certain emission reductions; and emission reductions easy and difficult to monitor?

Or should the aim be for a simple, clear and transparent system that governs eligibility, environmental additionality and crediting? Is the widespread use of AIJ, JI and the CDM, and the associated technological and developmental benefits that these mechanisms could bring, more important than ensuring the environmental effectiveness of each and every project?

If project-based co-operative mechanisms are to contribute significantly towards greenhouse gas mitigation, JI and CDM projects will need to become more widespread than AIJ projects are at present. This means that more private sources of finance, i.e. industry, will be needed. This is unlikely to be forthcoming if the benefits of project-based co-operative mechanisms are variable and uncertain and transaction costs are high. A balance therefore needs to be reached between requiring the rigorous monitoring and reporting efforts that would be needed to ensure the environmental effectiveness of project-based mechanisms, and obtaining cost-effective and predictable emission benefits via simple procedures that would encourage the uptake of these projects. An approach to setting emission baselines that was conservative but streamlined could be one way of reaching that balance.

Training Module Evaluation Form

Title of Module: Project-Level GHG Baseline Determinations for Energy Supply Facilities
Date: **Module # 7**

For each statement below, mark the circle on the scale that corresponds to your opinion.

		Evaluation score					
		1	**2**	**3**	**4**	**5**	
1. The presentation of this module was	Unclear	O	O	O	O	O	Clear
2. The objectives of this module were	Not important	O	O	O	O	O	Important
3. The information presented in this module was	Not sufficient	O	O	O	O	O	Sufficient
4. The information presented in this module was	Not useful	O	O	O	O	O	Useful
5. The exercises in this module were	Not interesting	O	O	O	O	O	Interesting
6. The knowledge acquired through this module was	Insignificant	O	O	O	O	O	Important
7. Participating in this module enable you to learn	Nothing new	O	O	O	O	O	Many new things

What did you like most about this module? _____

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What did you like least about this module? _____

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What is your opinion on presenters? _____

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What is your opinion on organization of this module? _____

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On what themes presented in the module would you like to get more information? _____

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What module themes would be interesting for you in the future? _____

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Comments: _____

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