The 2nd CDM Capacity Building Workshop in the Pacific Under the EC ACP MEA Project

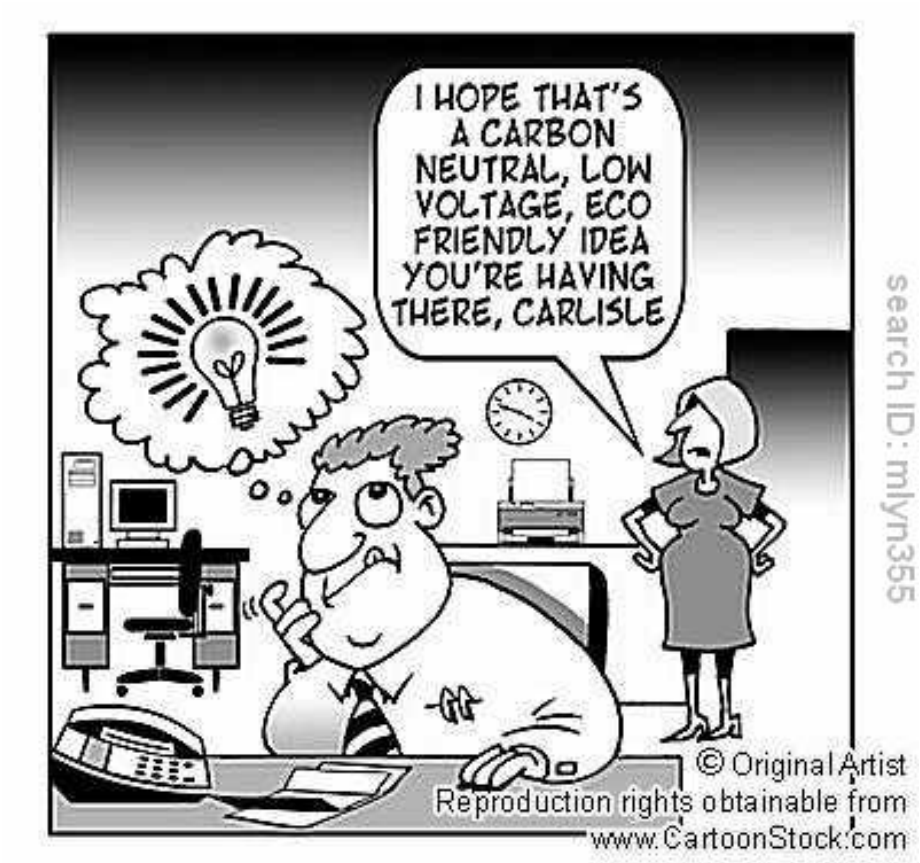
Energy Efficiency based CDM Projects

Atul Raturi

University of South Pacific

June 27-30, 2011, Suva, Fiji

Reducing Your Carbon Footprint



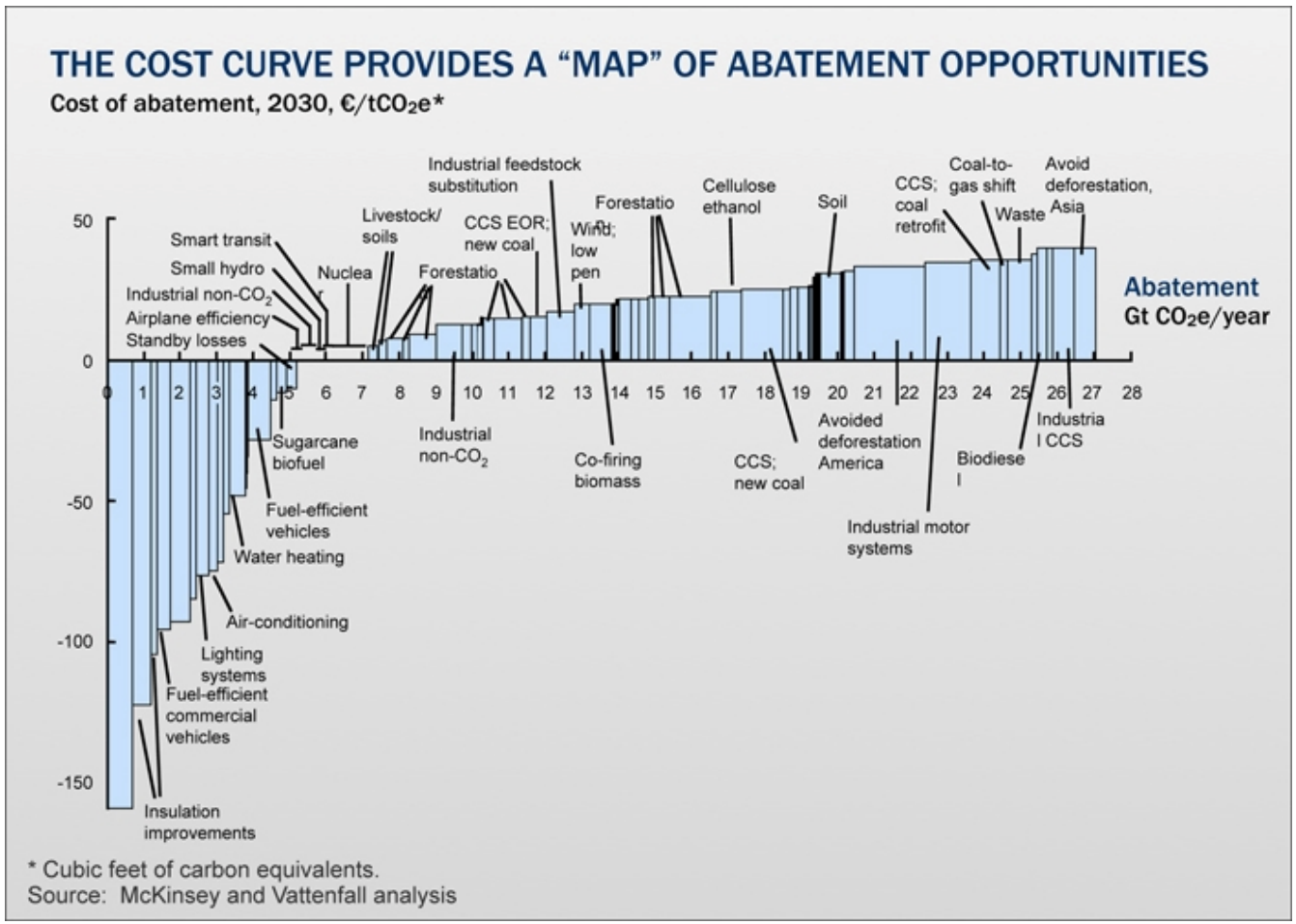
EE in CDM

Project Type	INDIA			CHINA			
Biomass	389	20.40%		110	4.20%		
Cement	27	1.50%		27	1%		
EE households	46	2.60%		13	0.50%		
EE industry	105	6.00%		8	0.30%		
EE own gen.	140.00	8.00%		285	11%		
EE service	19	1.10%		0	0%		
EE supply side	51	2.90%		16	0.60%		
Fossil fuel switch	42	2.40%		37	1.40%		
Hydro	180	10.30%		1021	39.1%		
Landfill gas	29	1.70%		81	3.10%		
Methand avoidanc	50	2.90%		62	2.40%		
Reforestation	12	0.70%		3	0.10%		
Solar	21	1.20%		35	1.40%		
Transport	15	0.90%		6	0.20%		
Wind	628	35.80%		755	2.90%		
Total	1758	100%		2600	100%		

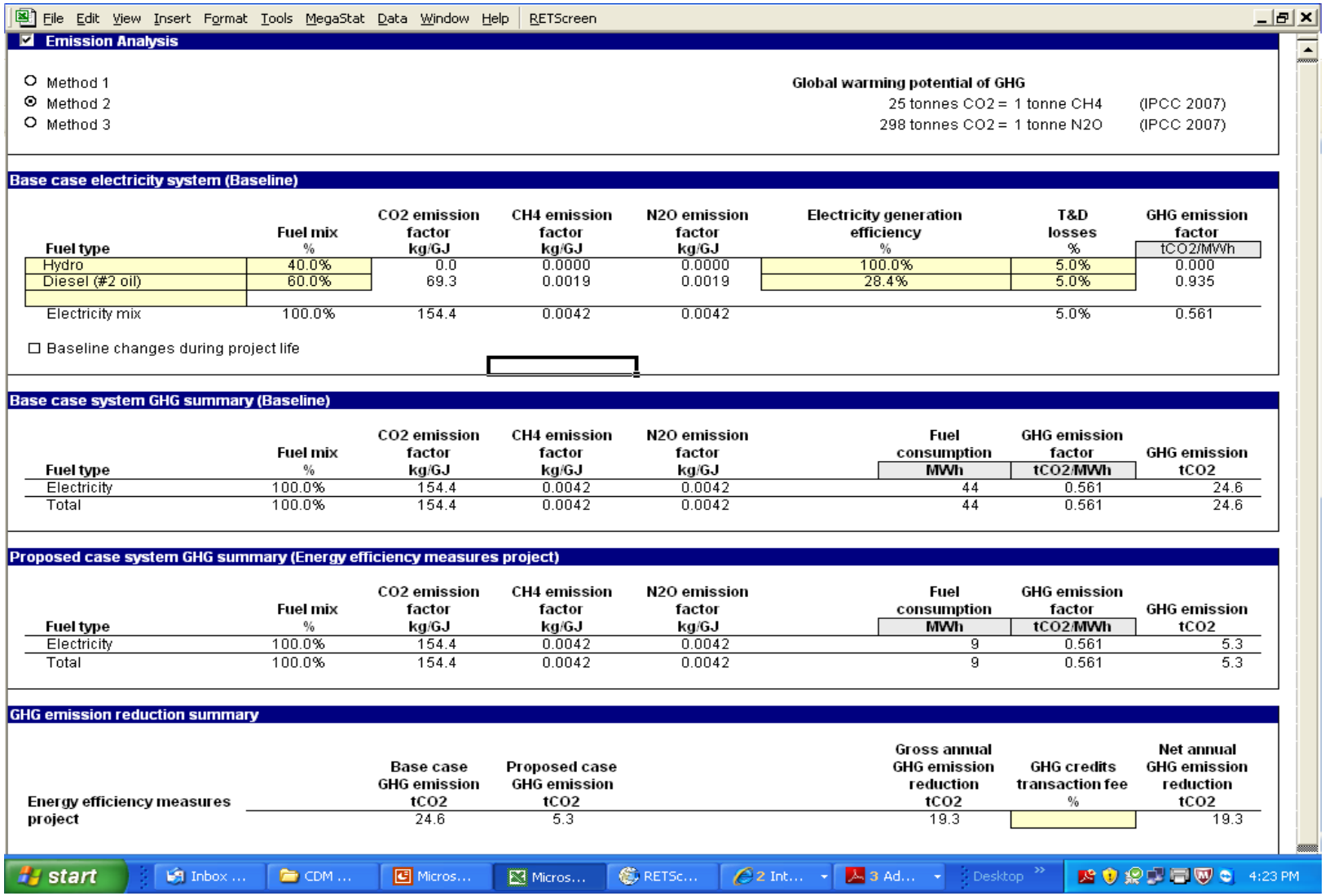
Cdmpipeline.org accessed on 20/6/2011

'Energy efficiency is not just low-hanging fruit; it is fruit that is lying on the ground'

Steven Chu, Noble Laureate
US secretary for Energy



Energy Efficiency- Lighting



File Edit View Insert Format Tools MegaStat Data Window Help RETScreen

Emission Analysis

- ○ Method 1
- ◉ Method 2
- ○ Method 3

Global warming potential of GHG

25 tonnes CO2 = 1 tonne CH4 (IPCC 2007)

298 tonnes CO2 = 1 tonne N2O (IPCC 2007)

Base case electricity system (Baseline)

Fuel type	Fuel mix %	CO2 emission factor kg/GJ	CH4 emission factor kg/GJ	N2O emission factor kg/GJ	Electricity generation efficiency %	T&D losses %	GHG emission factor tCO2/MWh
Hydro	40.0%	0.0	0.0000	0.0000	100.0%	5.0%	0.000
Diesel (#2 oil)	60.0%	69.3	0.0019	0.0019	28.4%	5.0%	0.935
Electricity mix	100.0%	154.4	0.0042	0.0042		5.0%	0.561

☐ Baseline changes during project life

Base case system GHG summary (Baseline)

Fuel type	Fuel mix %	CO2 emission factor kg/GJ	CH4 emission factor kg/GJ	N2O emission factor kg/GJ	Fuel consumption MWh	GHG emission factor tCO2/MWh	GHG emission tCO2
Electricity	100.0%	154.4	0.0042	0.0042	44	0.561	24.6
Total	100.0%	154.4	0.0042	0.0042	44	0.561	24.6

Proposed case system GHG summary (Energy efficiency measures project)

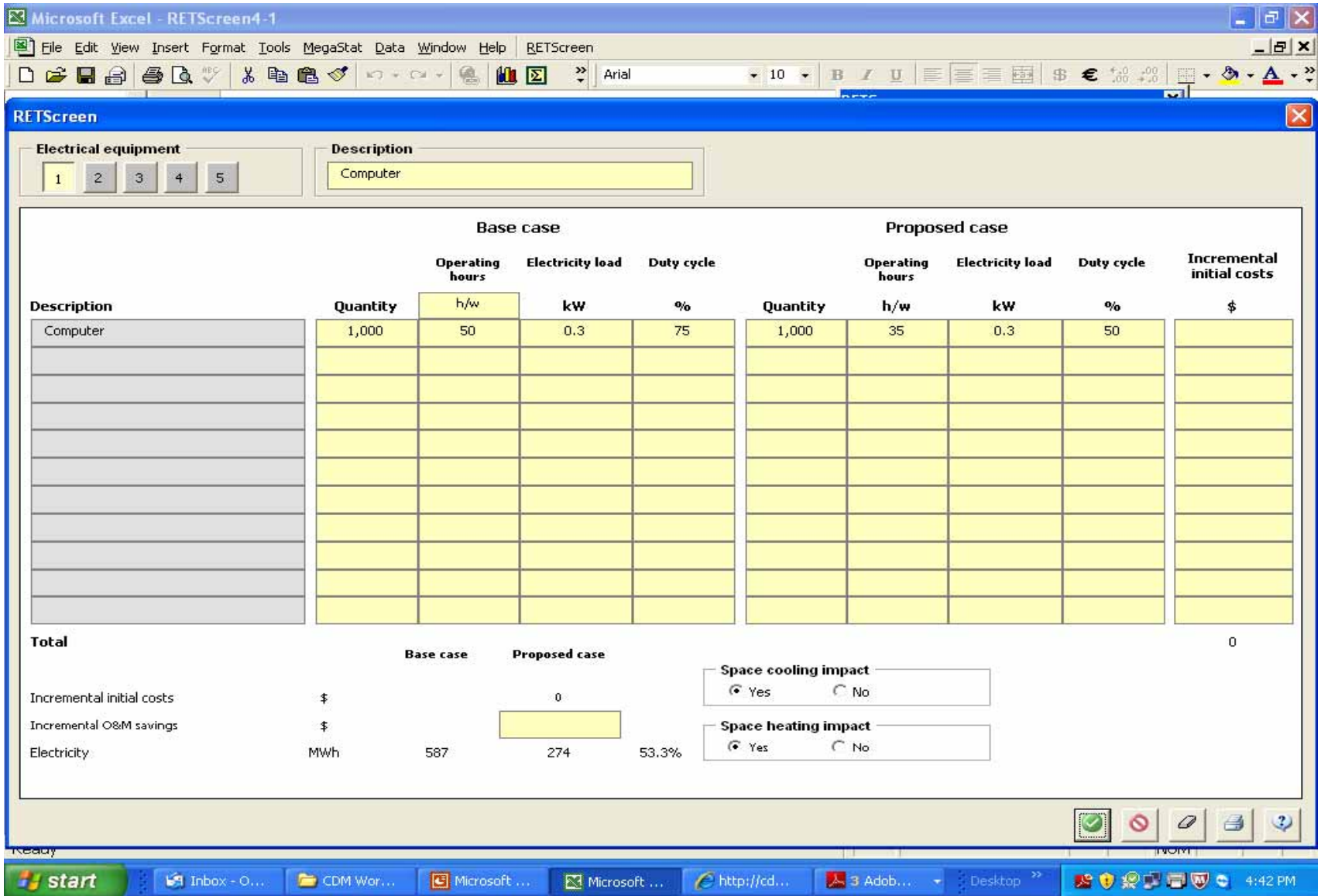
Fuel type	Fuel mix %	CO2 emission factor kg/GJ	CH4 emission factor kg/GJ	N2O emission factor kg/GJ	Fuel consumption MWh	GHG emission factor tCO2/MWh	GHG emission tCO2
Electricity	100.0%	154.4	0.0042	0.0042	9	0.561	5.3
Total	100.0%	154.4	0.0042	0.0042	9	0.561	5.3

GHG emission reduction summary

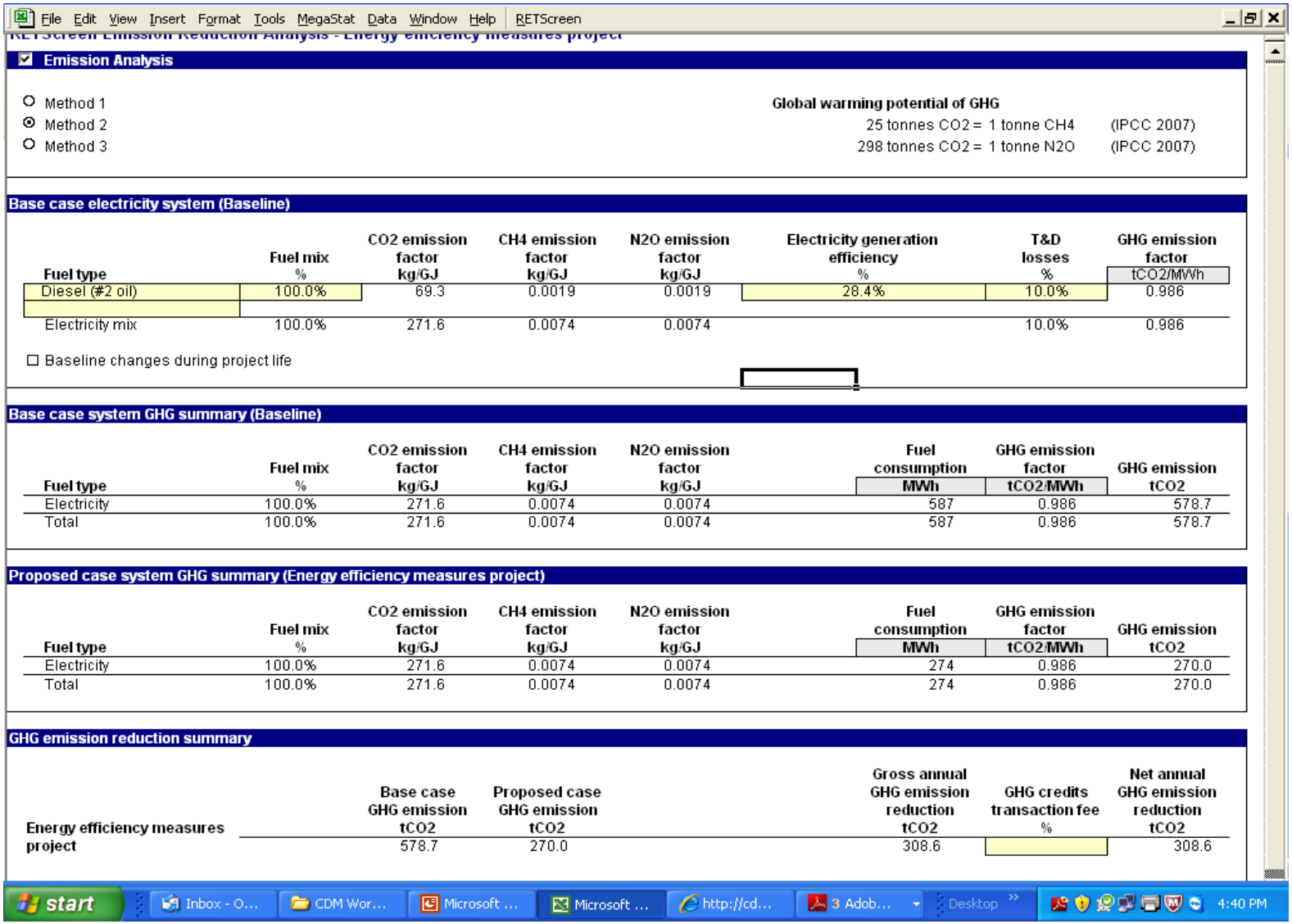
	Base case GHG emission tCO2	Proposed case GHG emission tCO2	Gross annual GHG emission reduction tCO2	GHG credits transaction fee %	Net annual GHG emission reduction tCO2
Energy efficiency measures project	24.6	5.3	19.3		19.3

start Inbox ... CDM ... Micros... Micros... RETSc... 2 Int... 3 Ad... Desktop 4:23 PM

Energy Efficiency- Computers



Energy Efficiency- Computers



File Edit View Insert Format Tools MegaStat Data Window Help RETScreen

RETScreen Emission Reduction Analysis - Energy efficiency measures project

Emission Analysis

- ○ Method 1
- ◉ Method 2
- ○ Method 3

Global warming potential of GHG

25 tonnes CO2 = 1 tonne CH4 (IPCC 2007)

298 tonnes CO2 = 1 tonne N2O (IPCC 2007)

Base case electricity system (Baseline)

Fuel type	Fuel mix %	CO2 emission factor kg/GJ	CH4 emission factor kg/GJ	N2O emission factor kg/GJ	Electricity generation efficiency %	T&D losses %	GHG emission factor tCO2/MWh
Diesel (#2 oil)	100.0%	69.3	0.0019	0.0019	28.4%	10.0%	0.986
Electricity mix	100.0%	271.6	0.0074	0.0074		10.0%	0.986

☐ Baseline changes during project life

Base case system GHG summary (Baseline)

Fuel type	Fuel mix %	CO2 emission factor kg/GJ	CH4 emission factor kg/GJ	N2O emission factor kg/GJ	Fuel consumption MWh	GHG emission factor tCO2/MWh	GHG emission tCO2
Electricity	100.0%	271.6	0.0074	0.0074	587	0.986	578.7
Total	100.0%	271.6	0.0074	0.0074	587	0.986	578.7

Proposed case system GHG summary (Energy efficiency measures project)

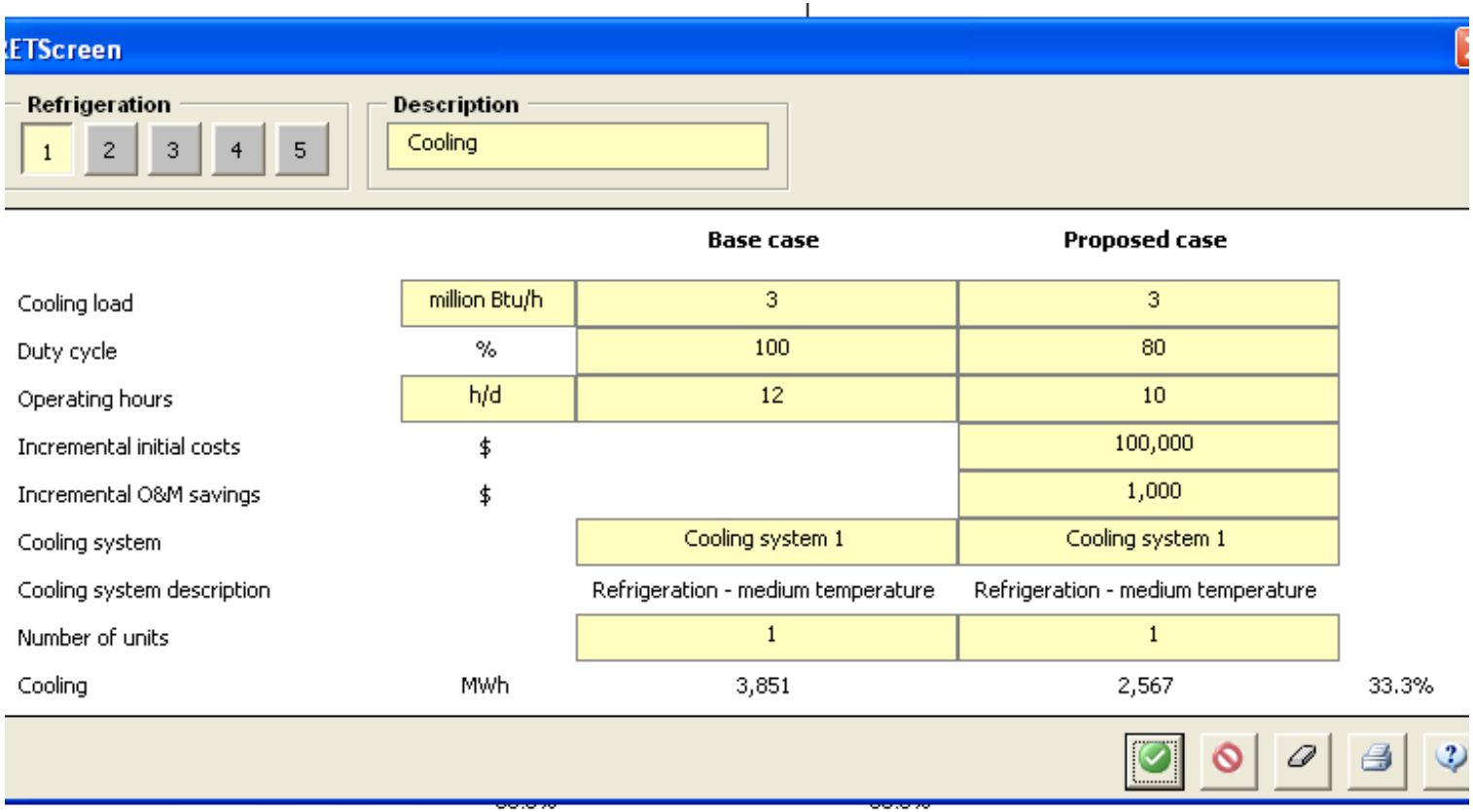
Fuel type	Fuel mix %	CO2 emission factor kg/GJ	CH4 emission factor kg/GJ	N2O emission factor kg/GJ	Fuel consumption MWh	GHG emission factor tCO2/MWh	GHG emission tCO2
Electricity	100.0%	271.6	0.0074	0.0074	274	0.986	270.0
Total	100.0%	271.6	0.0074	0.0074	274	0.986	270.0

GHG emission reduction summary

	Base case GHG emission tCO2	Proposed case GHG emission tCO2	Gross annual GHG emission reduction tCO2	GHG credits transaction fee %	Net annual GHG emission reduction tCO2
Energy efficiency measures project	578.7	270.0	308.6		308.6

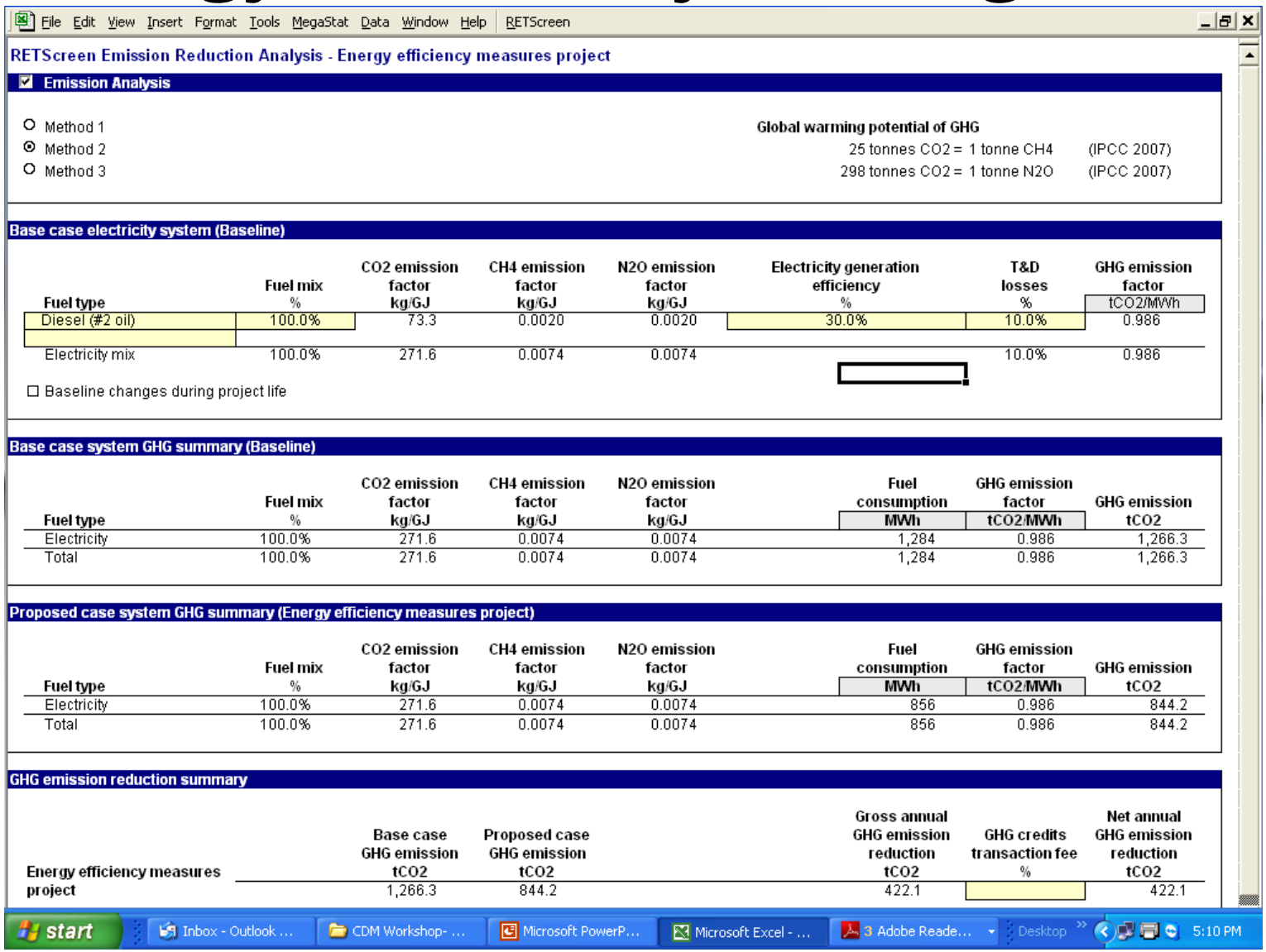
start | Inbox - O... | CDM Wor... | Microsoft ... | Microsoft ... | http://cd... | 3 Adob... | Desktop | 4:40 PM

Energy Efficiency- Refrigeration



		Base case	Proposed case	
Cooling load	million Btu/h	3	3	
Duty cycle	%	100	80	
Operating hours	h/d	12	10	
Incremental initial costs	$		100,000	
Incremental O&M savings	$		1,000	
Cooling system		Cooling system 1	Cooling system 1	
Cooling system description		Refrigeration - medium temperature	Refrigeration - medium temperature	
Number of units		1	1	
Cooling	MWh	3,851	2,567	33.3%

Energy Efficiency- Refrigeration



File Edit View Insert Format Tools MegaStat Data Window Help RETScreen

RETScreen Emission Reduction Analysis - Energy efficiency measures project

Emission Analysis

- ○ Method 1
- ◉ Method 2
- ○ Method 3

Global warming potential of GHG

25 tonnes CO2 = 1 tonne CH4 (IPCC 2007)

298 tonnes CO2 = 1 tonne N2O (IPCC 2007)

Base case electricity system (Baseline)

Fuel type	Fuel mix %	CO2 emission factor kg/GJ	CH4 emission factor kg/GJ	N2O emission factor kg/GJ	Electricity generation efficiency %	T&D losses %	GHG emission factor tCO2/MWh
Diesel (#2 oil)	100.0%	73.3	0.0020	0.0020	30.0%	10.0%	0.986
Electricity mix	100.0%	271.6	0.0074	0.0074		10.0%	0.986

☐ Baseline changes during project life

Base case system GHG summary (Baseline)

Fuel type	Fuel mix %	CO2 emission factor kg/GJ	CH4 emission factor kg/GJ	N2O emission factor kg/GJ	Fuel consumption MWh	GHG emission factor tCO2/MWh	GHG emission tCO2
Electricity	100.0%	271.6	0.0074	0.0074	1,284	0.986	1,266.3
Total	100.0%	271.6	0.0074	0.0074	1,284	0.986	1,266.3

Proposed case system GHG summary (Energy efficiency measures project)

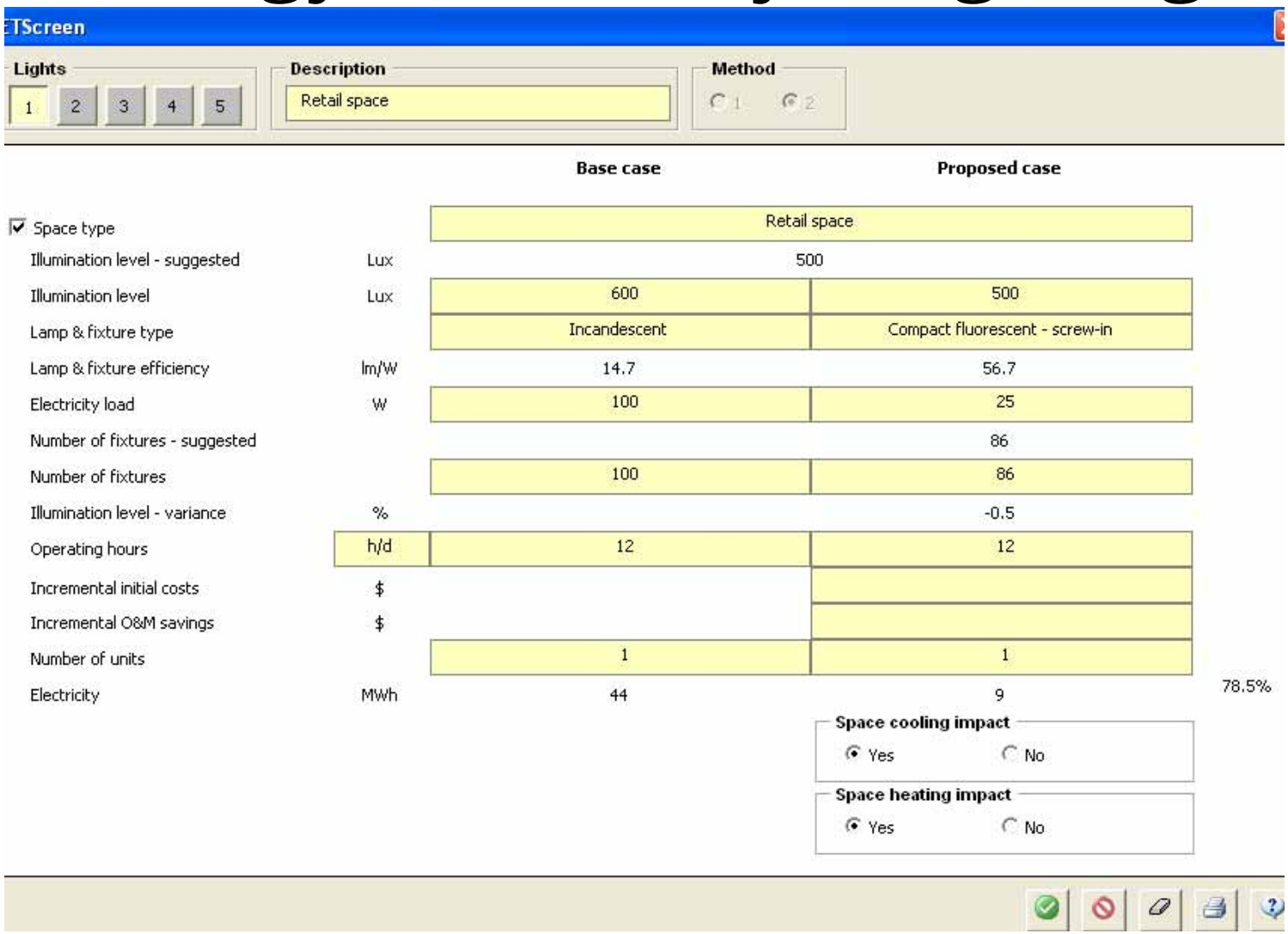
Fuel type	Fuel mix %	CO2 emission factor kg/GJ	CH4 emission factor kg/GJ	N2O emission factor kg/GJ	Fuel consumption MWh	GHG emission factor tCO2/MWh	GHG emission tCO2
Electricity	100.0%	271.6	0.0074	0.0074	856	0.986	844.2
Total	100.0%	271.6	0.0074	0.0074	856	0.986	844.2

GHG emission reduction summary

	Base case GHG emission tCO2	Proposed case GHG emission tCO2	Gross annual GHG emission reduction tCO2	GHG credits transaction fee %	Net annual GHG emission reduction tCO2
Energy efficiency measures project	1,266.3	844.2	422.1		422.1

start | Inbox - Outlook ... | CDM Workshop- ... | Microsoft PowerP... | Microsoft Excel - ... | 3 Adobe Reade... | Desktop | 5:10 PM

Energy Efficiency- Lighting



Energy efficiency (Lighting-India)

Project registered on 4th June 2010

Project Description : Uttar Pradesh Lighting Energy Efficiency Project (ULEEP) in Circles I & II of Varanasi, Zone, Uttar Pradesh, India- Small scale Project Activity.

The objective of the project is to distribute **300,000** New self ballasted Compact Florescent Lamps (CFLs), at a price comparable to that of incandescent lamp (ICL).Involves return of ICLs in exchange for an equal number of CFLs.

Luminous ratings of CFLs and ICLs)

ICL Wattage	ICL Lumen Rating	CFL Wattage	Allowed/Target Lumen Rating of CFL	Net Saving /ICL
40 W	340	8W (40We ICL)	Min 340	32W
60 W	610	12W (60We ICL)	Min 610	48W
100 W	1230	20W (100We ICL)	Min 1230	80W

Project participant

EDF Trading Limited (UK) and Banyan Environmental Innovations Private Limited (India)

*Source :Project PDD @ cdm.unfcc.int

Project type and Methodology

Type II project activity, energy efficiency project activity, which reduces energy consumption on the demand side. Category: J. ***Demand-side activities for efficient lighting technologies.***

The small-scale methodology used is AMS II.J: ***Demand-side activities for efficient lighting technologies, Version 3.***

Estimated Emissions Reduction

Years	Annual etimation of emission reduction in tonnes of CO_2e
Year 1	39,831
Year 2	34,703
Year 3	29,575
Year 4	24,447
Year 5	0
Year 6	0
Year 7	0
Total estimated reductions (tonnes of CO_2e)	1,28,555
Total number of crediting years	**7 years**
Annual average over the crediting period of estimated reductions (tonnes of CO_2e)	**18,365**

Additionality

Additionality of the project was shown using investment barrier

CFL Wattage	Wholesale INR/CFL	Wholesale €/CFL
08	90	1.55
12	95	1.61
23	125	2.19

The project proponents will sell a CFL for the price of an ICL which is only INR 15 . Without the CDM revenue , the project will incur a loss of INR 35.1 Million without considering the costs involved in collection and safe destruction of ICLs.Clearly without additional income (through CERs) the project will not be viable.

Emission Reduction calculations (Formulae)

The annual electricity saving through this project is given by

$$NES_y = \sum_{i=1}^{n} Q_{PJ,i} \times (1 - LFR_{i,y}) \times ES_i \times \frac{1}{(1 - TD_y)} \times NTG \quad (1)$$

Where:

$$ES_i = (P_{i,BL} - P_{i,PJ}) \times O_i \times 365/1000 \quad (2)$$

Where: Q_{PJi} =Number of ICLs of the group of "*i*" devices replaced, by energy efficient CFLs

$LFR_{i,y}$ = Lamp Failure Rate for device of type *"i"* in year *"y"* (fraction)

Es_i = Estimated annual electricity savings for device of type *"i"* (kWh) using eq.(2)

TD_y = Average annual technical grid losses (transmission and distribution)

NTG = Net-to-gross adjustment factor=0.95

$P_{i,BL}$ = Power of the devices of the group of "*i*" baseline devices (ICL)

$P_{i,PJ}$ = Power of the devices of the group of "*i*" project devices (CFL)

O_y = Average annual operating hours of the devices of the group

Emission Reduction calculations (Formulae)

The annual emission reduction is now given by

$$ER_y = NES_y \times EF_{CO2,ELEC,y}$$ = 39,831 t CO_2

The yearly failure rate of CFLs was also included in the calculations

An Emission factor ($EF_{CO2,ELEC,y}$) value of 0.80 t CO_{2e} / MWh was used.

Year	Estimation of project activity emissions (tonnes of CO_2 e)	Estimation of baseline emissions (tonnes of CO_2 e)	Estimation of leakage (tonnes of CO_2 e)	Estimation of overall emission reductions (tonnes of CO_2 e)
Year 1	9,958	49,789	-	39,831
Year 2	8,676	43,379	-	34,703
Year 3	7,394	36,968	-	29,575
Year 4	6,112	30,558	-	24,447
Year 5	-	-	-	-
Year 6	-	-	-	-
Year 7	-	-	-	-
Total Emission Reductions (tonnes of CO_2 e)	32,139	1,60,694	-	1,28,555

SS CDM –Example (Efficient Cooking stoves)

•Project : **Efficient Fuel Wood Cooking Stoves Project in Foothills and Plains of Central Region of Nepal**)

• Methodology:Type II AMS IIG. / Version 02 EB 51 “Energy Efficiency Measures in Thermal Applications of Non-Renewable Biomass"

• Baseline : 1. *Average annual biomass consumption per household*

2. Fossil fuels likely to be used by similar project people.(EF projected fossil fuel)

• Emissions reduction : Approx. 19899 t CO_{2e} / Year

• Funding : Only Carbon Finance

Crediting period: 10 years fixed

Energy Efficiency project- India

Project registered –18/11/06

Project description : Improvement in energy consumption of a Hotel (SS CDM)

To implement and encourage energy efficiency measures both at the generation and demand side of energy being consumed by the new hotel unit (commercial building(s)) and thus reduce greenhouse gases emissions directly or indirectly attributed to the business activities being carried out within the hotel facility. Two components:

a) Energy efficiency measures – generation side;

b) Energy efficiency measures – demand side;

SD indicators:

Social, economic, environmental and technological well being

*Source :Project PDD @ cdm.unfcc.int

Project participants

Name of Party involved (*) ((host) indicates a host Party)	Private and/or public entity(ies) project participants (*) (as applicable)
Government of India (Host)	ITC Limited – Hotel Sonar Bangla Sheraton and Towers
United Kingdom	ABN AMRO Bank N.V., London (Annex I Proponent)

Methodologies:

Type II – Energy Efficiency Improvement Projects

Project Category - II. B. Supply side energy efficiency improvements – generation – applicable to energy efficiency measures adopted at generation end of thermal energy (steam/ hot water);

Project Category – II. E. – Energy Efficiency and fuel switch measures for building – applicable to energy efficiency measures adopted at consumption side of electrical energy;

Project Category - II. B. Supply side energy efficiency improvements – generation

Implement technologies or measures to improve the efficiency of fossil fuel generating units that supply an electricity or thermal system by reducing energy or fuel consumption by up to the equivalent of 15 GWh_e per year.

Project Category – II E – Energy Efficiency and fuel switch measures for building

New technologies may replace existing equipment or be installed in new facilities. The aggregate energy savings of a single project may not exceed the equivalent of 15 GWh per year

The technology and the measures includes:

- **Installation of various frequency drives;**
- **Retrofit of existing heat, ventilation and air-conditioning (HVAC) system to reduce unwarranted moisture laded air load in the pre-cooled air unit (PAU)**
- **Retrofitting various pumps located at many site within the hotel facility;**

  Enhancement of the treatment efficiency of the sewage treatment unit
- **Replacement of electric water heater with solar alternative;**

Emissions reduction

Year (calendar year)	Actual Net Emission Reduction (tCO2e)
2006	2987
2006	2987
2006	2987
2006	2987
2006	2987
2006	2987
2006	2987
2006	2987
2006	2987
2006	2987
Total Net Estimation of Emission Reduction (tCO2e)	29870
Total Crediting Period	10 years
Average Net Emission Reduction per year (tCO2e)	2987

Barrier Analysis

- Investment Barrier
- Technology Barrier
- Prevailing Practice

Potential EE CDM projects in the PICs

- Efficient lighting (replacing ICLs with CFLs and LEDs)
- Improved cooking stoves
- Factory energy efficiency (dairy, brewery etc.)- e.g. Vapour Re-compression (VRC) and Heat pump in a brewery.
- Energy efficiency –Hotels, resorts
- Optimization of steam generation in FSC sugar mills