Energy Supply Challenges Confronting Bangladesh

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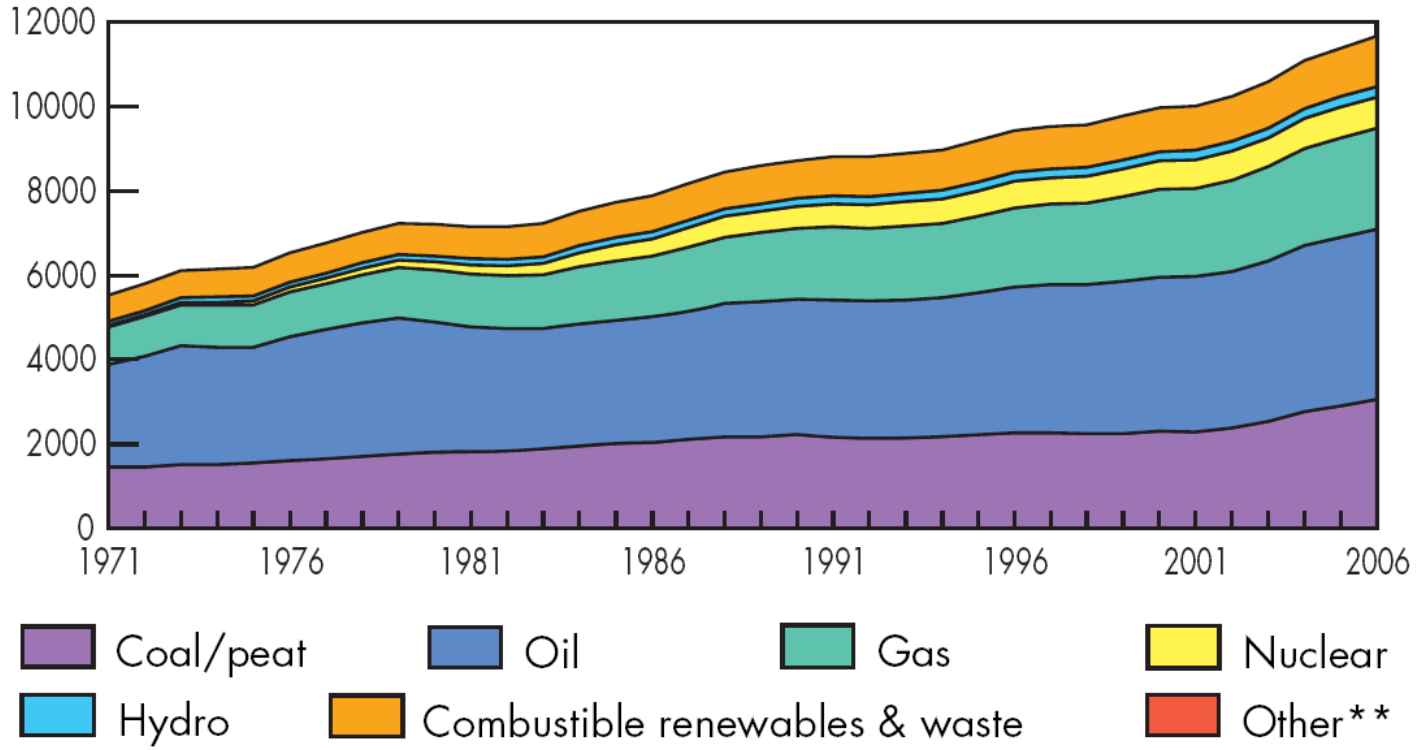
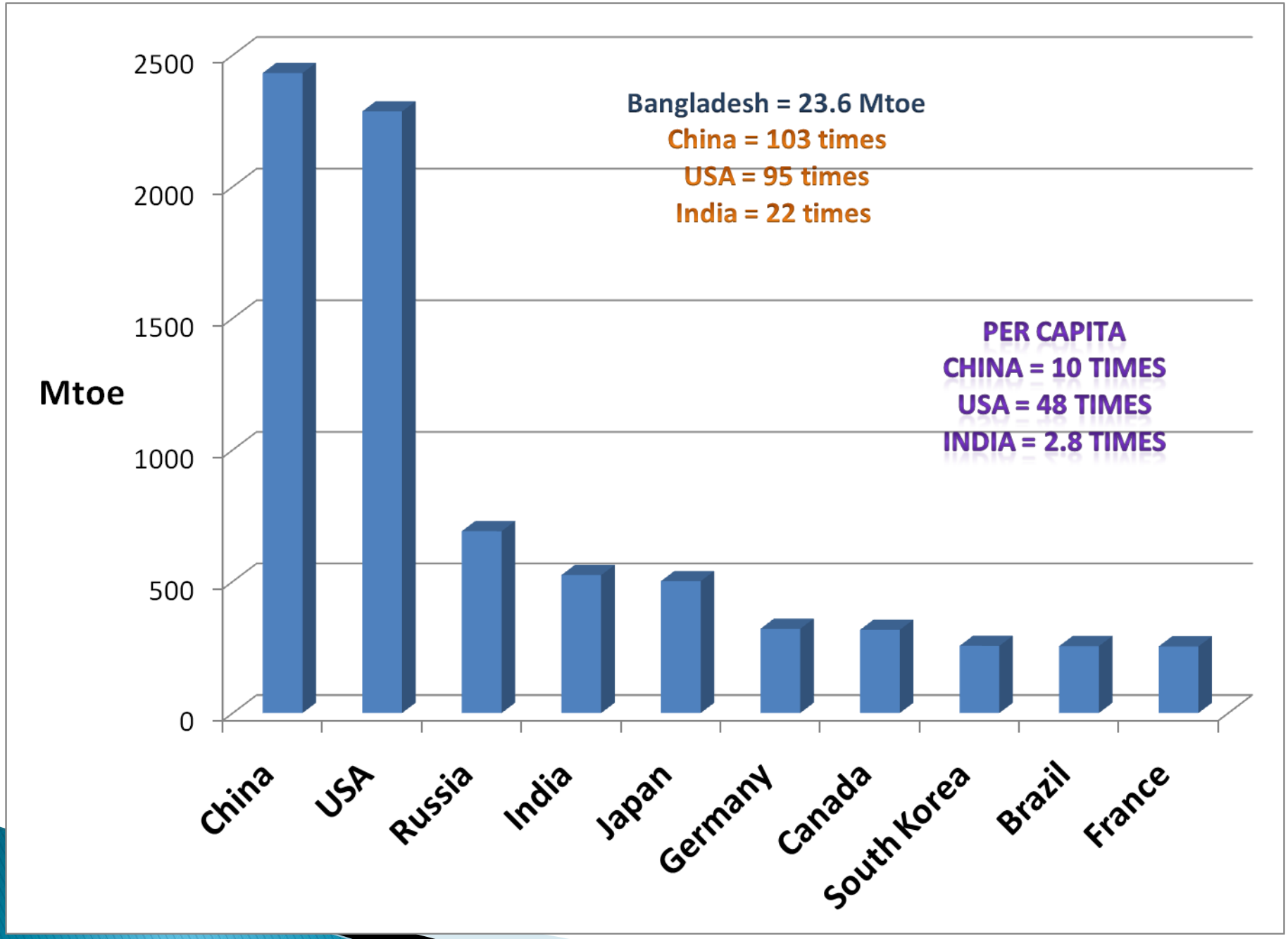
TOTAL PRIMARY ENERGY SUPPLY

World

Evolution from 1971 to 2006 of world total primary energy supply* by fuel (Mtoe)




Mtoe
2500
2000
1500
1000
500
0
Bangladesh = 23.6 Mtoe
China = 103 times
USA = 95 times
India = 22 times
PER CAPITA
CHINA = 10 TIMES
USA = 48 TIMES
INDIA = 2.8 TIMES
China
USA
Russia
India
Japan
Germany
Canada
South Korea
Brazil
France

2010 World Energy Consumption

Global energy consumption; the strongest growth since 1973.

+5.6%

China's share of global energy consumption; the world's largest.

20.3%

Coal's share of global energy consumption; the highest since 1970.

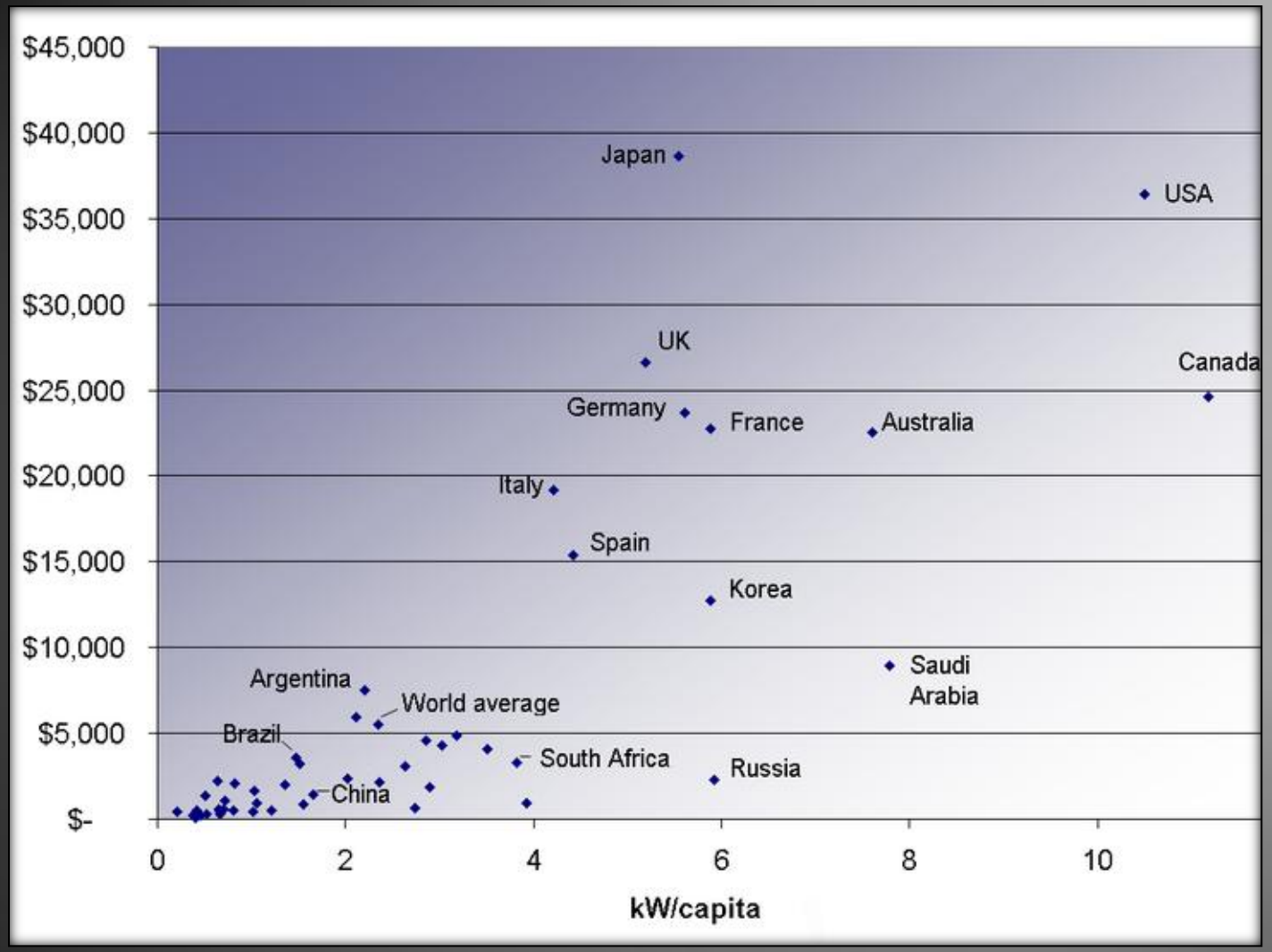
29.6%

Share of renewables in global energy consumption.

1.8%

Chinese share of global coal consumption.

48.2%

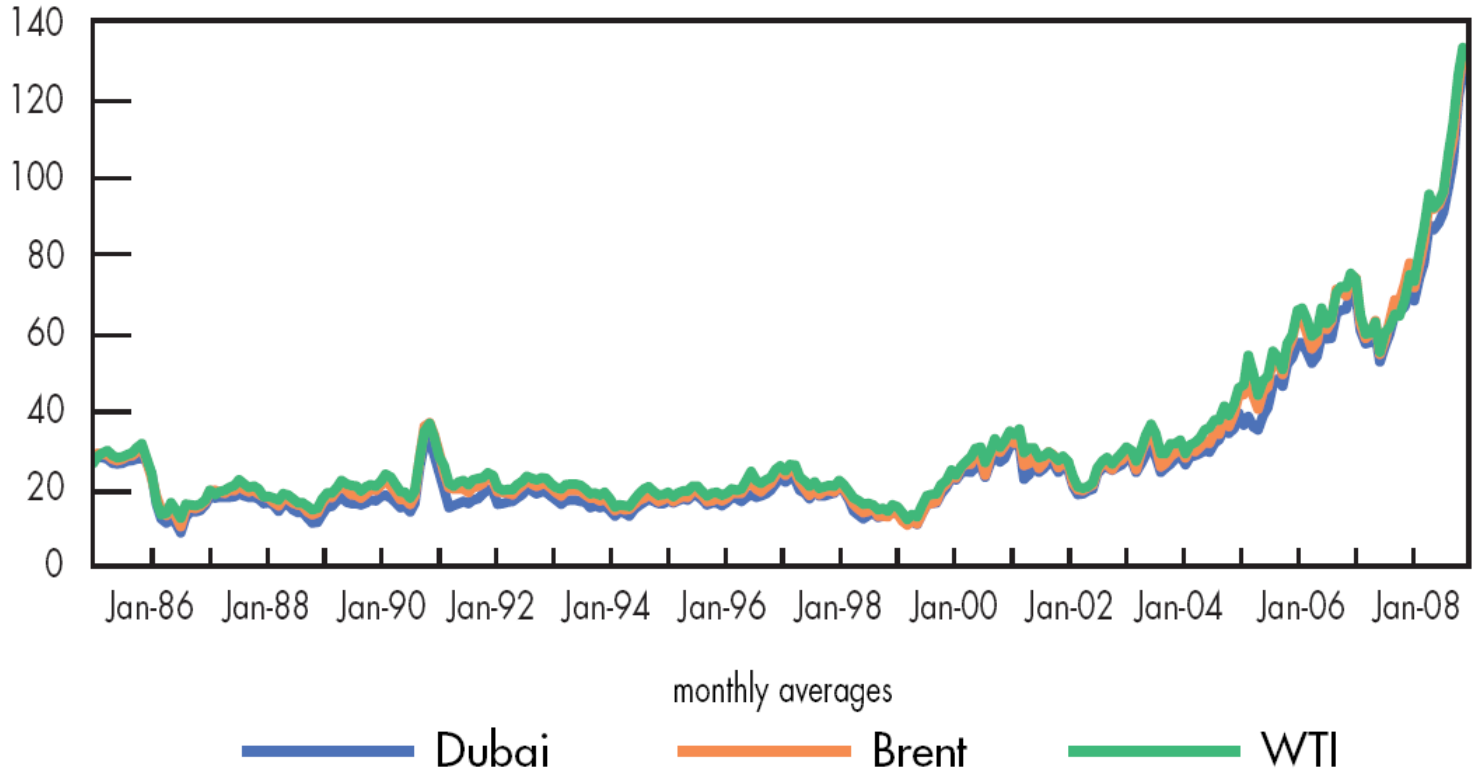


GDP vs. Power per Capita

World Average: $5500 – 2.4 kW/capita

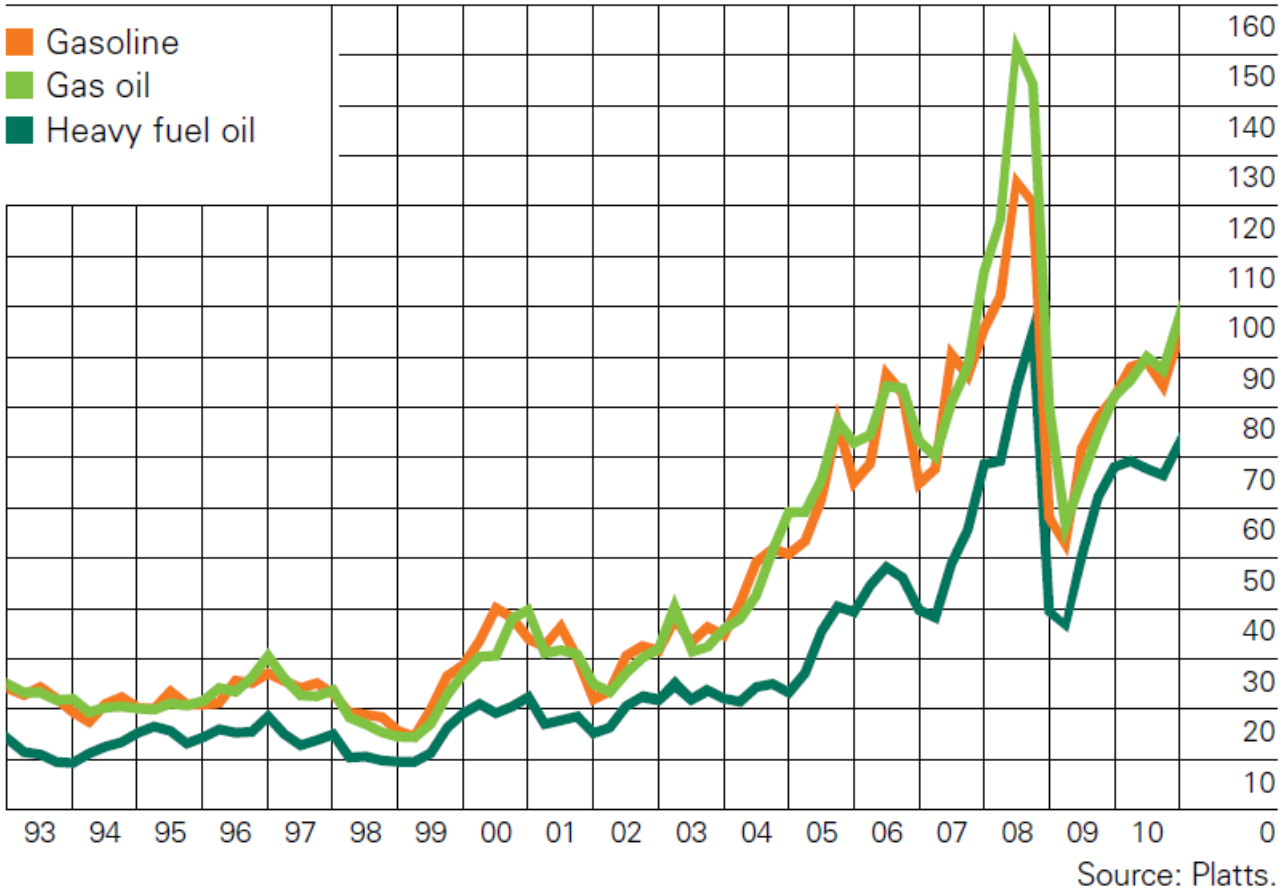
Crude Oil

Key crude oil spot prices in US dollars/barrel



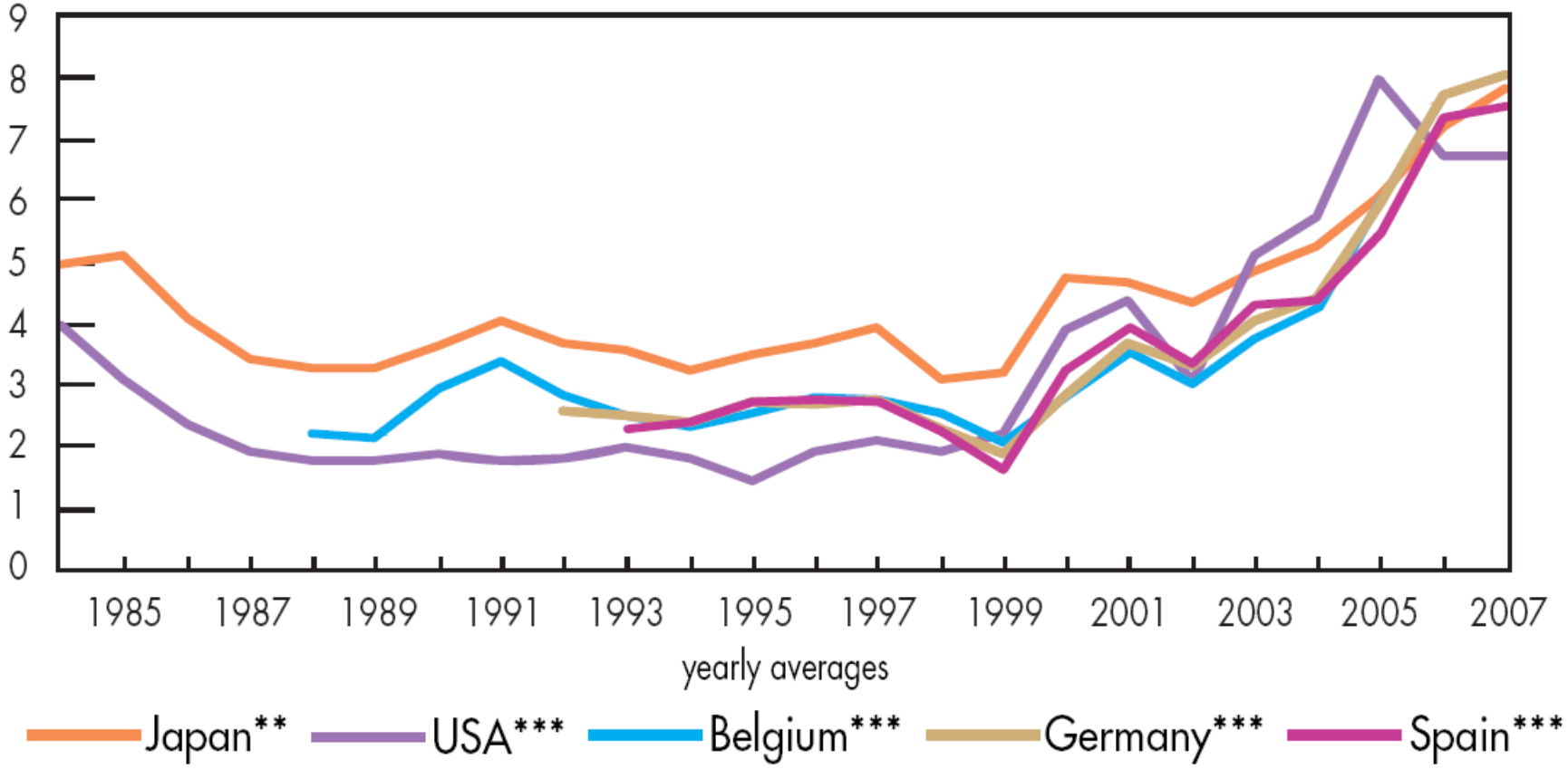
Rotterdam product prices

US dollars per barrel



Source: Platts.

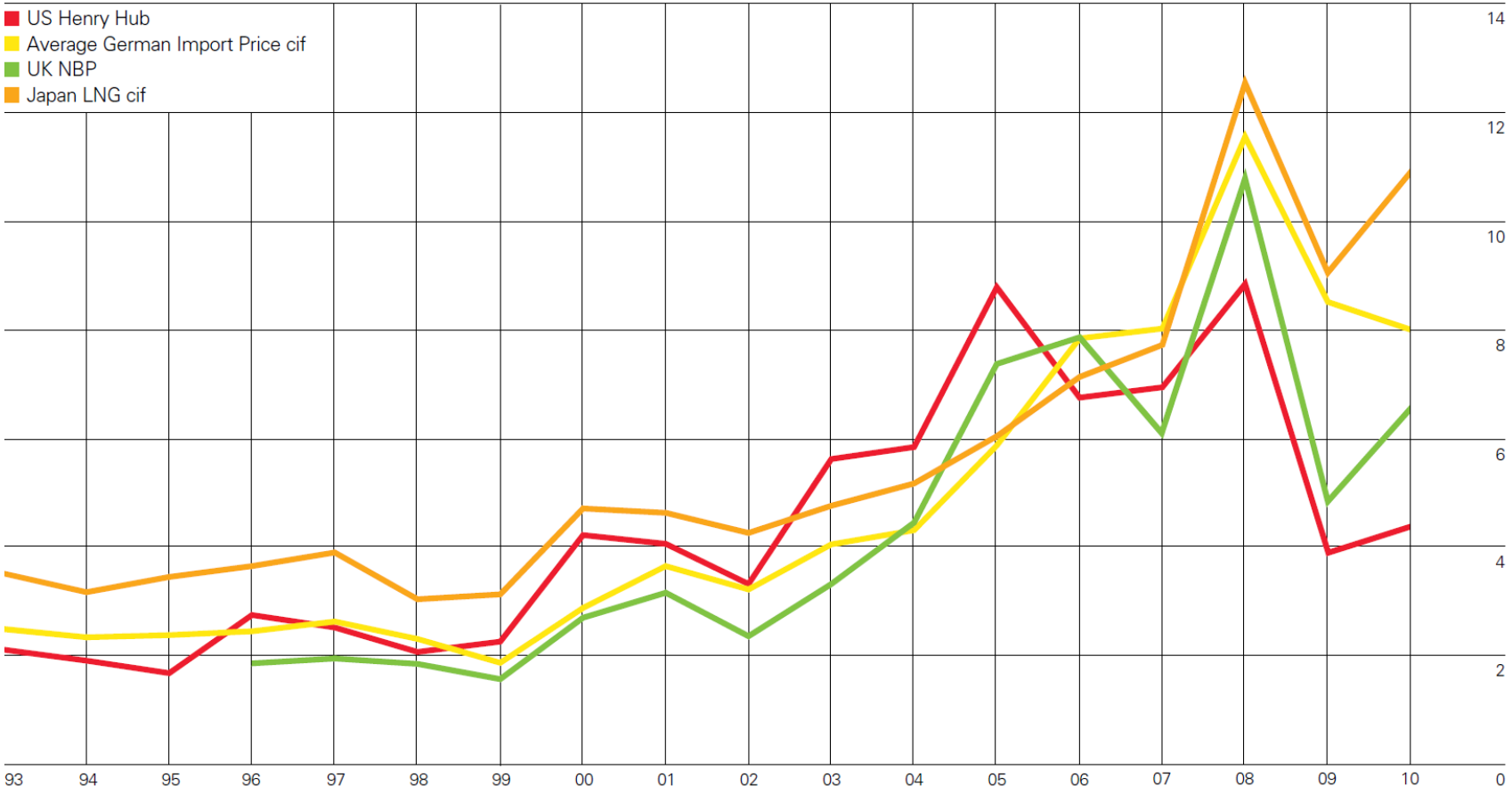
Natural gas import prices in US dollars/MBtu



*European Union member states excluding Romania and Bulgaria, where information is available.
**LNG ***Pipeline

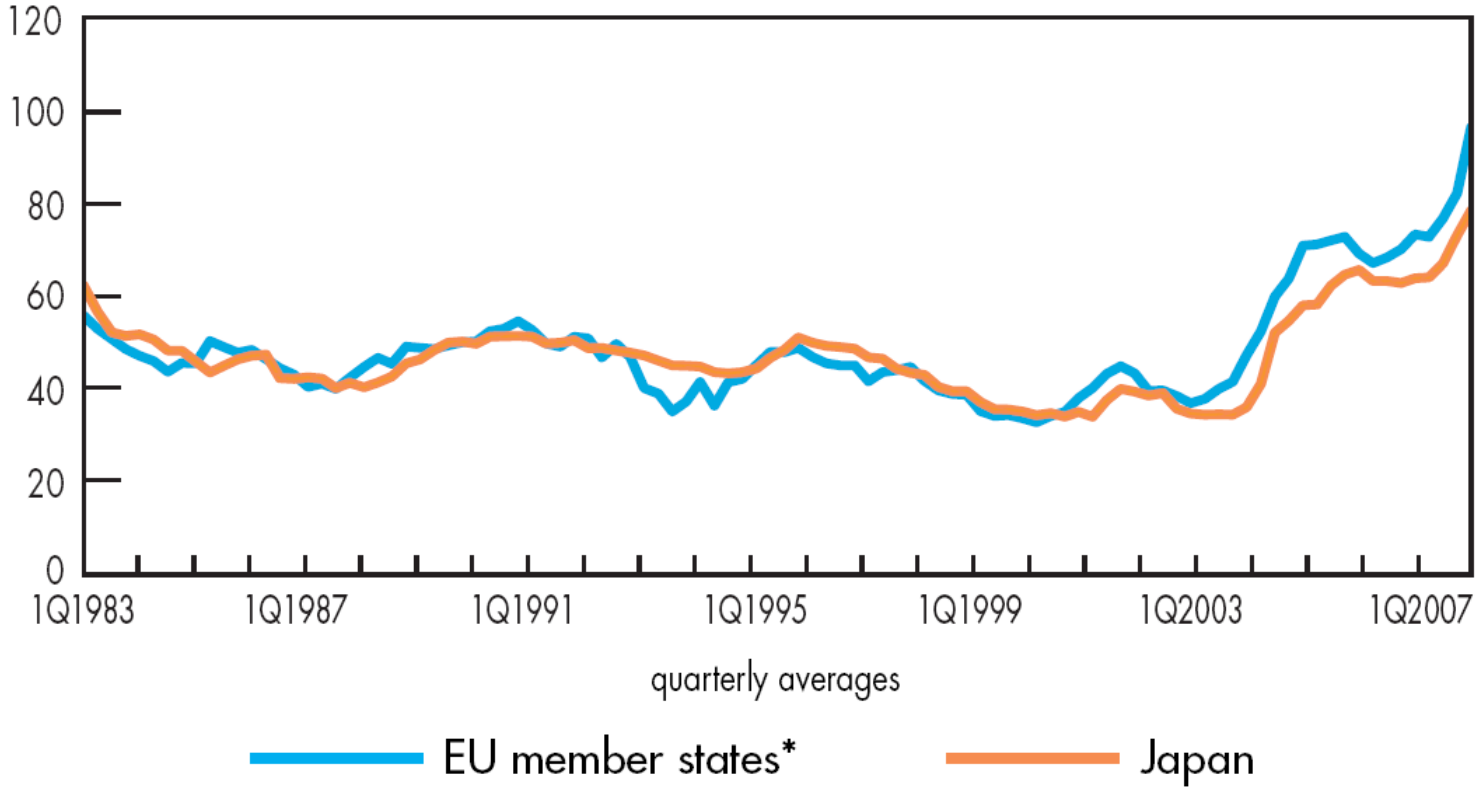
Prices

$/Mmbtu

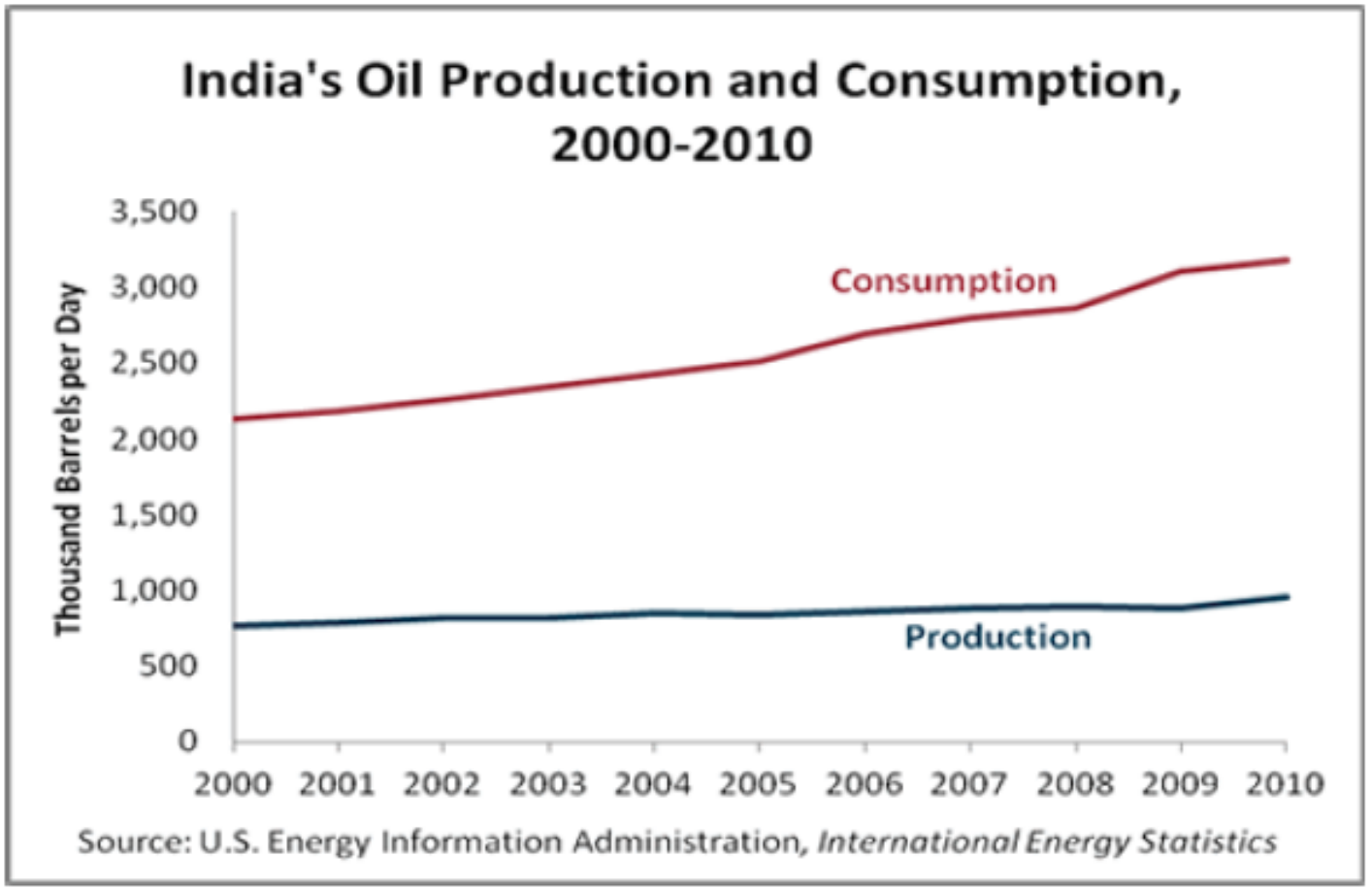


Coal

Steam coal import costs in US dollars/tonne

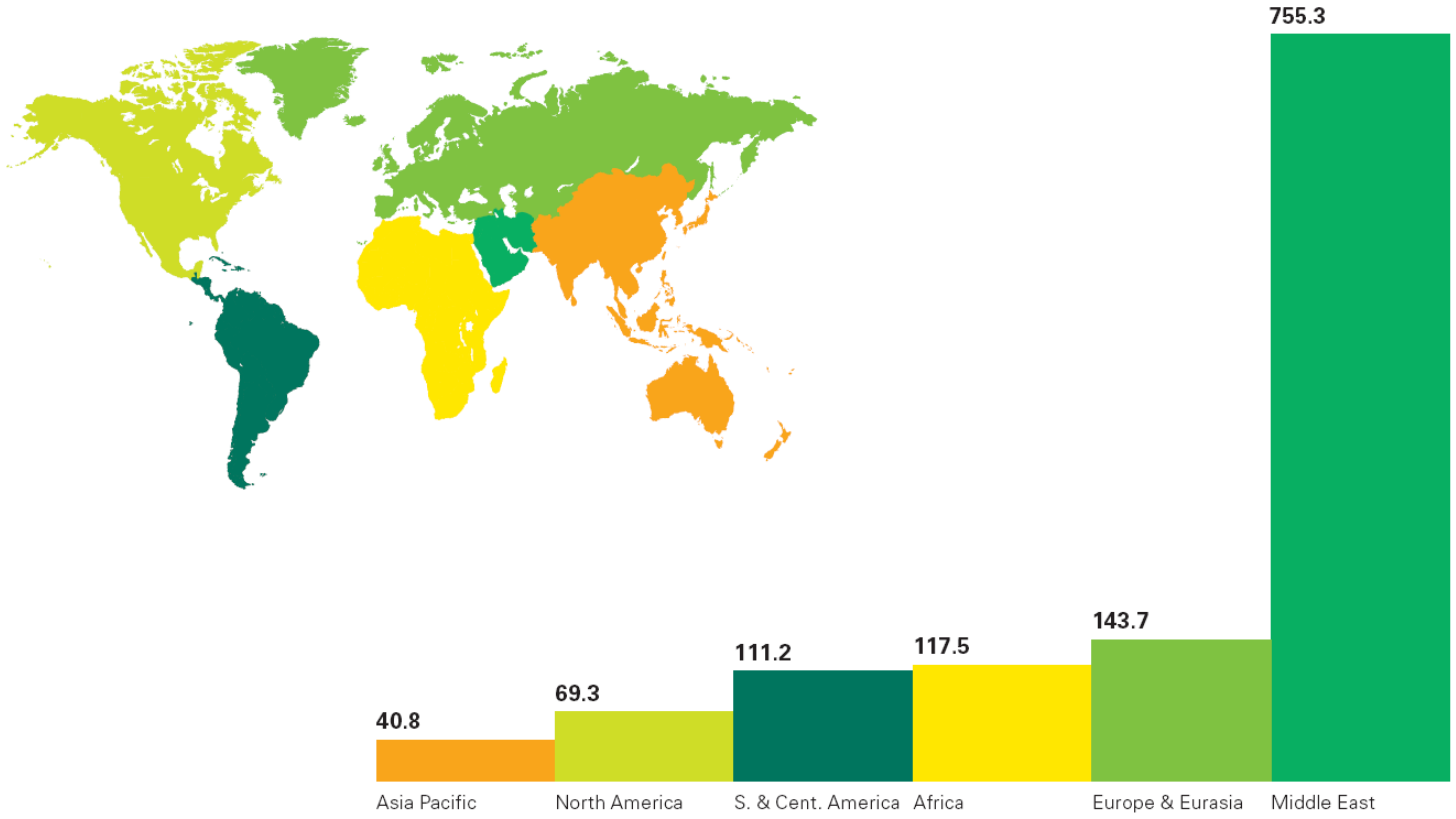


INDIA – Oil Demand and Supply

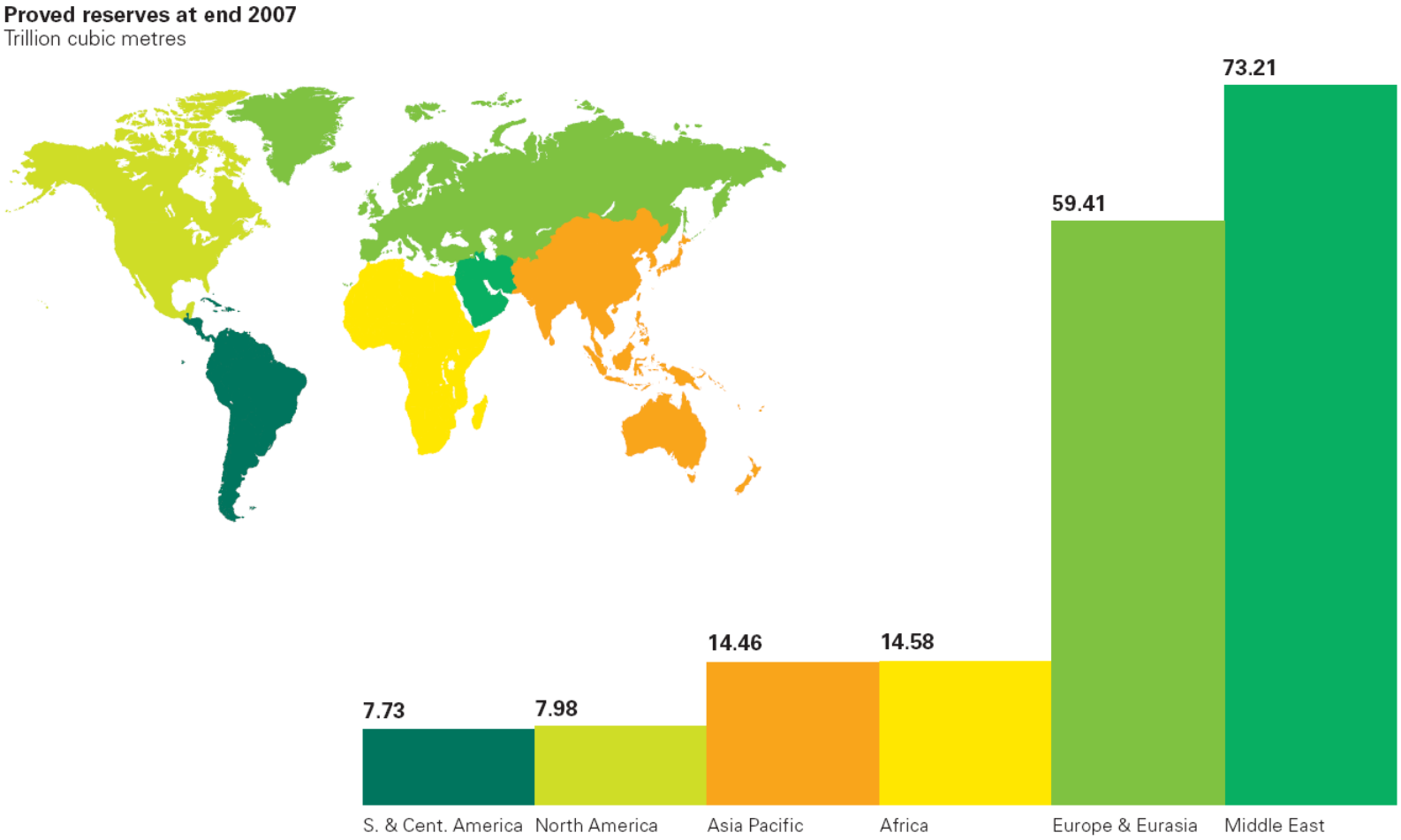


OIL

Proved reserves at end 2007
Thousand million barrels

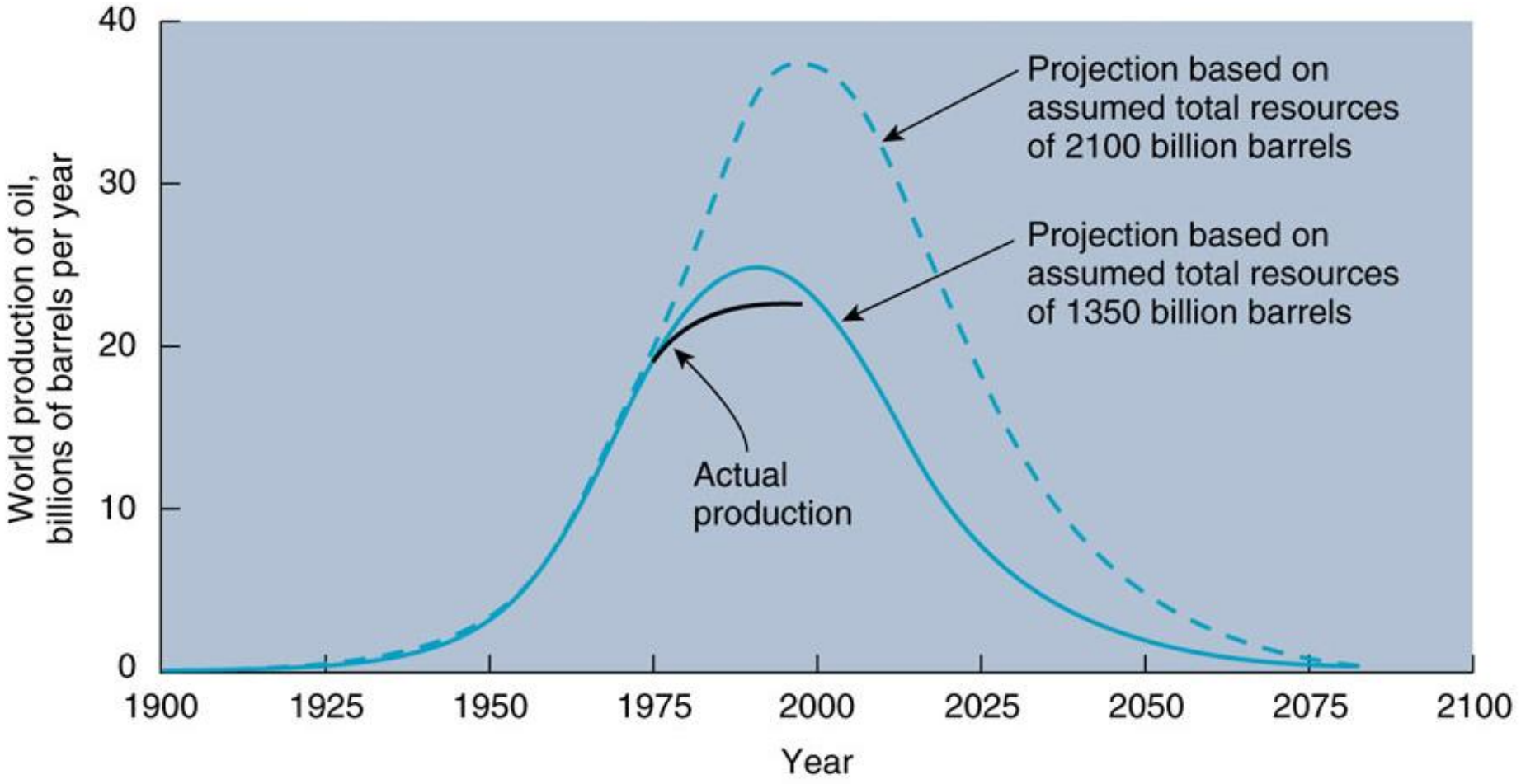


Proved natural gas reserves at end 2007



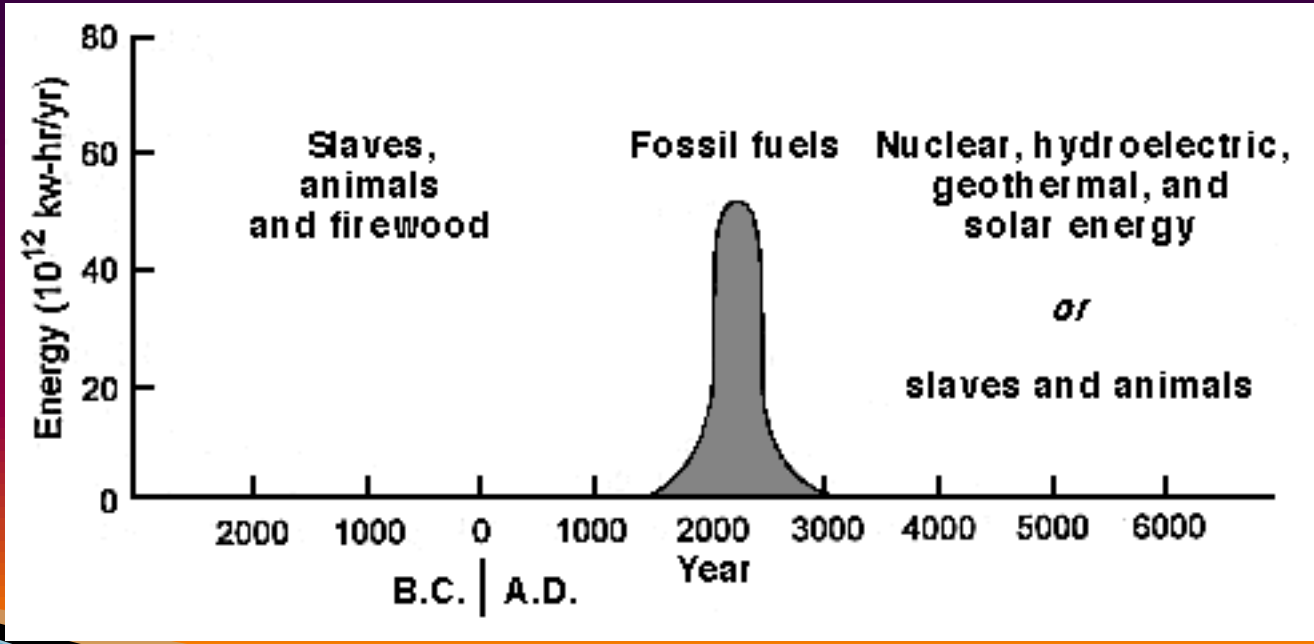
1. Russia 2. Iran 3. Qatar

Projected Oil Resources



A forecast for fossil fuels

- There will be no worldwide shortage of fossil fuels during this century
- [there is coal]
- Their cost will not increase dramatically for several more decades
- [$150 is not dramatic]
- Shortages of oil and large price fluctuations will occur regularly
- [signs already there]
- On the timescale of hundreds of years, the outlook for continued availability of fossil fuels is bleak
- [renewables are the ultimate source]



Comparison of energy (electricity and primary) and energy intensity

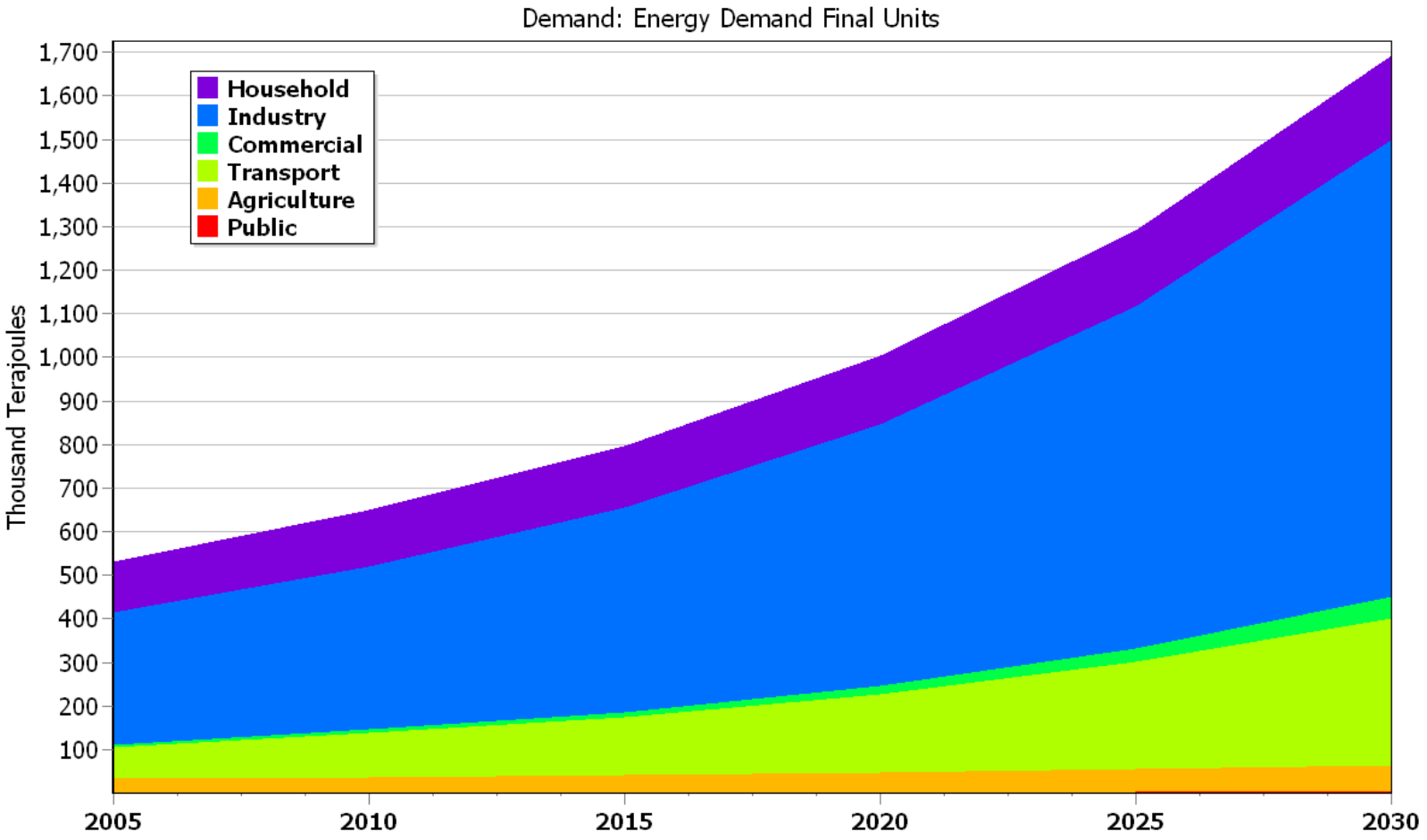
Parameter	INDIA	BANGLADESH	
Per capita kWh	770	260	**3** times more
Per capita kgoe	437	157	**2.8** times more
Hydro + Wind	25.2 + 5	0.3 + 0	**100** times more
Toe / 1 M $	190	98	**2** times more

Summary of Primary Energy Supply in Bangladesh in 2009-10

Fuel Type	Original Unit	(TJ)	(%) of Total	(%) Without Biomass
Natural Gas	703 BCF	868,600	44.5%	77.1%
Oil	3.5 million Tons	155,400	8.0%	13.8%
Coal (estimate)	3.5 million Tons	98,000	5.0%	8.7%
Hydro	1000 GWh	3,600	0.18%	0.36%
Solar PV (estimate)	60 MW-p (equivalent)	400	0.02%	0.04%
Biomass (estimate)	55 million Tons	825,000	42.3%	
	TOTAL →	**1,951,000**	100.0%	100.0%

Last year (2010-11): Extra 2 million tons of OIL had to be used for power

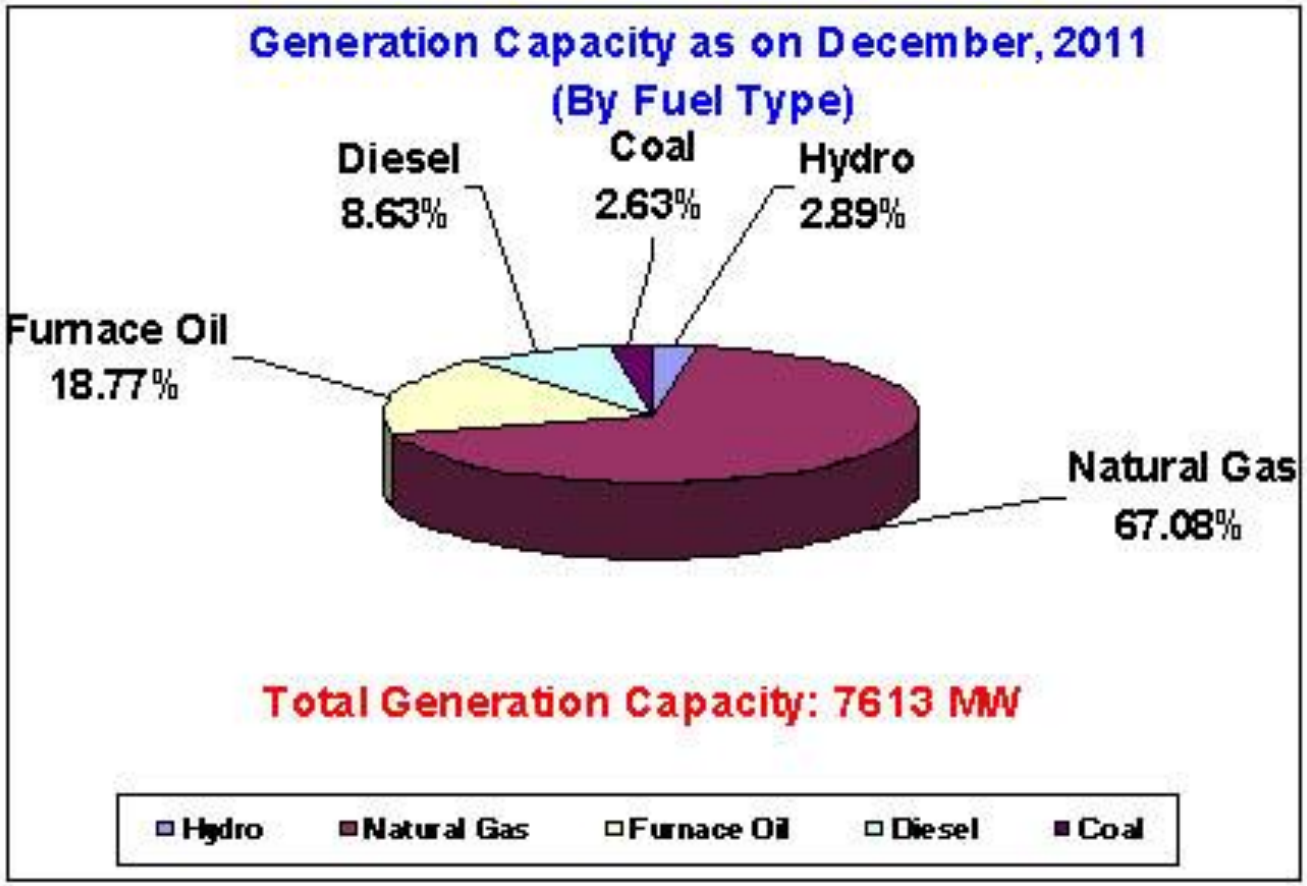
Energy projection of the demand sectors for the period 2005 to 2030



Present Energy Situation

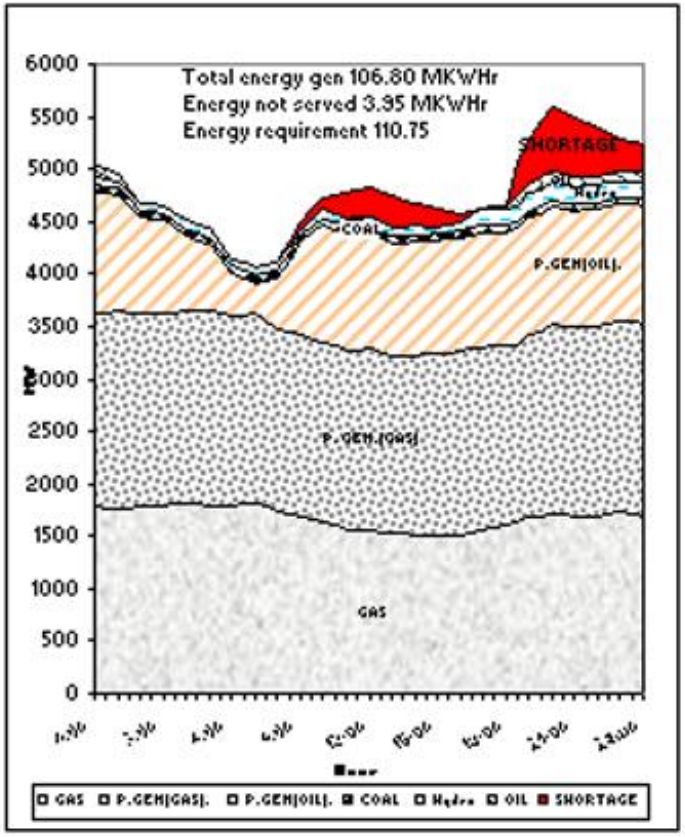
	Present Capacity	Demand	Shortfall/Remarks
POWER	5500 MW	6500 MW (Peak) (connected load)	1000 MW (peak) At least 1000 MW suppressed demand; 8% growth rate/yr BORO season extra 1500 MW
GAS	2050 MMCFD 0.74 Tcf/yr	2500+ MMCFD (connected load)	25% (without suppressed demand) 8% growth rate/yr
Oil	0	3-4 million Ton	Imported
COAL	1 million Ton/yr (Barapukuria)	3-4 million Ton/yr	2-3 million Ton imported from India for mainly brick making Can produce 20 million Ton/yr
HYDRO	200 MW		Not much potential

Power Plants – by fuel type



Energy Curves of Bangladesh

11-09-2011



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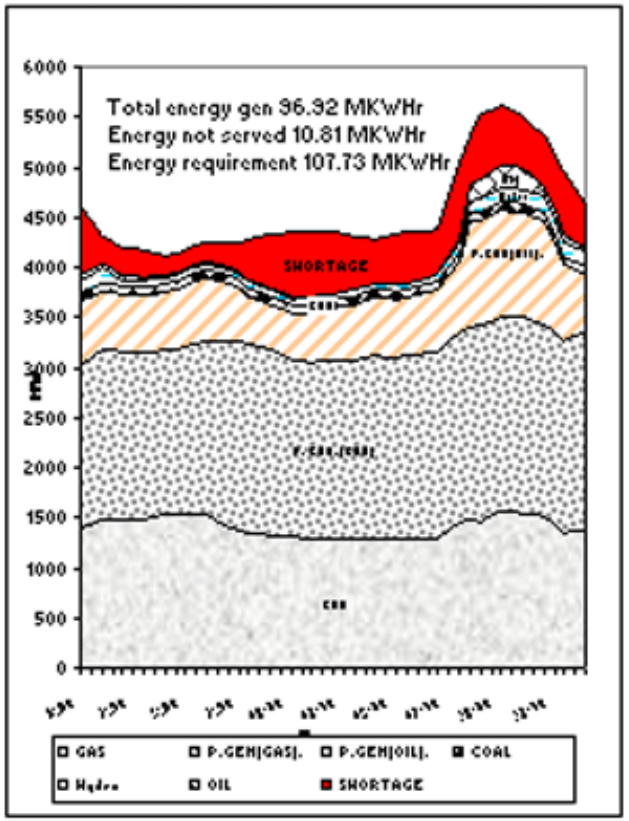
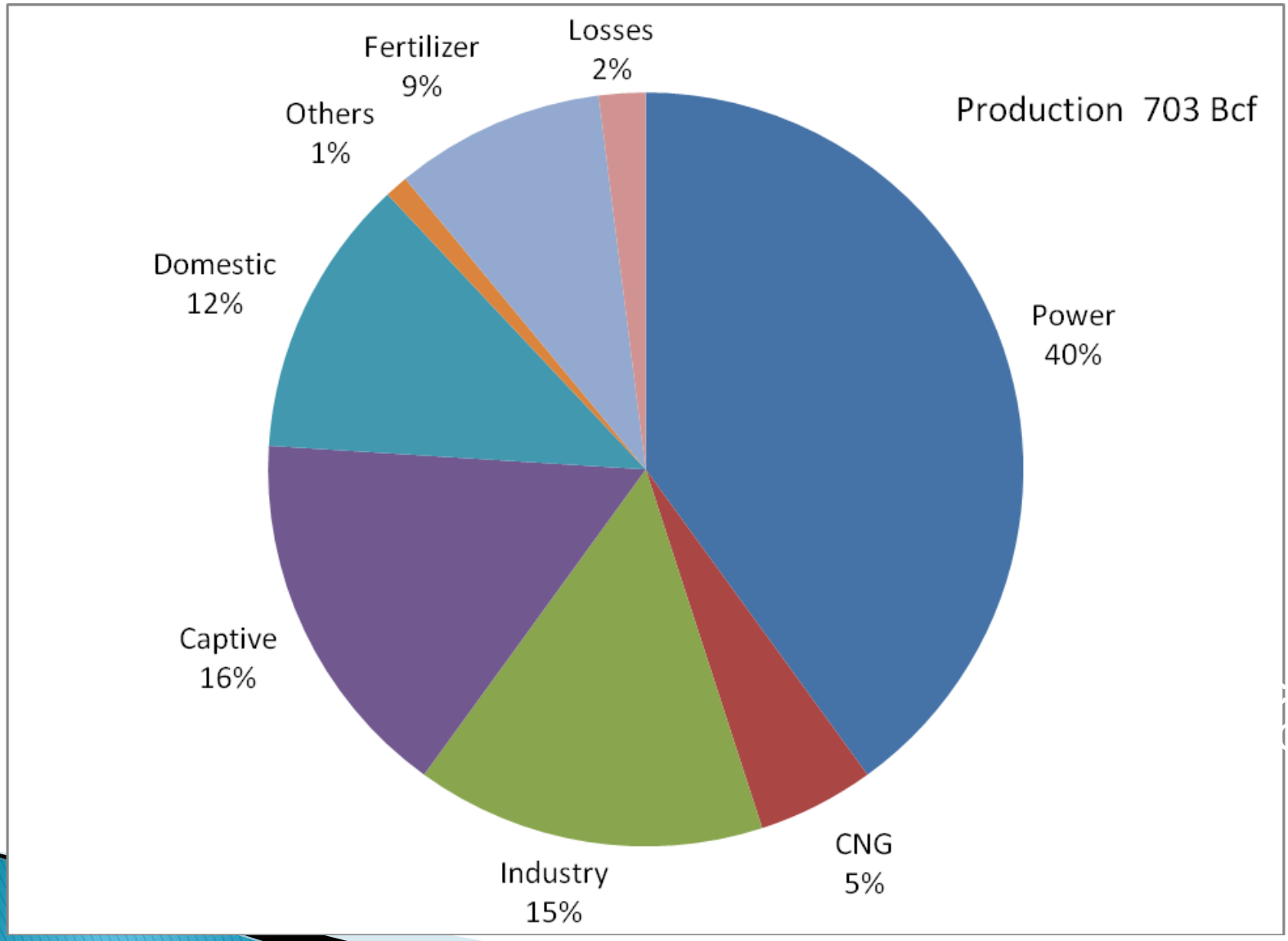


Gas Consumption by different sectors – 2009-10



Present Energy Plan

POWER

Year	2010	2011	2012	2013	2014	2015	Total
Additional Generation	792	920	2269	1675	1170	2600	9426
Quick Rental	350	857					1207
Total	1142	1795	2269	1675	1170	2600	10633

GAS

1300 MMcfd additional gas supply by end of 2012

4000 MMcfd total supply by 2015

Present energy plan analysis

GAS in MMcfd

500 from IOCs (mainly Bibiyana)

300-500 from own fields (Titas, Habiganj, ….)

300-500 from new onshore discoveries

500 LNG from Qatar (by 2012 ?????)

Coal

Imported from India, Indonesia, Australia,….

Electricity import from India – 250-500 MW

1000 MW Nuclear by 2017/2018 ?????

Reserve Adequacy to Support Mega Plan

- 2010 Production – 2000 MMcfd
- Proposed addition by 2012 – 1300 MMcfd
- **TOTAL (2012) – 3300 MMcfd**

- 3300 MMcfd $\times$ 365 = 1.2 Tcf per year (Consumption in 2012)

THUMB RULE

- Must find 1.2 Tcf per year

HOW MANY DRILLING NEEDED TO ACHIEVE THAT?

Can our reserves sustain the production rate?

What reserve is required for 1.2 Tcf/yr?

- If demand is capped (i.e. no new gas connections after 2012) then for 20 years supply we need **24 Tcf of gas**
- If supply grows to meet demand at 6%/yr then we will need more than **45 Tcf of gas** [DO WE HAVE SUCH RESOURCE?]
- Oil will be phased out in 5 years, no coal plant before 2015 – How is this MEGA PLAN assisting FUEL DIVERSIFICATION?
- **When in TROUBLE all governments try to take the easy way out – increase gas production with no regard to reserves and reservoir capability** ***[We should not forget the Bakhrabad Gas Field]***

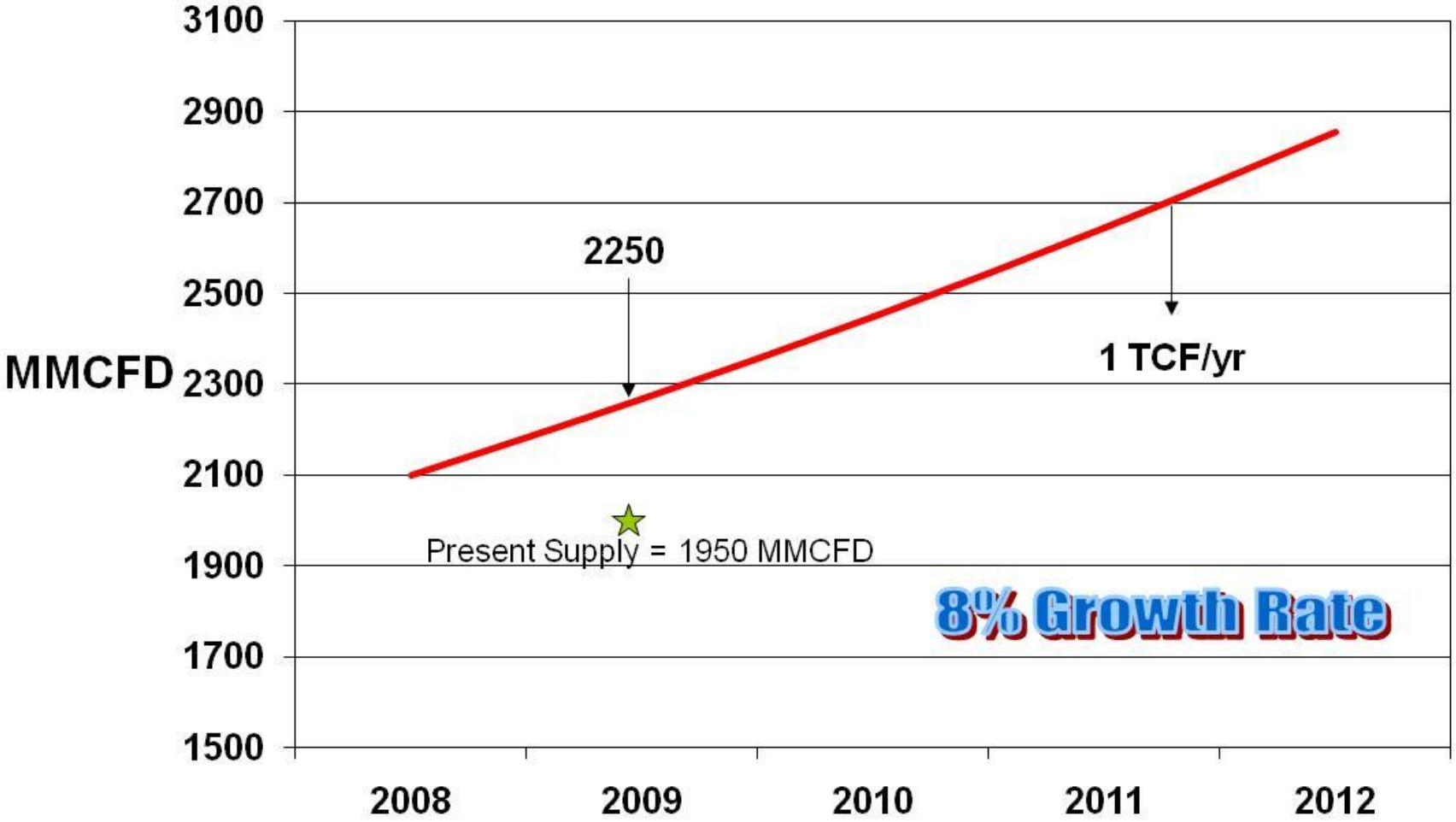
- IOCs have been allowed a very generous production rate of 7.5%/yr. At this rate a reserve will be exhausted in **13.3 years** if all gas can be produced [from 2.4 Tcf allowed 500 MMcfd]

- Chevron is producing nearly 700 MMcfd from Bibiyana by showing a higher reserve. Reserve has been enhanced to 4.6 Tcf, which can support **950 MMcfd** (250 MMcfd additional)

- Jallalabad and Moulovibazar are capable of giving more gas – but how much more? Have their new reserves been certified? Can these two fields give more than another **250 MMcfd**?

- At peak these fields may be producing **1500 MMcfd**

Gas Demand at Present Price



How much gas do we have?

19 Tcf Remaining Reserve

2010 Consumption:

- 1980 MMcfd or **0.72 Tcf** per year
- 19 ÷ 0.72 = **26 years**, if demand is **constant**
- But, how long with **increasing demand**?

Assuming a 6% demand growth

When will 19 Tcf be exhausted?

2010 Consumption <> 0.74 Tcf

2012 Consumption <> 0.83 Tcf

2014 Consumption <> 0.93 Tcf

2015 Consumption <> 0.99 ~ 1 Tcf

Total Consumption by 2015 = **6.5 Tcf**

When will the 19 Tcf of existing reserve be exhausted?

2016 Consumption <> 1.05 Tcf

2018 Consumption <> 1.18 Tcf

2020 Consumption <> 1.32 Tcf

Total Consumption by 2020 = **12.5 Tcf**

ALL EXHAUSTED BY 2025

Exploration Activity

- In the last 10 years we have added approximately **1.0 Tcf** of gas to our reserves
- **Last year alone we consumed 0.8 Tcf of gas**
- In 2015, according to plans we will consume around **1.2 Tcf** of gas
- **We need more than 10 exploratory wells/year**
- Last 3 years we have drilled only 5 wells
- **If we do not find new gas our reserves will be exhausted in less than 15 years**

NEW GAS?

- USGS study –
  32 Tcf (mean – 50%)
  8.5 Tcf (95% certainty)
  62 Tcf (5% certainty)

- ONSHORE (at least 5 Tcf in existing fields; 10 Tcf in new fields)

- OFFSHORE (> 15 Tcf)

Pricing

- We have gotten used to low energy prices
- New electricity and new gas is DOUBLE that of present retail price
- How will the Government make the necessary transition?
- HOW LONG CAN GOVERNMENT SUBSIDISE?

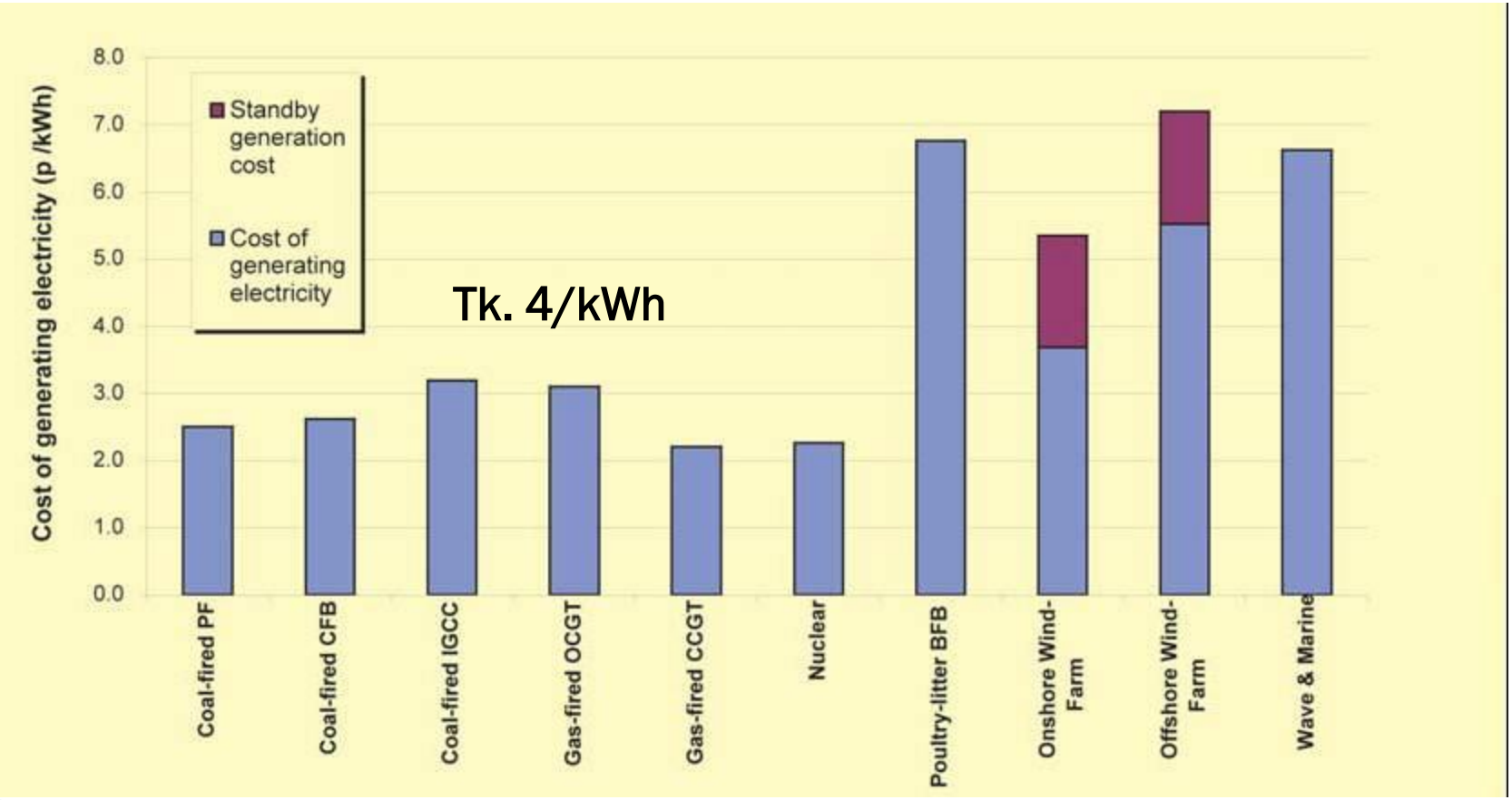
The following fuel/sources are used worldwide for electricity generation

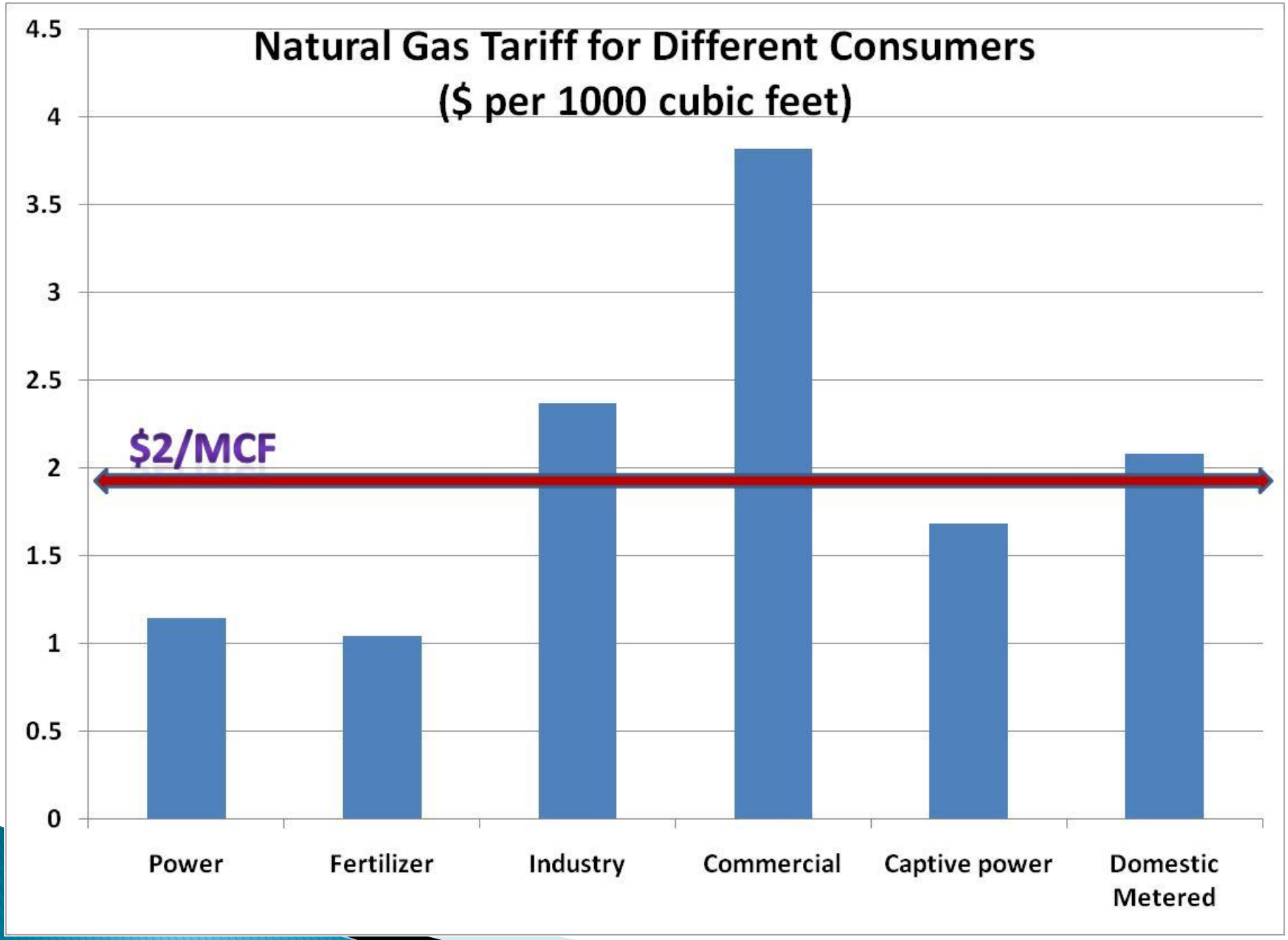
- Coal
- Natural Gas
- Hydro
- Nuclear

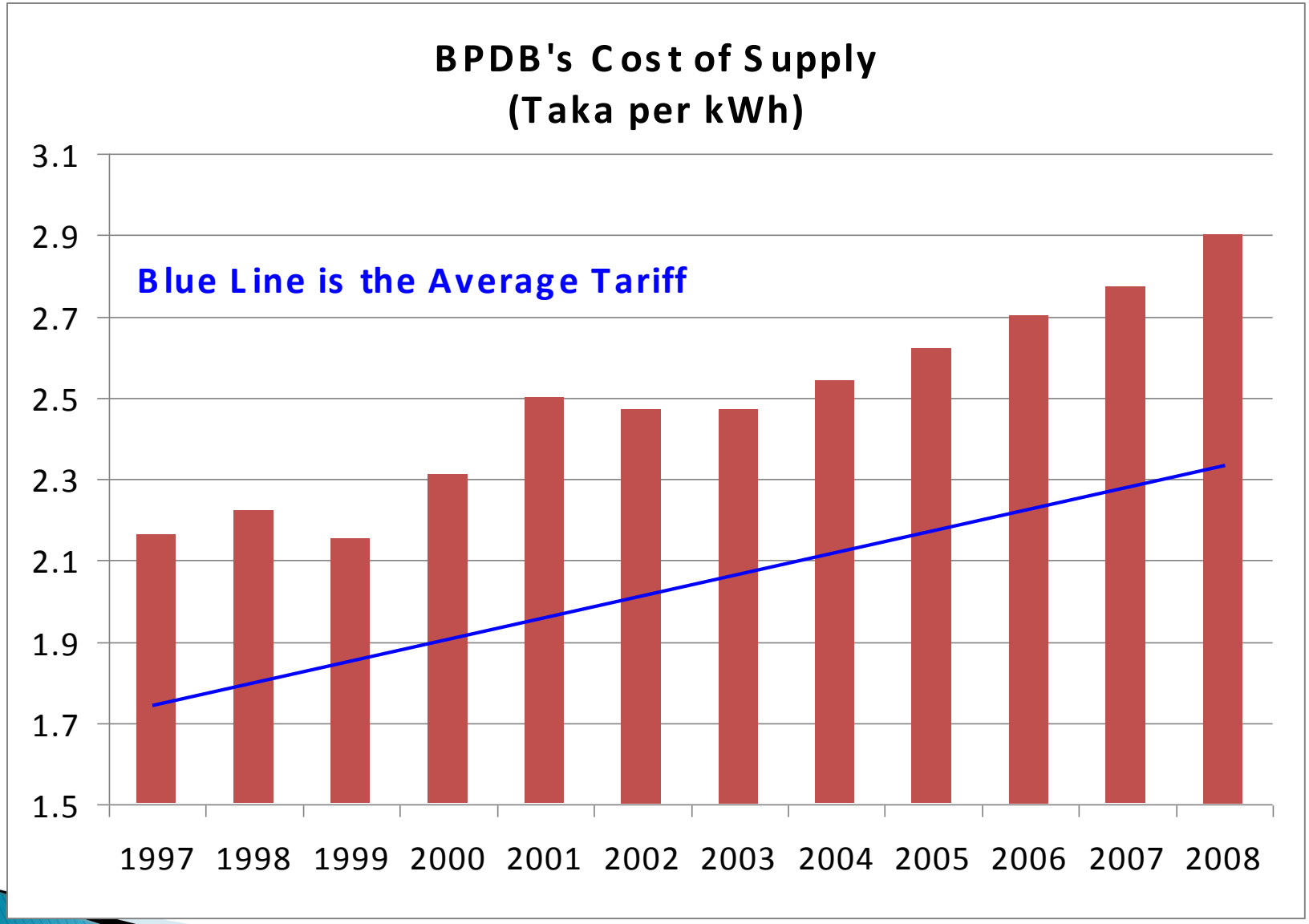
4 to 10 cents per kWh
(Tk 3-8/kWh)

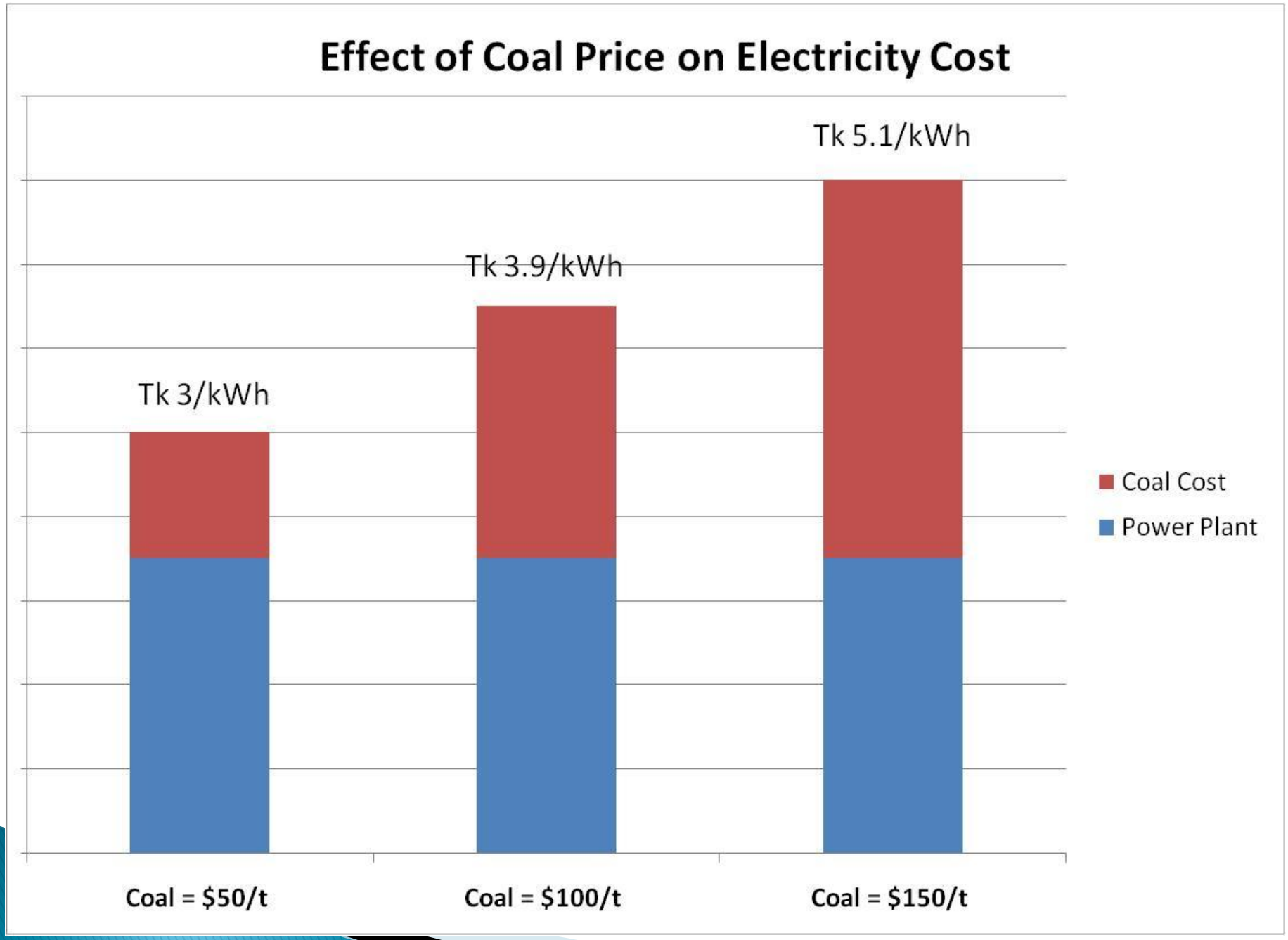
Issues Involved in Electricity Trading: Tariff

Cost of generating electricity (pence per kWh)




Natural Gas Tariff for Different Consumers
($ per 1000 cubic feet)
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
$2/MCF
Power
Fertilizer
Industry
Commercial
Captive power
Domestic Metered


BPDB's Cost of Supply
(Taka per kWh)
Blue Line is the Average Tariff
3.1
2.9
2.7
2.5
2.3
2.1
1.9
1.7
1.5
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008


Effect of Coal Price on Electricity Cost
Tk 5.1/kWh
Tk 3.9/kWh
Tk 3/kWh
Coal Cost
Power Plant
Coal = $50/t
Coal = $100/t
Coal = $150/t

NUCLEAR

Benefits

- Cheap electricity
- Energy security
- Fuel diversification

DIS-BENEFITS

- Very high initial investment. And, WB, ADB, IFC will not provide any funds
- Other problems: (i) Technology (ii) Management (iii) Fuel (iv) Waste Fuel (v) Accident and Security
- Transport and Handling of fuel and waste poses huge risks
- After so much trouble it will provide only 5-10% of future demand (2030)

Nuclear – why the time has not come?

1. Very Expensive, and we don't have the money? No one other than technology supplier will help us
2. **Merchant Nuclear Power is more expensive than imported coal**
3. We will have to employ foreign operators for at least 3 years, which will increase cost
4. Site problems: population density too high
5. AND, most important, can we manage an accident

LNG for Power

- LNG prices are nowadays tagged to oil prices. LNG prices will therefore keep on increasing

- LNG will cost $10-12 per thousand cft (we buy IOC's share of gas at $3 per thousand cft; new offshore price $4.6+pipeline cost)

- LNG is too expensive for electricity generation compared to even imported coal

- In the future, if domestic retail electricity price can be increased, then LNG can be considered

- But, LNG can be acceptable for other uses even now

We only talk about POWER PLANTS

- Where will the primary fuel come from?
- Can we afford imported fuels (oil, LNG, coal)?
- What about Transmission and distribution infrastructure?
- What about system loss?
- What about the Ministry's capability of managing all these?

So, what is the future?

- **We have to find the NEW GAS – A vigorous exploration program is needed**
- If we continue to use gas at a high rate, even new gas (**32.5 Tcf**) will be exhausted by **2036**
- Therefore, we urgently need to **diversify**
- **COAL + GAS** can smoothly take us to **2050**
- After that, most countries will have to depend on **RENEWABLES, and we have to also**

What are our options for primary fuel for electricity generation?

Cannot devote gas to new power plants;

Do not have hydro potential;

Do not have the money to build more than 1000 MW of Nuclear by 2018;

What then is our realistic option?

Can it be anything but coal

Best option is own coal because importing and managing large quantities of bulky coal is not only difficult, but is also expensive. Moreover, ecologically sensitive areas will be impacted

Coal: Resources and reserves

- Resources: 3300 million tonnes
- Proven reserves: 884 million tonnes
- 5 coalfields:

  Barapukuria, Khalishpir, Phulbari, Jamalgonj, Dighipara
- There is strong evidence that Jamalgonj coal deposit has 500 BCF of coal-bed methane (CBM)
- Huge controversy regarding open-pit mining. Environmentalists opposing it vehemently

What is our coal situation?

- In 5 coal fields we have 3300 million Tons of high grade (low sulfur, low ash) coal
- If we use underground mining we will be able to extract less than 30%
- If we use open pit mining we can extract more than 80%

A Probable Coal Consumption Scenario

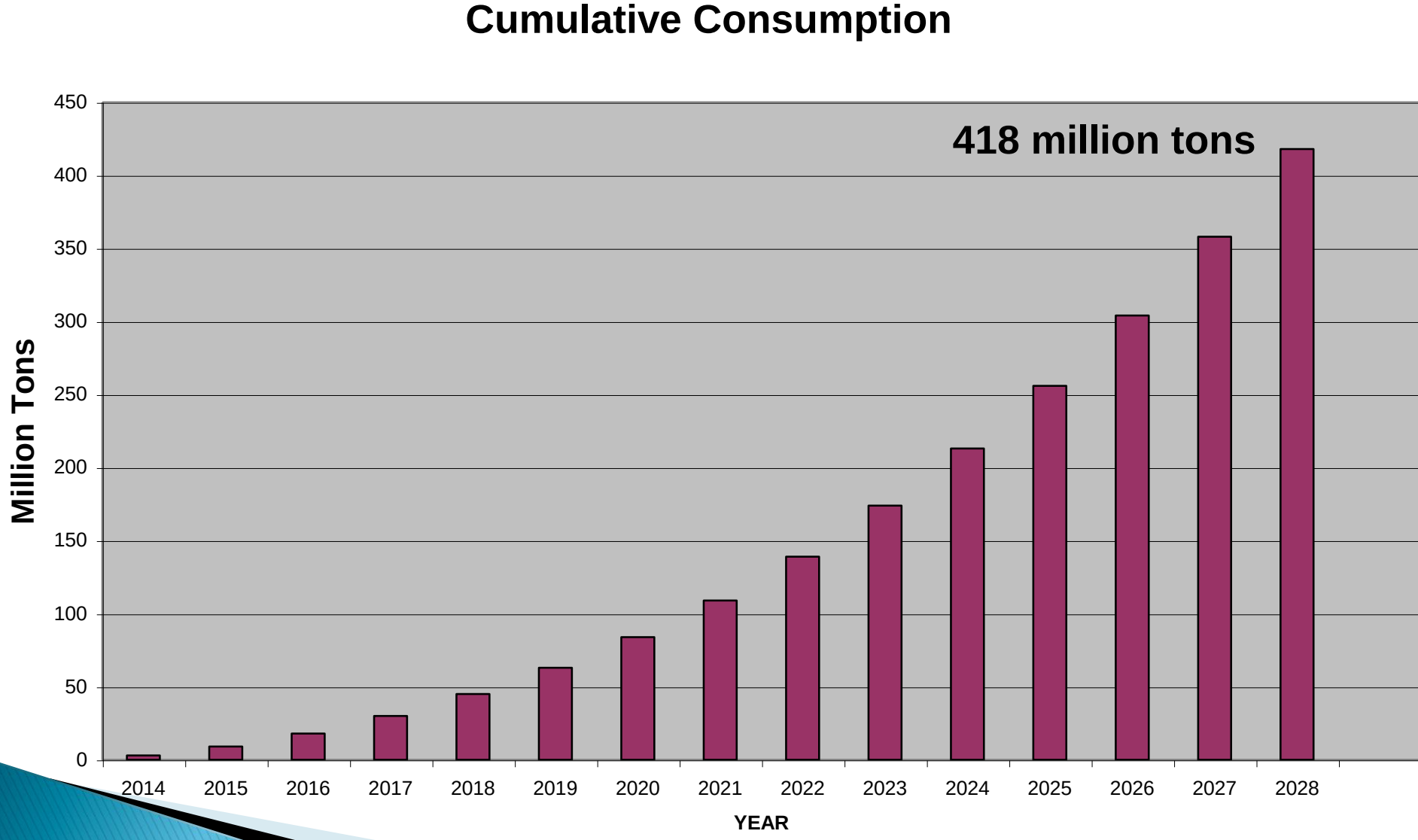
1000 million tons (1 billion ton)

2014	1000 MW		3 m t
2015	1000 MW	2000 MW	6 m t
2016	1000 MW	3000 MW	9 m t
2017	1000 MW	4000 MW	12 m t
2018	1000 MW	5000 MW	15 m t
2019	1000 MW	6000 MW	18 m t
2020	1000 MW	7000 MW	21 m t
2021	1500 MW	8500 MW	25 m t
2022	1500 MW	10000 MW	30 m t
2023	1500 MW	11500 MW	35 m t
2024	1500 MW	13000 MW	39 m t
2025	1500 MW	14500 MW	43 m t
2026	1500 MW	16000 MW	48 m t
2027	2000 MW	18000 MW	54 m t
2028	2000 MW	20000 MW	60 m t

418 Mtons

Even this aggressive coal consumption scenario uses 42% of the 1 billion tons

COAL – Electricity Generation



A coal import scenario

- 2600 MW At 75% capacity factor in 25 years would generate about 450,000 GWh
- For 2600 MW annually 7.5 million tons of coal would be required. If $50 extra is paid,
- 7.5 million Ton/year $\times$ $50/Ton $\times$ 25 years = **9.4 billion dollars**
- **Without deep seaport even 2000 MW is difficult**

A coal import scenario

- 5000 MW At 75% capacity factor in 25 years would generate 820,000 GWh
- For 5000 MW annually 15 million tons of coal would be required. If $50 extra is paid,
- 15 million Ton/year $\times$ \$50/Ton $\times$ 25 years = 18.75 billion dollars

System Loss

- How can an organization that is losing 10-12% of its earnings survive?
- Future growth in electricity sector will depend critically on how well system loss is managed
- Technical system loss is also important in Bangladesh because it is too high
- Station's own use also needs to be addressed

An electricity expansion plan can never be achieved unless,

- Pricing issues are resolved
- Financing is secured
- Energy sector reform is undertaken
  - High quality motivated workforce
  - Incentive based pay structure
  - Adequate maintenance budget
  - Quick decision making independent board
  - No bureaucratic and political interference

Energy Sector Funds Requirement up to 2020

Gas Sector	
Purchase of IOC gas	US$ 5.3 billion (US$ 4.5 – 6.0 billion, depen on how much IOC gas is bou
PB Gas Supply Augmentation	US$ 0.6 billion (only from existing fields)
Gas Infrastructure Development (6^{th} five-year plan – actual)	US$ 1.7 billion (plan submitted by Petrobang
Gas Infrastructure Development (7^{th} and 8^{th} five-year plan – estimate)	US$ 4.0 billion (requirement to supply 6% ga demand growth)
Subtotal(A)	**US$ 11.6 billion**
Power Sector	
New generation capacity 10000 MW (IPP:PDB ratio 1:2)	
IPP payment (existing+new), Average 2000 MW for 18 years	US$ 5.4 billion (without gas cost, 2 cents/kW average price during 2002-2
PDB Power Plants (6700 MW)	US$ 2.8 billion
Transmission and Distribution	US$ 4.2 billion
Subtotal (B)	**US$ 12.4 billion**
Grand Total (A+B)	**US$ 24 billion**

What are our options?

BEST

WORST

1. Own Coal (at $70 - $80 per ton)
2. Imported Coal (at $120-150 per ton)
3. Electricity Import from India, Nepal or Bhutan (price Tk 5 to Tk 7 per kWh)
4. Pipeline gas from Myanmar (????)
5. LNG (at $ 10-12 per MMBtu)
6. Energy Plantation in Myanmar
7. Renewables

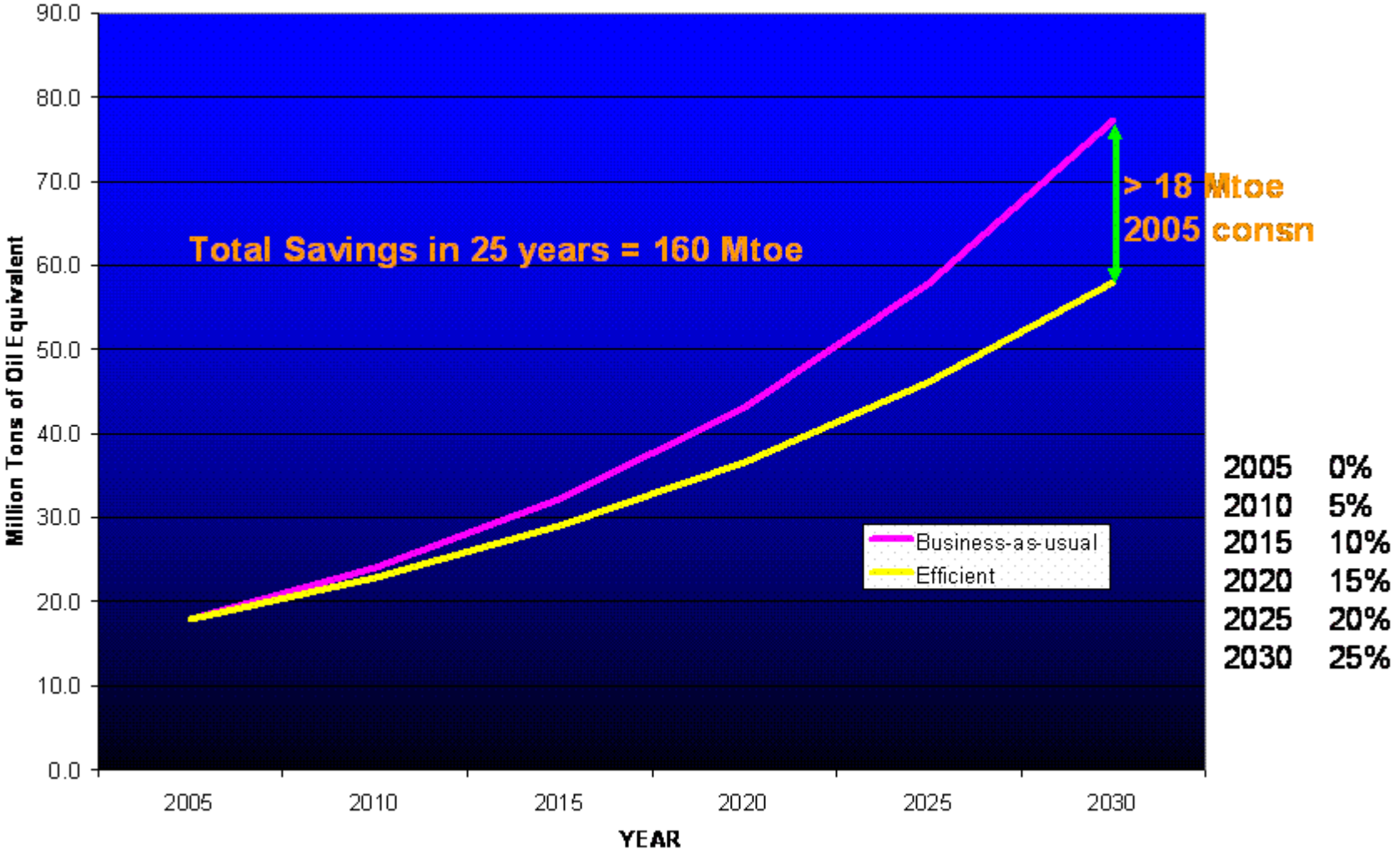
The Era of CHEAP ENERGY is over

We must control demand
Reduce wastage
Use the best energy consuming equipment

History of low prices!

- All Governments since 1972 have promised citizens affordable energy
- Up to 1990, it was OK; we had zero-price gas, and, power plants built through bilateral donor support
- Since 1990, ELECTED Governments found it too unpopular to tackle the issue of: increasing gas and electricity prices
- Utilities were left to shoulder the burden: from SURPLUS to SUBSIDY

Impact of Conservation, Efficiency and Renewables



An energy efficient path as shown by bottom line will lead to an annual savings of 18 Mtoe in 2030, which was the total annual consumption in the year 2005

Energy Modesty

- Conserve as much energy as possible
- Use super efficient devices
- Use cogeneration extensively
- Design cities and travel differently
- Change behavior so that less energy is required

Thank You!