National Environmental Standards:

Ambient Air Quality, Industrial Emissions, Workplace Air Quality, Noise Levels

National Stakeholder Workshop for Bhutan under Malé Declaration Project Phase IV

Thimphu, 28 April 2008

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Outline

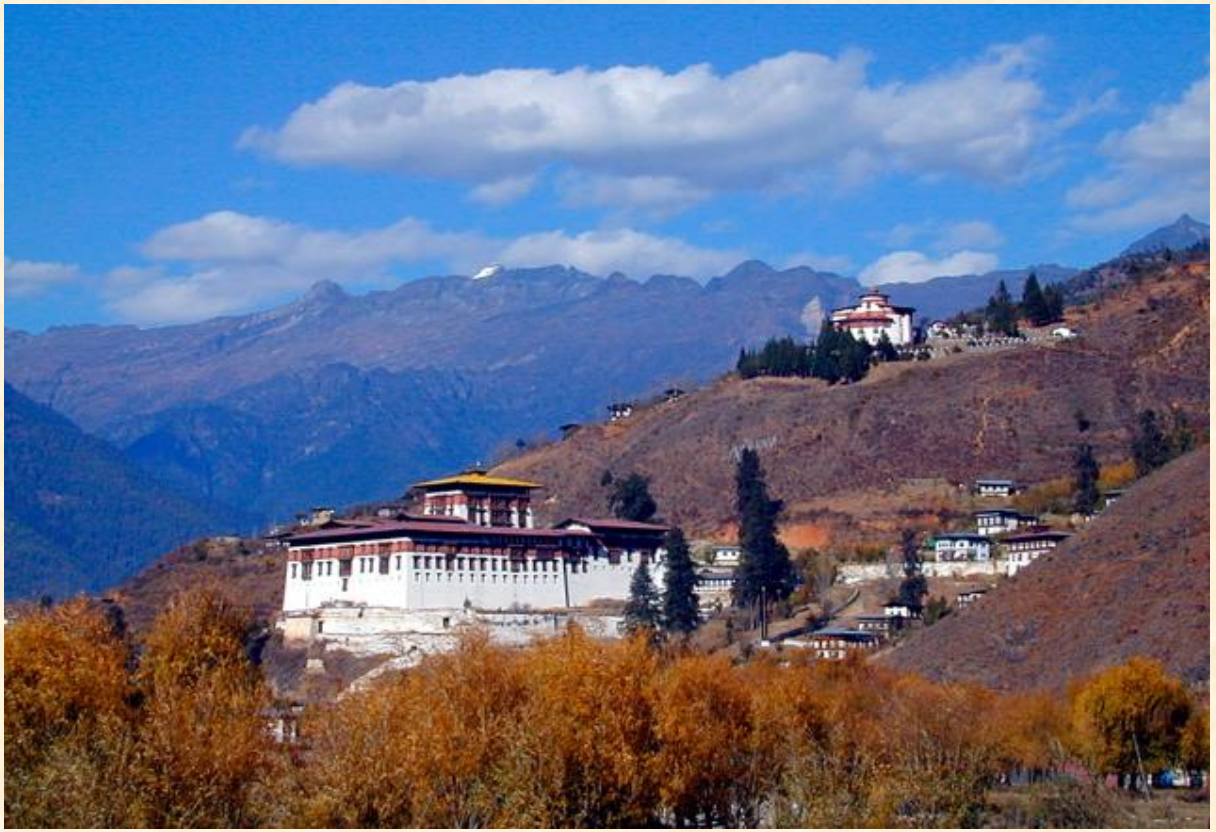
1. Background
   - Air quality and pressures in Bhutan
   - Policy response
   - Quality standard setting process

2. National Air Quality Standards
   - Ambient Air Quality Standards
   - Industrial Emission Standards
   - Workplace Emission Standards
   - Ambient Noise Level Standards

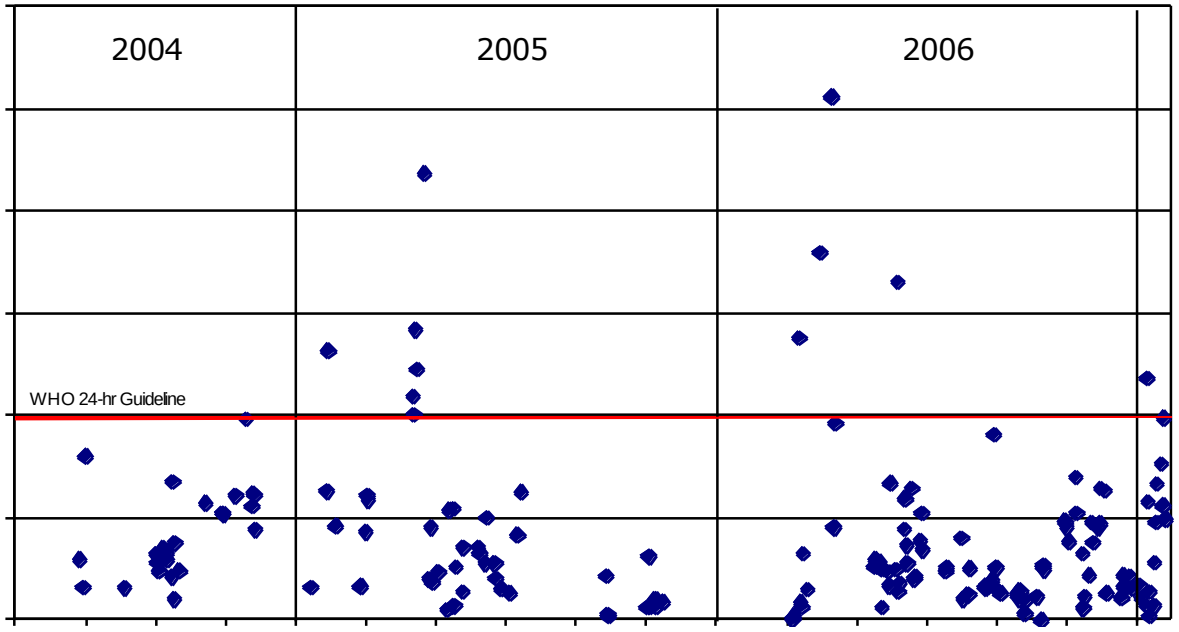
3. Conclusions

State of the Air Environment

Air Quality in Bhutan is generally regarded as pristine.



State of the Air Environment



NO_2 and SO_2

- Low to moderate at traffic circle in Thimphu
- Below detection levels in Bhur

Source: Data from Male Project summarised in Bhutan Environment Outlook 2008

Pressure on Air Environment

- Increasing pressure on air quality in urban and industrial areas from development

- Sources of air pollution
  - Exhaust emissions from vehicles
  - Industrial emissions
  - Smoke from wood stoves (bukhari)
  - Wind-blown dust from construction, roads, bare soil
  - Forest fires & agricultural burnings esp. in dry seasons

Response: Setting Standards

Purpose of air quality standards

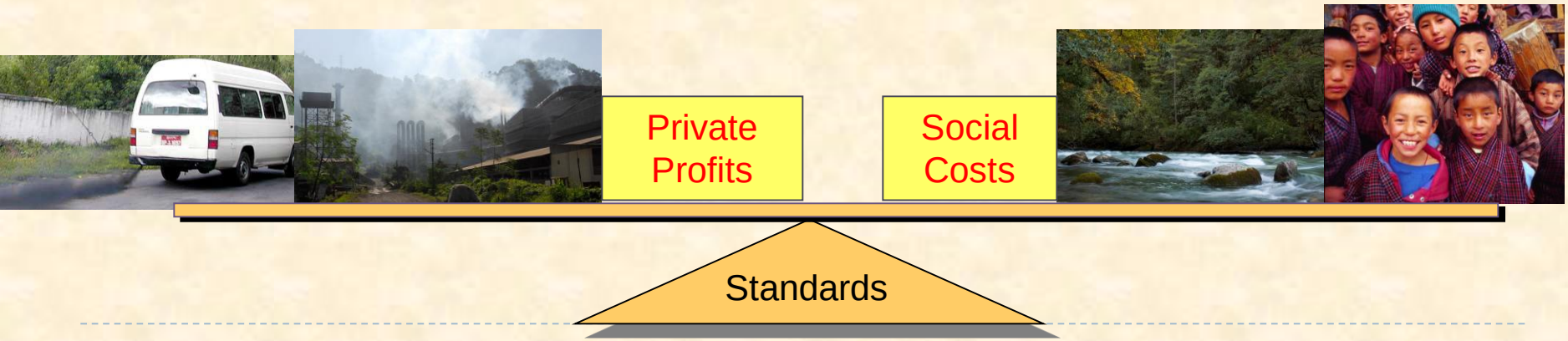
Establish upper limits on the concentration of air pollutants for the protection of human health, agricultural and natural vegetation and ecosystems

Background: The Middle Path

Balancing Economic Development
with Health and Environmental Priorities

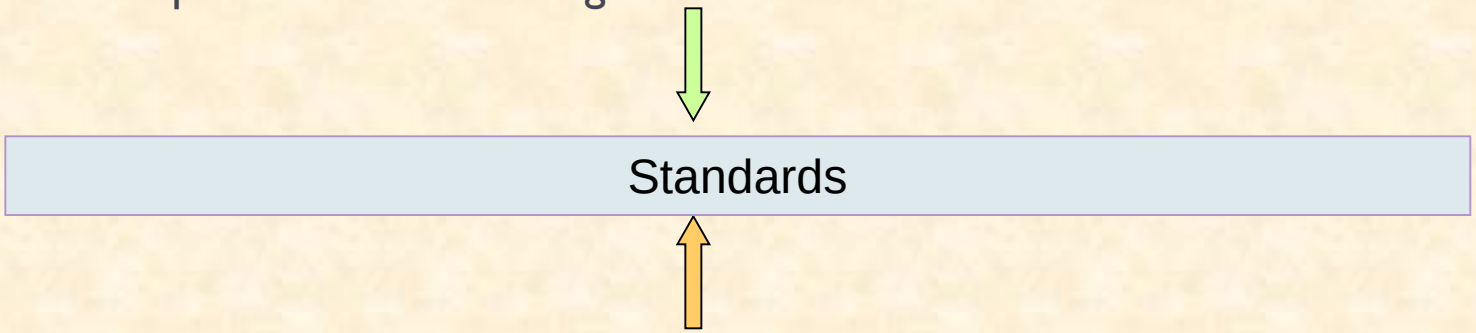
- Pollutants are by-products of economic development
- Standards can be perceived constraints on economic development

- Standards should reflect a balance between the costs of limiting emissions against the costs of damage to health, the environment and the quality of life.



Background: Function of Standards

- As **reference levels for improving** air quality when pollution levels are higher than the standards



- As **thresholds to limit deterioration** in air quality before it becomes unacceptable or harmful

Background: Timeline of Policy & Standards

Bhutan 2020: Vision Document
"*Fully elaborated Air Quality Standards*" by 2007

Environmental Assessment Act 2000

EA Regulations 2002

National Environmental Protection Act 2007
Chapter 4: Protection of Environmental Quality

Constitution of the Kingdom of Bhutan
Article 5.1: "Fundamental duty" of every citizen to contribute to environment protection.. Including prevention of "noise, visual and physical pollution"
Article 5.2(b): Govt shall "prevent pollution" and ecological degradation:

1999
2000
2001
2002
2003
2004
2007
2008

Environmental Discharge Standards (1999)
Based on desktop study

Vehicle emission standards 2003
Based on analysis of primary data

Revised Industrial Discharge standards 2004
Based desktop study

Revised Vehicle Emission standards
Passed by 353rd session of CCM. 2007
Based on analysis of primary data

Revised Air Quality Standards 2007
Adopted by 24th meeting of NEC
Based on primary data and desktop study

Background: Draft Constitution

Article 5
Environment

1. **Every Bhutanese** is a trustee of the Kingdom's natural resources and environment for the benefit of the present and future generations and it is the fundamental duty of every citizen to contribute to the protection of the natural environment, conservation of the rich biodiversity of Bhutan and prevention of all forms of ecological degradation including noise, visual and physical pollution through the adoption and support of environment friendly practices and policies.

2. The **Royal Government** shall:
   a) Protect, conserve and improve the pristine environment and safeguard the biodiversity of the country;
   b) Prevent pollution and ecological degradation;
   c) Secure ecologically balanced sustainable development while promoting justifiable economic and social development; and
   d) Ensure a safe and healthy environment.

Background: Methodology & Process

- Technical Work
  - Collection and analysis of available baseline data for ambient air quality & industrial emissions in Bhutan
  - Review of comparable regional and international standards
  - Expert Input from Shriram Institute for Industrial Research, New Delhi

- Policy Review
  - Recommendations and options reviewed by Commission
  - Standards adopted by 24th Meeting of NEC on 11 September 2007

National Environmental Standards

1. Ambient Air Quality Standards
2. Industrial Emission Standards
3. Workplace Emission Standards
4. Ambient Noise Level Standards

Setting Ambient Air Quality Standards

Ambient Air Quality =

*limits on concentration of air pollutants in **outdoor air**.*

- Requires detailed information on;
  - past and present air quality
  - costs of damage to health, environment and quality of life
- Bhutan lacks almost all the required information
  - Expensive and time intensive to study.
- In absence of such information,
  - Use of available data and
  - Review standards in region and other countries.

Ambient Air Quality Standards for Bhutan

(all units in $\mu g/m^3$)

Parameter	Industrial Area	Mixed Area*	Sensitive Area**	Actual Data Range+
Total Suspended Particulate Matter	500	200	100	***100 - 504***
Respirable Particulate Matter (PM 10)	200	100	75	***49 - 389***
Sulfur Dioxide	120	80	30	Nil – 6.9
Nitrogen Oxides	120	80	30	8.2 - 26.6
Carbon Monoxide	5000	2000	1000	200 - 800

Note: All parameters are 24 hourly average values except carbon monoxide which is 8 hourly average values.

* **Mixed Area** means area where residential, commercial or both activities take place,

** **Sensitive Area** means area where sensitive targets are in place like hospitals, schools, sensitive ecosystems.

\+ **Actual Data Range** for Ambient Air Quality from Thimphu (since 2002), Pasakha & Gomtu

Ambient Air Quality Standards for Bhutan - Zones

- Examples of Industrial Areas:
  - Pasakha Industrial Complex
  - Gomtu
- Examples of Mixed Areas:
  - Thimphu Throm
  - Phuentsholing
- Examples of Sensitive Areas
  - National Parks
  - Isolation Hospitals (Gidakom)

Comparative standards:
Particulate Matters PM_{10}

		PM_{10}			
Averaging period		*Annual*	*24-hour*		
		µg/m³	µg/m³	%-tile	may be exceeded
Bhutan	Industrial	120	150	98th	7 days
	Mixed/Residential	60	100		
	Sensitive	50	75		
WHO Interim target-1		70	150	99th	3 days
WHO Interim target-2		50	100	99th	3 days
WHO Interim target-3		30	75	99th	3 days
WHO Guideline		20	50	99th	3 days
EU Limit Values		40	50	90th	35 days
US EPA Standards			150	99.7th	1 day
India	Industrial	120	150	98th	7 days
	Residential	60	100		
	Sensitive	50	75		
Bangladesh		50	150	99.7th	1 day
Nepal			120	95th	18 days

Comparative standards:
Nitrogen Oxides

	NO_2 - µg/m³				
Averaging period	*Annual*	*24-hour*	*24-hour*	*1-hour*	*1-hour*
Statistic	Average	95th pctile	98th pctile	95th pctile	maximum
Allowed to exceed (per year)		*18 days*	*7 days*	*18 hours*	
Bhutan Industrial	80		120		
Mixed/Residential	60		80		
Sensitive	15		30		
WHO Guideline	40				200
EU Limit Values	40			200	
EPA	100				
					320
India Industrial	80		120		
Residential	60		80		
Sensitive	15		30		
Nepal	40	80			

Comparative standards:
Sulphur Dioxide

	SO_2			
Averaging period	*Annual*	*24-hour*		
	$\mu g/m^3$	$\mu g/m^3$	%-tile	may be exceeded
Bhutan Industrial Residential Sensitive	80 60 15	120 80 30	98^{th}	7 days
WHO Interim target-1		125	99^{th}	3 days
WHO Interim target-2		50	99^{th}	3 days
WHO Guideline		**20**	99^{th}	3 days
EU Limit Values		125		
EPA	80	373	99.7^{th}	1 day
India Industrial Residential Sensitive	80 60 15	120 80 30	98^{th}	7 days
Bangladesh	80	373	99.7^{th}	1 day
Nepal	50	70^{a}	95^{th}	18 days

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Types of Industries and Pollution Sources in Bhutan

- Types of Industries
  - chemicals,
  - cement,
  - metallurgical,
  - food processing,
  - wood processing
- Sources of pollution
  - lime kiln
  - arc furnace
  - raw mill kiln
  - vertical shaft kiln
  - induction furnace
  - coal and oil fired boiler wood boiler
  - blending silo

Industrial Emission Standards for Bhutan

- Standards are comparable to Indian CPCB Standards
  - Technology & raw materials all from India
  - Detailed research on permissible limits already complete by CPCB, India
  - Most industries in compliance

Industrial Emission Standards

Industrial Type by Technology	Maximum Limits for Pollutants (mg/Nm^3)			
	SPM	SO_2	NOx	CO
Lime Kilns	150	100	100	50
Arc Furnace, Induction Furnace	150	100	100	50
Tapping Fume Stack	150	-	-	-
Coal fired, Oil fired and Wood fired Boiler	150	100	100	50
Horizontal/Rotary Kiln, Vertical Shaft Kiln and other Kilns	150	100	100	50
Other Technologies: for sectors that are not covered in the above sections	150	100	100	50

Status of Compliance to standards (1)

Industry	Source	Emission of PM, mg/Nm3	Limit/ Compliance
Penden Cement Authority Ltd.	ESP to kiln C-line-Raw Mill Raw Mill –1 Blending Silo	1063* 23 56 99	150 / No? 150 / Yes 150 / Yes 150 / Yes
Lhaki Cement	Cement Mill VSK	33 1187	150 / Yes 150 / No
BCCL	Lime kiln Carbide furnace Tapping stack Silico manganese furnace	145 2916** 3800*** 7	150 / Yes 150 / NA 150 / No 150 / Yes
BFAL	Before bag house	1304****	150 / NA

Note:

*There was some problem with the ESP during sampling.

** The sampling was done at the inlet to bag filter house. If 95% efficiency factor applied for bag filter, then the estimated concentration of PM from bag filters will be about 145 mg/Nm^3 which is within the limits.

*** Sampling was done at the peak of tapping time.

****The sampling was done at the inlet to bag filter house. If we apply the 95% efficiency factor for bag filter, then the estimated concentration of PM coming out of bag filters will be about 70 mg/Nm^3 which is well within the limits.

Status of Compliance to standards (2)

Industry	Source	Emission of PM, mg/Nm3	Limit/ Compliance
Druk Cement	Raw mill kiln VSK	27 2117	150/Yes 150/No
Bhutan Iron and Steel	Induction furnace	226	150/No
Singye Vanaspati	Coal fired boiler Oil fired boiler	76 167	150/Yes 150/No
Druk Iron and Steel	Induction furnace	64	150/Yes
Bhutan fruit products	Coal fired boiler	370	150/No
Kenpa Vanaspati	Coal fired boiler	507	150/No
Manufacturing	Wood fired boiler	140	150/Yes

Comments on Industrial Emission Standards

- Most existing industries will not have difficulty in meeting the proposed standards
- Some modification/installation of air pollution control measures may be needed for some industries to comply with the standards.
- However, technologies such as Vertical Shaft Kiln (VSK) might face difficulty in meeting the proposed standards.
  - VSK is obsolete technology.
  - requires major change in process technology or installation of proper air pollution control measures

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Workplace emission standards

Workplace emission =

the quality of air within the industrial premises.

- Important for occupational health and safety of workers
- Comparable to US OSHA standards

Workplace emission standards

Parameter	Standard	Measured Data Range*
Total Suspended Particulate	10mg (10,000 µg/m^3)	131 µg/m^3 - 12,703 µg/m^3.
Respirable Particulate Matter	5mg (5,000 µg/m^3)	93 µg/m^3 - 5,682 µg/m^3.
Sulfur Dioxide	1mg	Nil - 14.3 µg/m^3.
Nitrogen Oxides	1mg	14 µg/m^3 - 39 µg/m^3.
Carbon Monoxide	5mg	500 µg/m^3 - 1800 µg/m^3.

Note: 1mg = 1000 µg

**** One time visit in August 2007***

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Ambient Noise Level Standards

Ambient noise level monitoring of different industries show that the leq values varied from 55 dB(A) to 68 dB(A).

Standards for Noise

Industrial Area		Mixed Area		Sensitive Area	
Day*	Night*	Day	Night	Day	Night
75 dB(A)	65 dB(A)	65 dB(A)	55 dB(A)	55 dB(A)	45 dB(A)

Note: All the values are maximum values
* **Day time** is from 0600 hours to 2200 hours (human activities)
** **Night time** is from 2200 hours to 0600 hours (ho human activities)

Ambient Noise Levels

- Maximum value allowed in workplace in any point of time is 75 dB(A).
  - > 75 dB(A) cause hypertension
  - > 83 dB (A) causes permanent ear damage

- If the noise level exceeds the maximum limit at any given point in time, measures are required:
  - Provisions of ear plug to workers;
  - Reduction of duty hours at high noise areas, and;
  - Putting acoustic enclosures on such machines.

Conclusions

- Most industries should be able to meet emissions standards
  - Few instances of exceeding limits
  - Problems can be rectified with appropriate measures

Challenges:

- Rapid vehicular growth
  - High altitude
  - Fuel quality and vehicle maintenance

- Lack of resources for monitoring
  - Financial, human and technical resources


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