

Developing Integrated Emission Strategies for Existing Land
Transport (**DIESEL**)



Demonstration of the DIESEL-IDEAS

Informed Decision-support for Evaluating Alternative Strategies
(**IDEAS**)

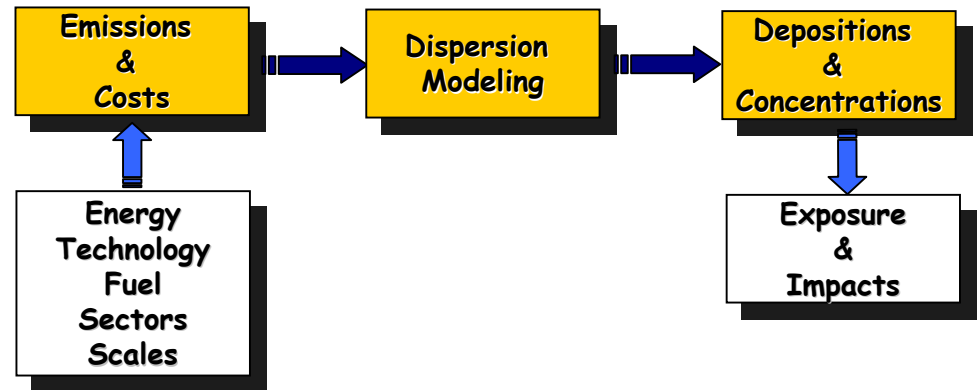
Sarath Guttikunda
World Bank

**Second Planning Meeting
Bangkok, February 17, 2004**



IDEAS Analytical Framework

Objective: To develop an analytical framework that involves an appropriate knowledge base and modeling tools to analyze diesel pollution options

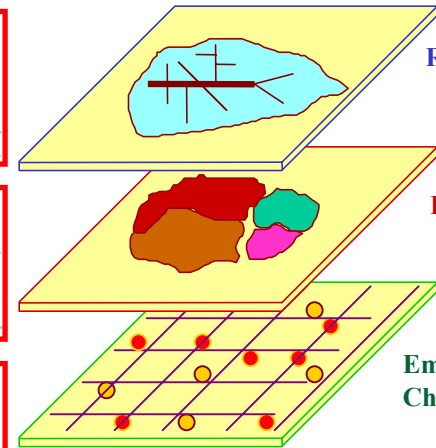
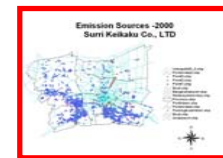
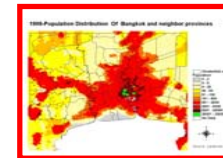
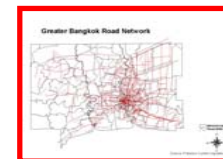


Activities:

- ✓ Database Development
- ✓ Modeling Framework Development and Application
- ✓ Selection and Analysis of Options/Scenarios
- ✓ Dissemination among Collaborative Working Group

IDEAS Activity 1: Emissions Module

- **General Information** - *geography, population Statistics, land use*
- **Sources** - *industries, power plants, transport, domestic sectors, etc*
 - **Energy Consumption Levels** - *fuel type, fuel characteristics*
 - **House Hold Energy Consumption** - *heating and cooking*
 - **Traffic Volumes** - *road network, location, traffic volume, vehicle number by age, and type, emission factors by type*
- **Emissions** - *criteria pollutants*
- **Monitoring**- *historical and present*



Road Network

BMR Regions

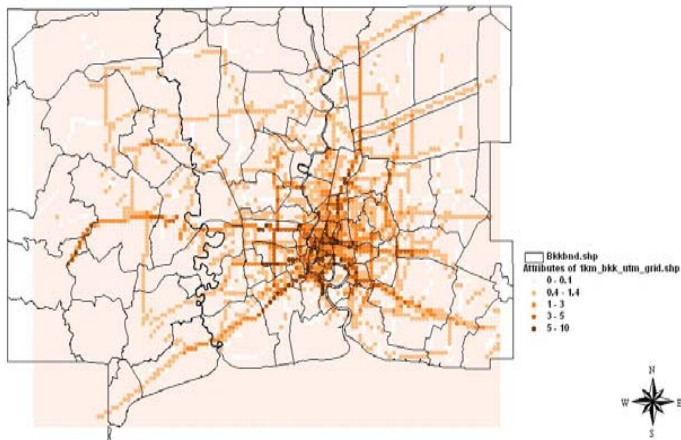
Emission Characteristics



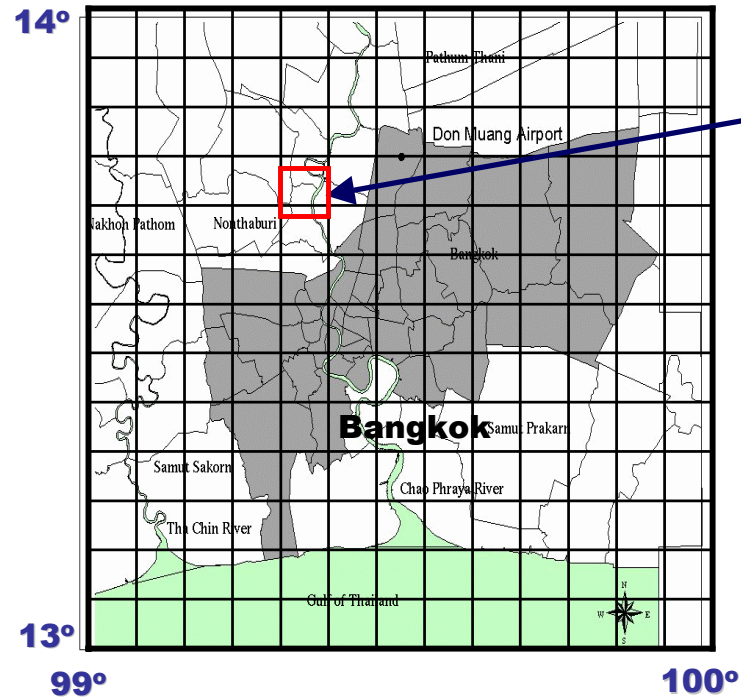
IDEAS Grid Based Approach

- **GIS Database** - *for distribution of emissions at industrial and grid level*
- **Sectoral Analysis** - *grid based emissions database for selection of options*

1 km gridded SO₂ emission



Source: Pollution Control Department



Vehicular Emissions Database

Developing Integrated Emission Strategies for Existing Land Transport (DIESEL) Program

Informed Decision-support for Evaluating Alternative Strategies (IDEAS)

DIESEL IDEAS-Bangkok (Version 1.0)

Emission Inventory Module

Input

Vehicle Number

Vehicle Characteristics

Reference Values

Car

MotorCycle

TukTuk

Taxi

Bus

Trucks

Van

Heavy-duty

Other Sources

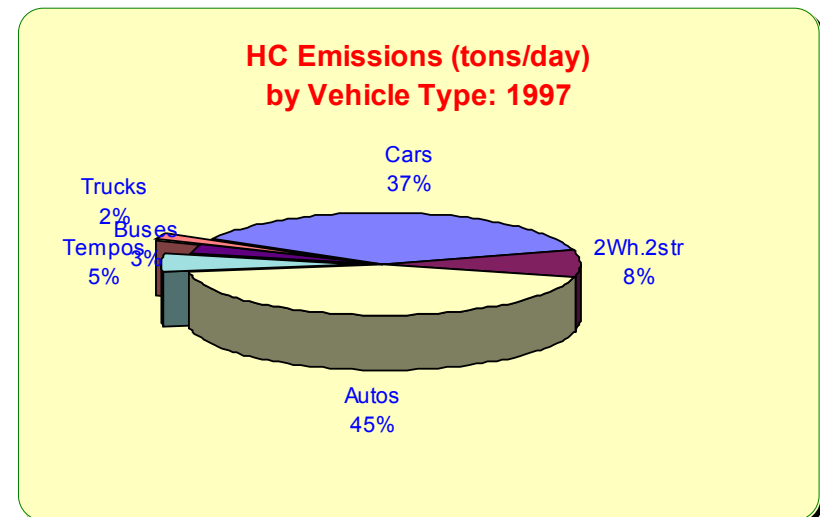
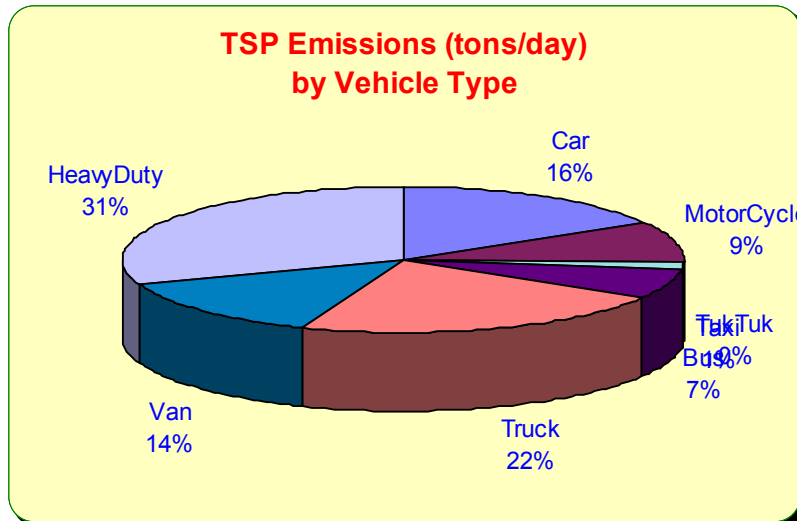
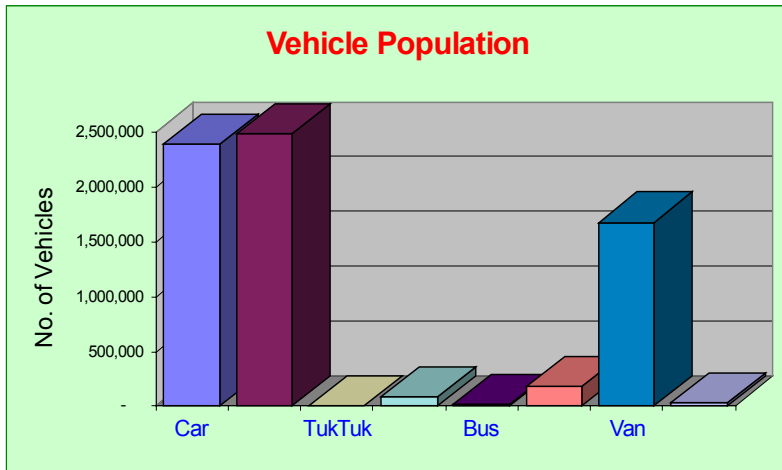
Road Network

Output

Overall Results

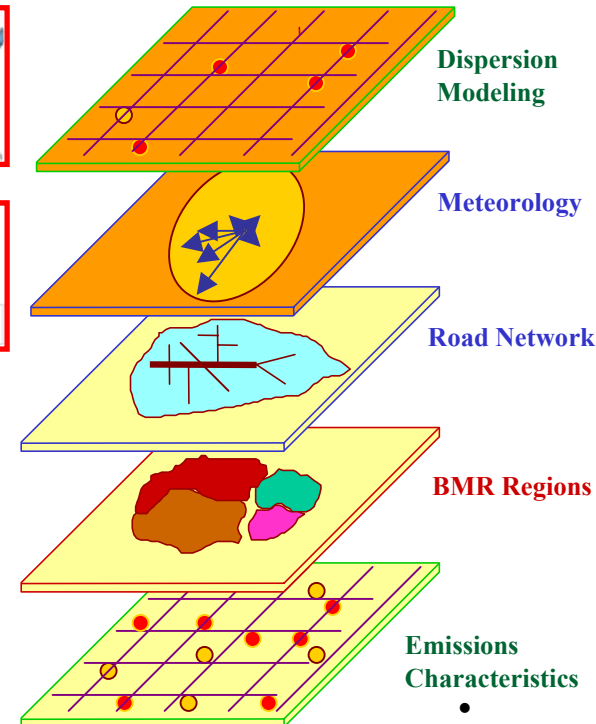
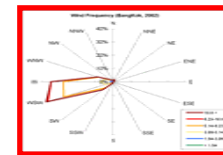
Summary Results
(for selected year)

IDEAS Emissions Module: Sample Outputs

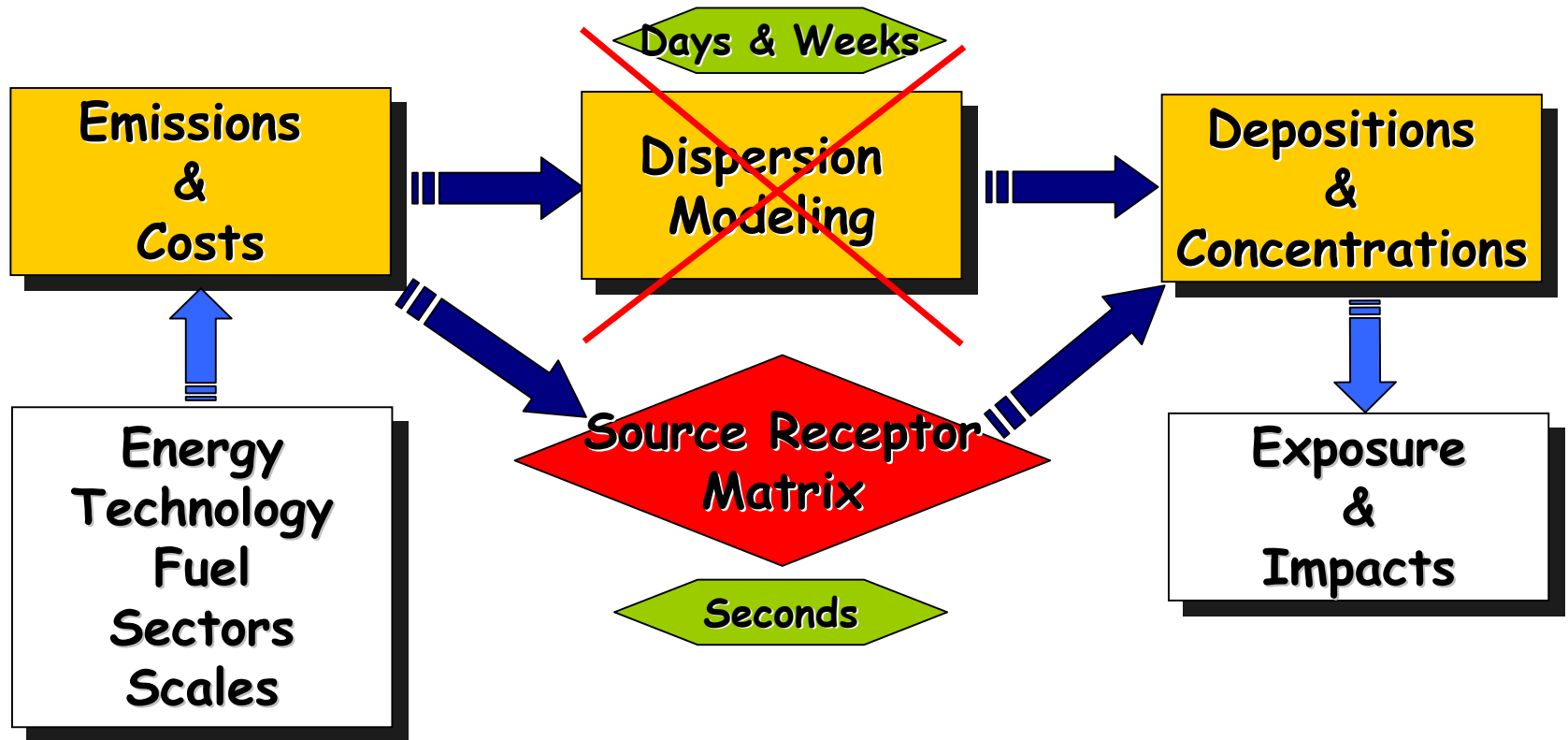


IDEAS Activity 2: Dispersion Module

- General Information - *climate and meteorological data (wind roses)*
- Dispersion Modeling - *models availability, institutional capacity and facilities to conduct modeling*
- Grid Based Pollution Analysis - *establishment of source receptor matrices for simplified analysis of DIESEL program policies and scenarios*



IDEAS Simplified Modeling Approaches

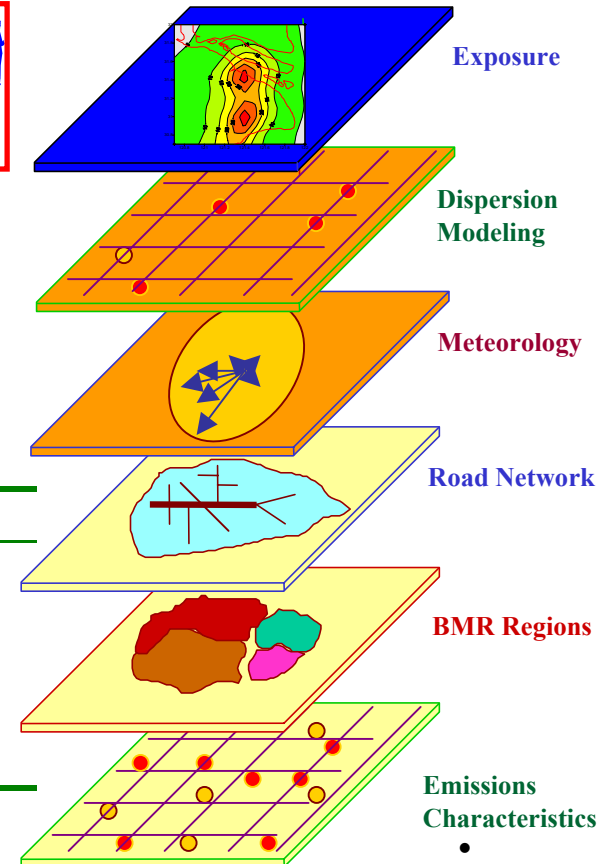


IDEAS Activity 3: Exposure Assessment Module

- **General Information** - *literature survey of relevant past and current studies*
- **Health Impacts** - *dose-response functions for Bangkok, hospital health statistics*



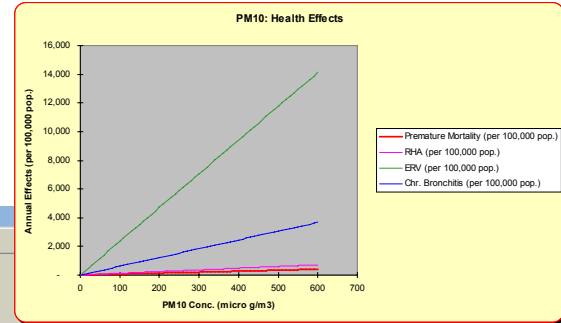
$$E_{ij} = P_j * \delta_{ij} * A_i * POP$$



Health Endpoint	Coefficient	Source
Mortality	0.84	Meta-analysis (Lvovsky and others 2000)
Hospital Visit	0.18	Beijing Study (Xu and others 1995)
Emergency Room Visit	0.1	Beijing Study (Xu and others 1995)
Hospital Admission	0.8	Meta-analysis (Dockery and Pope 1994)
Chronic Bronchitis	0.1	Beijing Study (Xu and Wang 1993)

Health Exposure Analysis Module

Calculates Health Damages for Mortality, Chronic Bronchitis, Hospital Visits, Work Day Losses.



Mortality									
Age	Percentage	Death Avoided	WTP Coeff.	CostCase (\$)	Avoided Costs	Per Year (5% discount)			
0-4	7%	70	0.71	\$60,000	\$180,000	\$550,000			
5-14	10%	13		\$2,978,283	\$7,942,088	\$27,300,027			
15-24	10%	18		\$545,383	\$1,454,356	\$4,999,488			
25-34	23%	37	1.14	\$751,540	\$2,004,107	\$6,889,199			
35-44	18%	105	1.19	\$2,554,765	\$6,812,707	\$23,418,799			
45-54	9%	168	1.26	\$7,509,453	\$20,025,208	\$68,836,633			
55-64	12%	752	1.01	\$12,725,463	\$33,934,569	\$116,850,631			
64+	11%	3396	0.75	\$45,571,866	\$121,524,975	\$417,742,011			
Total		4560		\$152,836,496	\$407,563,989	\$1,401,001,122			
				\$225,473,249	\$601,261,998	\$2,066,838,719			

Chronic Bronchitis Avoidance				
CB/Mortality	Reduction	Cost/Case (\$)	Avoided Costs	Per Year (5% discount)
a. WTP	0.32	2,846	\$19,200	\$54,644,364
			\$51,200	\$145,718,305
			\$176,000	\$500,906,674
b. COL				\$188,786,457

Acute Morbidity Reductions				
	Reduction	Cost/Case (\$)	Avoided Costs	
Hospital Visits	156,371	23	\$3,596,540	
ERVs	78,769	23	\$1,811,689	
Hospital Admissions	70,610	132	\$9,320,546	

Work Day Losses				
	Patient	Relative	Wage/Day (\$)	Avoided Costs
Acute Diseases	1	0.3	15	\$4,585,237
Hospital Admissions	14	3	15	\$18,005,600

Total Economic Benefits					
WTP	Mortality	Morbidity	Total	Per Capita	Benefit/Emissions (\$/ton)
low	\$225,473,249	\$48,593,952	\$274,067,201	\$9.31	0.56
medium	\$601,261,998	\$82,918,762	\$684,180,760	\$23.23	1.40
high	\$2,066,838,119	\$216,785,523	\$2,283,623,642	\$77.55	4.67

Scenario Implementation Costs			
Scenario	Cost (\$)	Benefit/Emissions (\$/ton)	Health Benefits/Costs
Scenario Implementation Costs	\$489,000,000		

Tracks Health Benefits to Costs Ratio.

IDEAS Activity 4: Economic Assessment Module

➤ General Information

➤ Health effect valuation estimates

e.g., mortality, morbidity, value of statistical life

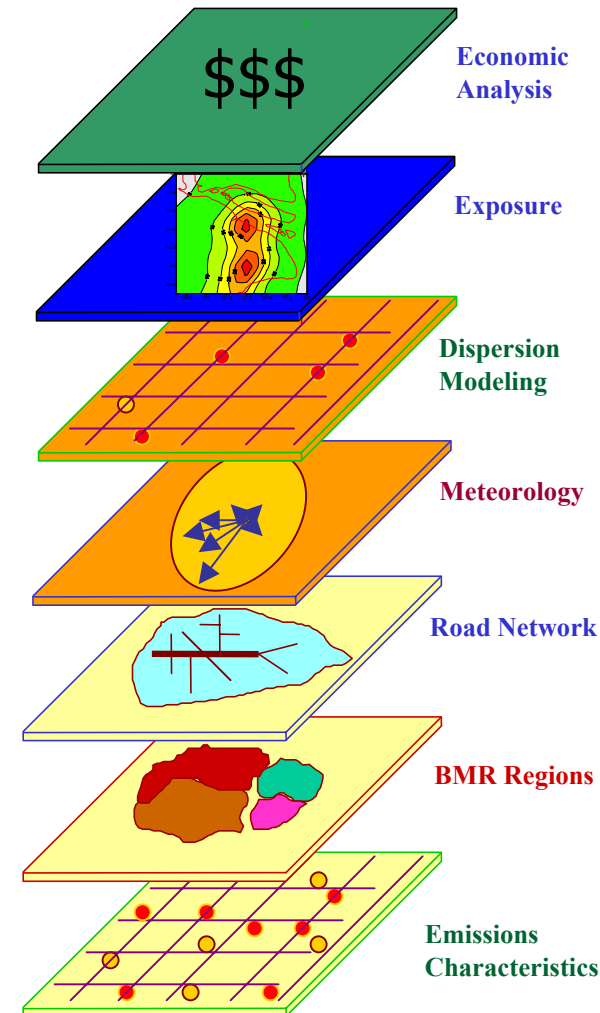
➤ Costs

e.g., control costs by type for diesel emissions management options

➤ Economic Assessment of Options

➤ Incremental Costs of reducing emissions

Cost effectiveness of options through health benefit to control cost analysis



Cost-Effectiveness Analysis

Microsoft Excel - VAPIS-Bkok.xls

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Cost-Effectiveness Analysis for IDEAS
Demonstration Only

Return to Main Page

Option	Description	Incr. Redn (ton/day) (for Selected Option)	Incr. Cost (\$/ton) (for Selected Option)	Cost (\$)	Emission Levels (tons/day)			Emissions Imp	
					Particulates	SOx	Pb	Particulates	S
Base Case	BAU			0	1000	300	100		
C	I&M	600.00	-2	-1000	400	200	80	600	100
B	Engine Improvement	300.00	7	2000	700	200	90	300	100
A	UF&Catalytic Converters	100.00	10	1000	900	290	0	100	10
D	Low S Fuel	200.00	15	3000	800	50	99	200	250
E	Traffic Sys Mgmt	200.00	23	4500	800	250	95	200	50

Select Cost-Effectiveness Option
Cost Effectiveness - Particulates

Select Desired Emission Reduction (%)
45%

Cost-Effectiveness Graph (for Selected Component)

Incremental Cost (\$/ton)

Emission Reduction (tons/day)

Emission Reduction = 450 tons/day
Total Cost = \$-750

Vehicle_Growth / Overall_Results / Total_Results / **Cost_Effective_Analysis** / Dialog1 / About

Ready

Start | Bangkok-Diesel | Sarah K. Gutt... | DIESEL IDEAS ... | WinZip - EER... | TEER.harsh.ppt | Microsoft Ex... | 2:52 AM

DIESEL IDEAS: Modular Approach

...towards a "knowledge-based" and "knowledge driven" tool with flexible and adaptable approach for analyzing alternative strategies

