Natural Gas Industry and Considerations for Ghana

Center for Energy Economics

Wednesday, February 15, 2006

NARUC Winter Meetings

Washington D.C.

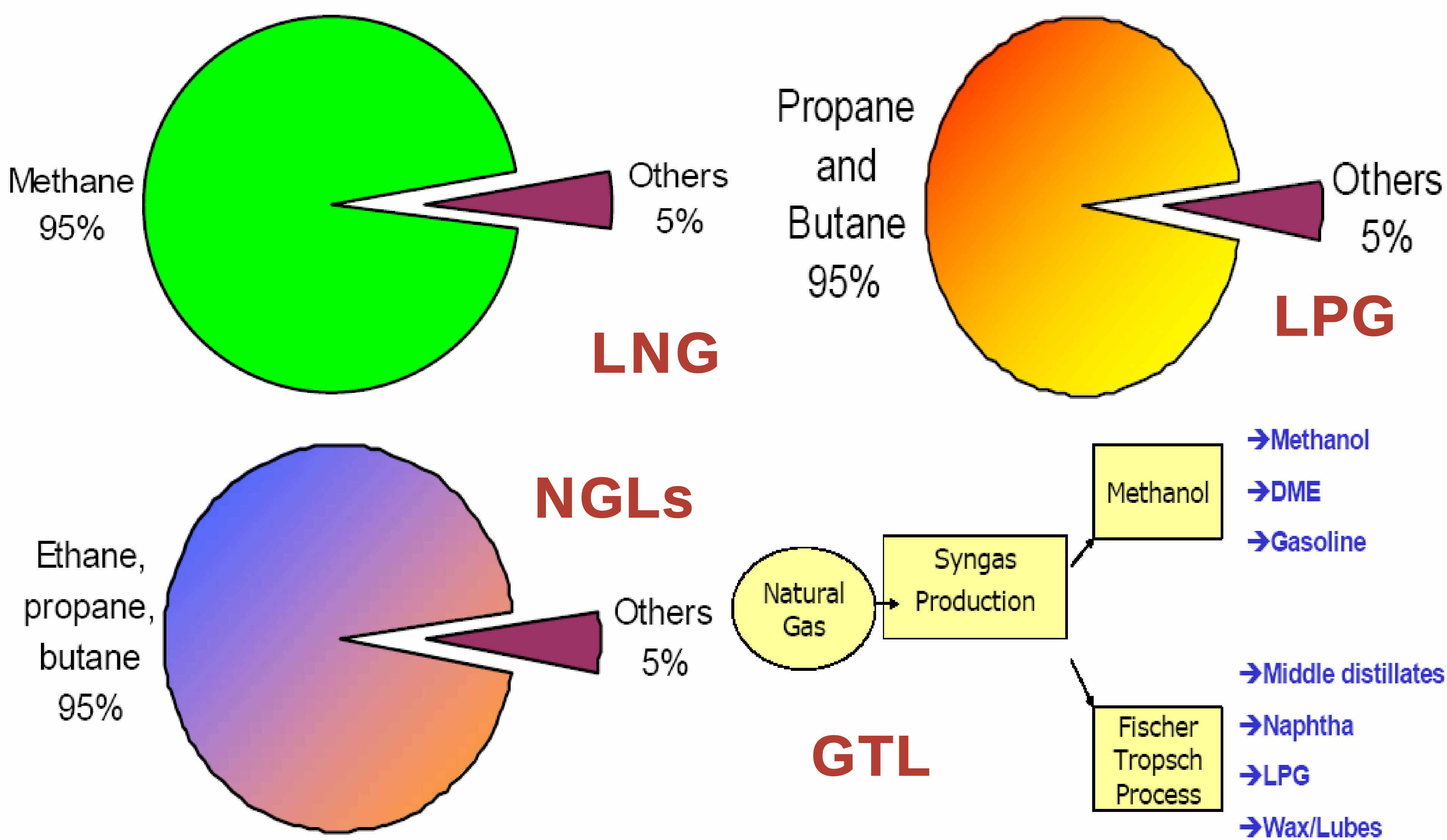
What is Natural Gas?

- A combustible, gaseous mixture of simple hydrocarbon compounds, mostly methane.

Methane	CH_4	70-90%
Ethane	C_2H_6	
Propane	C_3H_8	0-20%
Butane	C_4H_{10}	
Carbon Dioxide	CO_2	0-8%
Oxygen	O_2	0-0.2%
Nitrogen	N_2	0-5%
Hydrogen sulphide	H_2S	0-5%
Rare gases	A, He, Ne, Xe	trace

Source: www.naturalgas.org

What it is not!



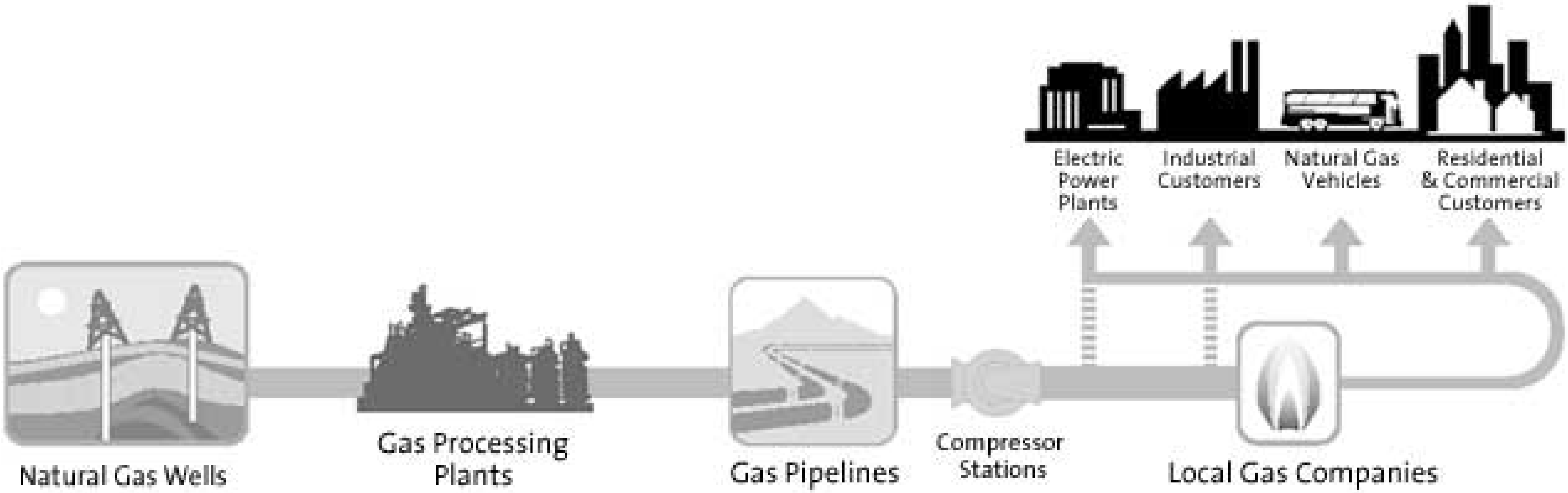
Where is it Used?

- Residential uses: cooking, water heating, space heating and/or cooling.
- Commercial uses: space heating, water heating, and cooling.
- Transportation uses: CNG, LNG as fuel (~2.5 million vehicles worldwide)
- Power generation: Steam, simple cycle, combined cycle, micro turbines, fuel cells

Where is it Used?

- Industrial uses:
  - base ingredients for such varied products as plastic, fertilizer, anti-freeze, pharmaceuticals and fabrics
  - pulp and paper, metals, chemicals, petroleum refining, stone, clay and glass, plastic, and food processing
  - waste treatment and incineration, metals preheating (particularly for iron and steel), drying and dehumidification, glass melting, food processing, and fueling industrial boilers

Physical Infrastructure



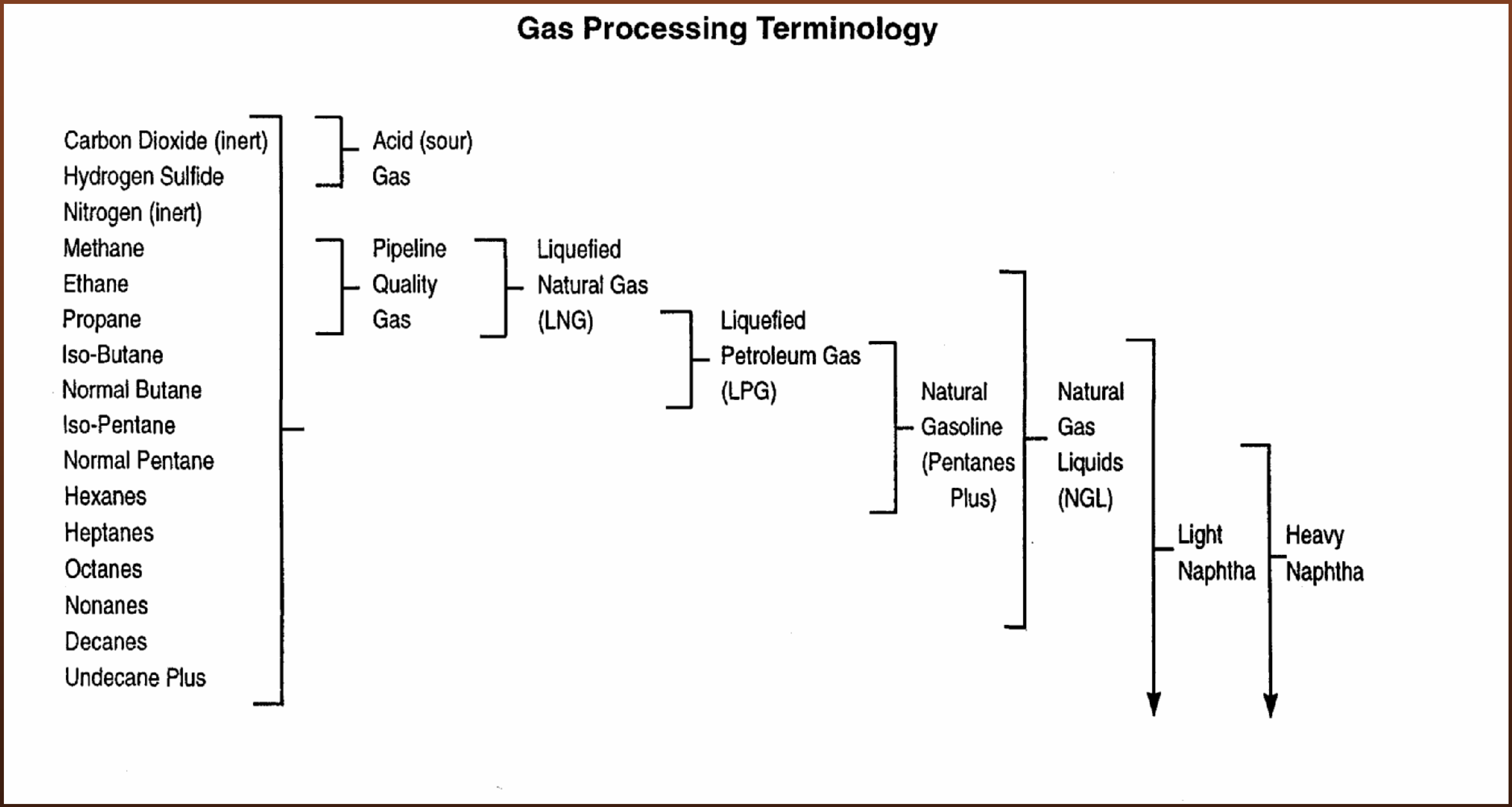
Gathering

- Removal of basic sediment & water
- Collection through field and gathering lines for removal of free liquids and extraneous materials
- Gas may also be sweetened with chemical agents to neutralize sulfur compounds and carbon dioxide
- From 2 inches to 24 inches in diameter
- Higher pressures than transmission lines—up to 2160 psi (≈150 bar)
- Generally, feed gas processing facilities

Processing

- Liquefy the heavier molecules that occur in the gas stream in order
  - to make the gas production marketable and safe for pipelines, and
  - to increase profits from the lease (non-methane molecules are marketable)
- “Wet” gas contains a higher proportion of larger molecules as well as oil condensate as opposed to ”dry” gas.

Natural Gas Products



Pipeline Transportation

- Line pipe—high strength carbon steel—seamless or welded (>24-inch)
- Strict metallurgical standards dictated by API
- Pipe joints are welded together
- Pipe Coating—Fusion Bond Expoxy (FBE)--Used to prevent external corrosion

Compressor Stations

- The compressor or pumping station is the "engine" that boosts pressure and moves gas (1,300 psi ≈ 90 bar)
- Typically installed every 40 to 100 miles - depending on number of compressors & HP, and diameter of pipe and volume to be moved
- Stations also typically have liquid separators in the form of scrubbers, strainers or filter separators.

Metering & Regulation

- Metering Stations are the "cash register" of the industry
  --Orifice meters
  --Turbine meters
  --Ultrasonic meters
  --Positive displacement meters

- Regulation serves to reduce pipeline pressure to an acceptable level for distribution and end use

Operations

- Mainline valves spaced 5 to 20 miles apart depending on population density and safety codes
- Allow isolation of pipeline segments for maintenance and emergencies

Operations

- Supervisory Control and Data Acquisition (SCADA) is a communication system to monitor and control certain equipment on the pipeline
- Transmits operating status, flow volumes, pressure and temperature data from compressor stations, M&R facilities and valves to a gas control facility
- Facilitates nominations, scheduling procedures, allocations & billing

Operations

- Integrity Assurance
  --Aerial Patrols
  --Pipeline Markers
  --Damage Prevention Program
  --Cathodic Protection
  --Pipeline Pigging
  --Leak Detection Surveys

Distribution

- From citygate to customers
- Small-diameter pipe (<12-inch)
  - Traditionally steel, but increasingly polyethylene (PE)
- 3 psi of pressurization
- Mercaptan (NG is odorless)
- Metering & billing
- ~50% of end-user price (U.S.)

Storage

- Gas storage supplements pipeline deliverability in peak demand winter periods
- Generally, storage fields are depleted reservoirs, aquifers or salt caverns
- In distribution regions, there are smaller LNG storage facilities used for "peak shaving"

Depleted reservoirs

- 50% base gas
- Advantages:
  - Typically near existing regional pipeline infrastructure.
  - Already a number of useable wells and field gathering facilities.
  - Low risk of reservoir “leaks”.
- Disadvantages:
  - Working gas volumes are usually cycled only once per season.
  - Substantial amount of well maintenance & monitoring to limit wellbore leaks.

Aquifer

- Advantages:
  - Typically, close to end user market.
  - High deliverability high quality reservoirs + water drive.
  - The ability to cycle the working gas volumes more than once per season.
- Disadvantages include:
  - A high level of geological risk - risk for substantial reservoir leaks.
  - Water production is often experienced during the withdrawal cycle, increasing operating costs.
  - Due to the water drive mechanism, the base gas requirements are high (80%). A large percentage of base gas is not recoverable after site abandonment. (increases the initial capital cost).

Salt cavern

- Advantages:
  - Low base gas requirements of 25% or less.
  - Ultra-high deliverability.
  - Operational flexibility - can cycle working gas 4-5 times a year.
  - Salt caverns provide excellent seals - risk of reservoir gas leaks is small.
- Disadvantages:
  - Costly initial startup (disposal of the saturated salt water generated during the solution mining process can be costly and environmentally problematic).

Typical Firm Storage Costs[1]		
Fee	Salt Dome Storage	Reservoir Storage
Fixed Fees (based on MMBtu of capacity reserved):		
Annual Demand Charge, $MMBtu[2]	$1.00	$0.40
Variable Costs[3] (based on volume of throughput):		
Injection Fee, $/MMBtu	$0.02	$0.02
Withdrawal Fee, $/MMBtu	$0.02	$0.02
Fuel Expense, %[4]	1.0%	1.0%
Injection Days To Fill	20	180
Withdrawal Days To Deplete	10	120
Typical Number Of Cycles Per Year	4 to 5	1 to 1.5

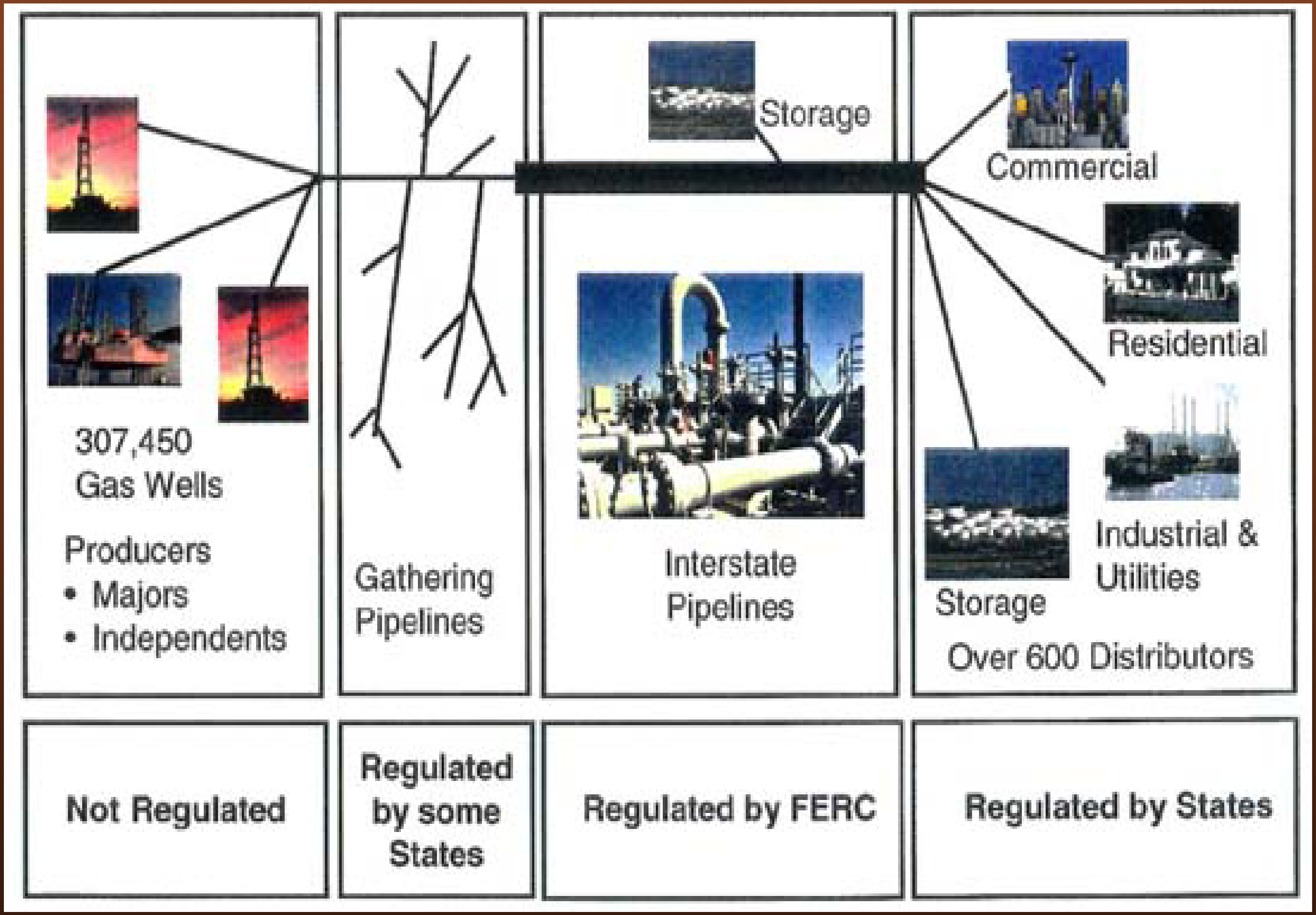
[1]Storage costs vary from facility to facility and are often based on negotiated rates. This example is for illustrative purposes only.

[2]Annual demand charges are assessed to the storage capacity reserved.

[3]Variable fees are based only on the volume actually injected or withdrawn.

[4]A percentage of the natural gas stream is used to fuel the compression required for injection into the reservoir.

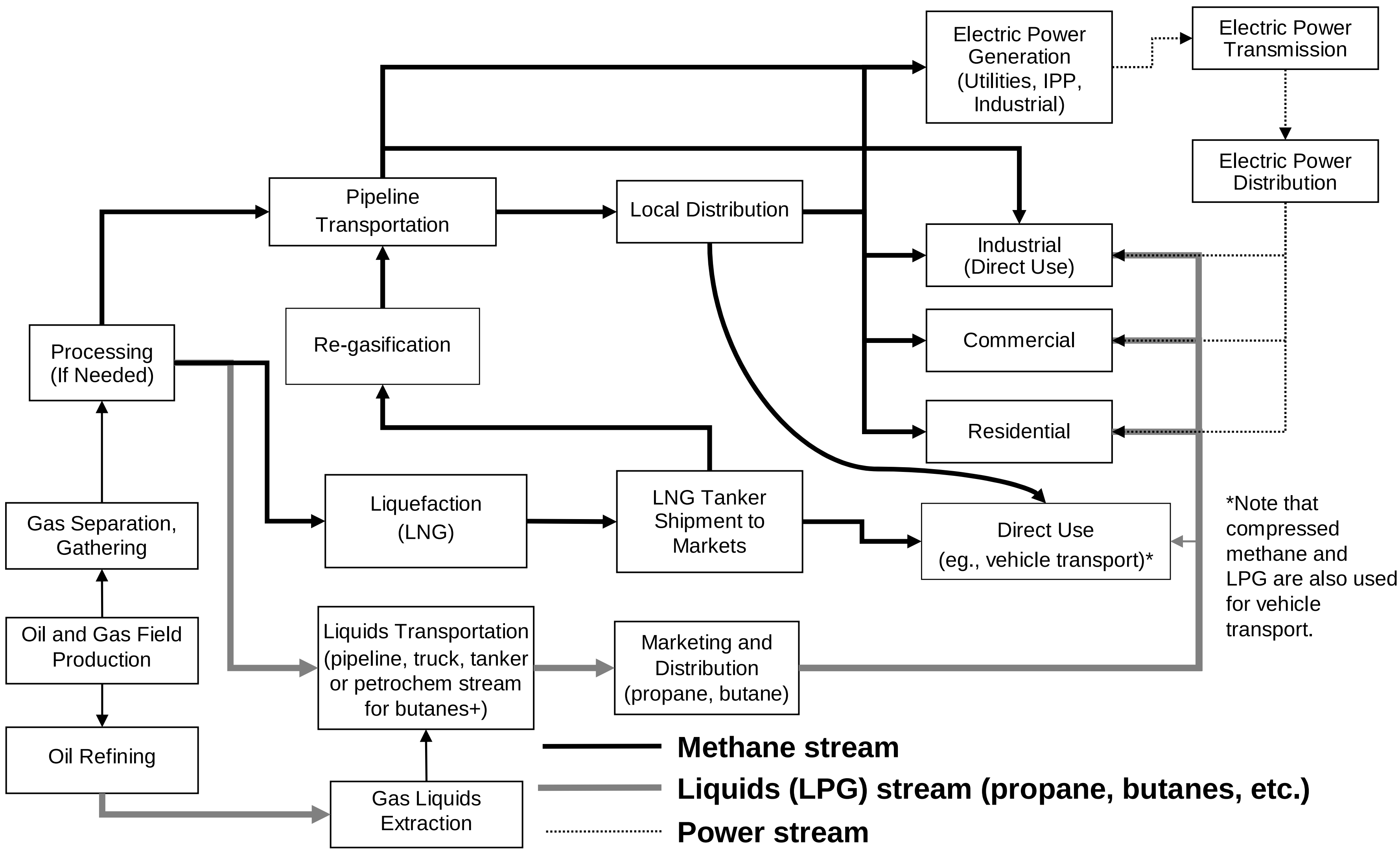
The U.S. Natural Gas Industry



U.S. Pipelines

- ~22,000 miles of gathering lines
- 237,079 miles of gas pipelines
  - 194,673 miles of long distance transmission lines,
  - 37,339 miles of field lines and
  - 5,067 miles of storage lines.
- Over 1 million miles of distribution pipelines.
- 152,005 miles of liquids pipelines.

Natural Gas Value Chain



Worldwide Natural Gas System Dynamics: Framework/Investment Issues, Role of Grids

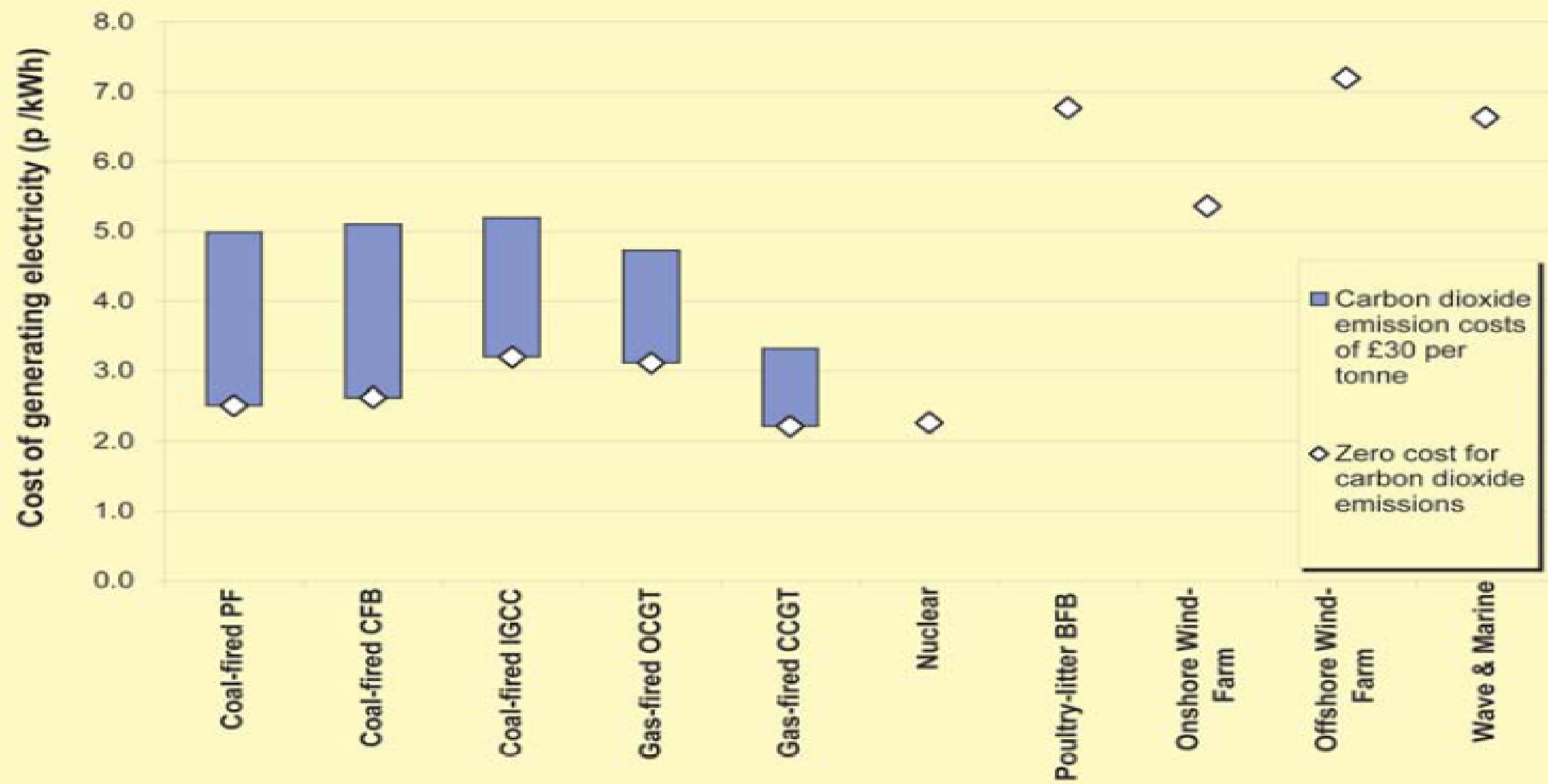
With TPA: Competitive Supply, Access, Pricing

E&P (LNG)	Profit driven; ROR decision based on expected prices; monetize stranded reserves
Power Gen	Profit driven; ROR decision based on expected prices; fuel competition for gen
Pipelines Transmission	Regulated asset optimization; market rates?
LDCs	Regulated asset optimization; proximity to final customers (gas, power); market rates?
End Users	End use based on expected prices; access to competitive supply

Cheapest fuel for power generation

Figure 1.3 – Cost of generating electricity with respect to carbon dioxide emission costs. (Zero to £30 per tonne)

Source: *The Cost of Generating Electricity,* a study carried out by PB Power for the Royal Academy of Engineering, March 2004.



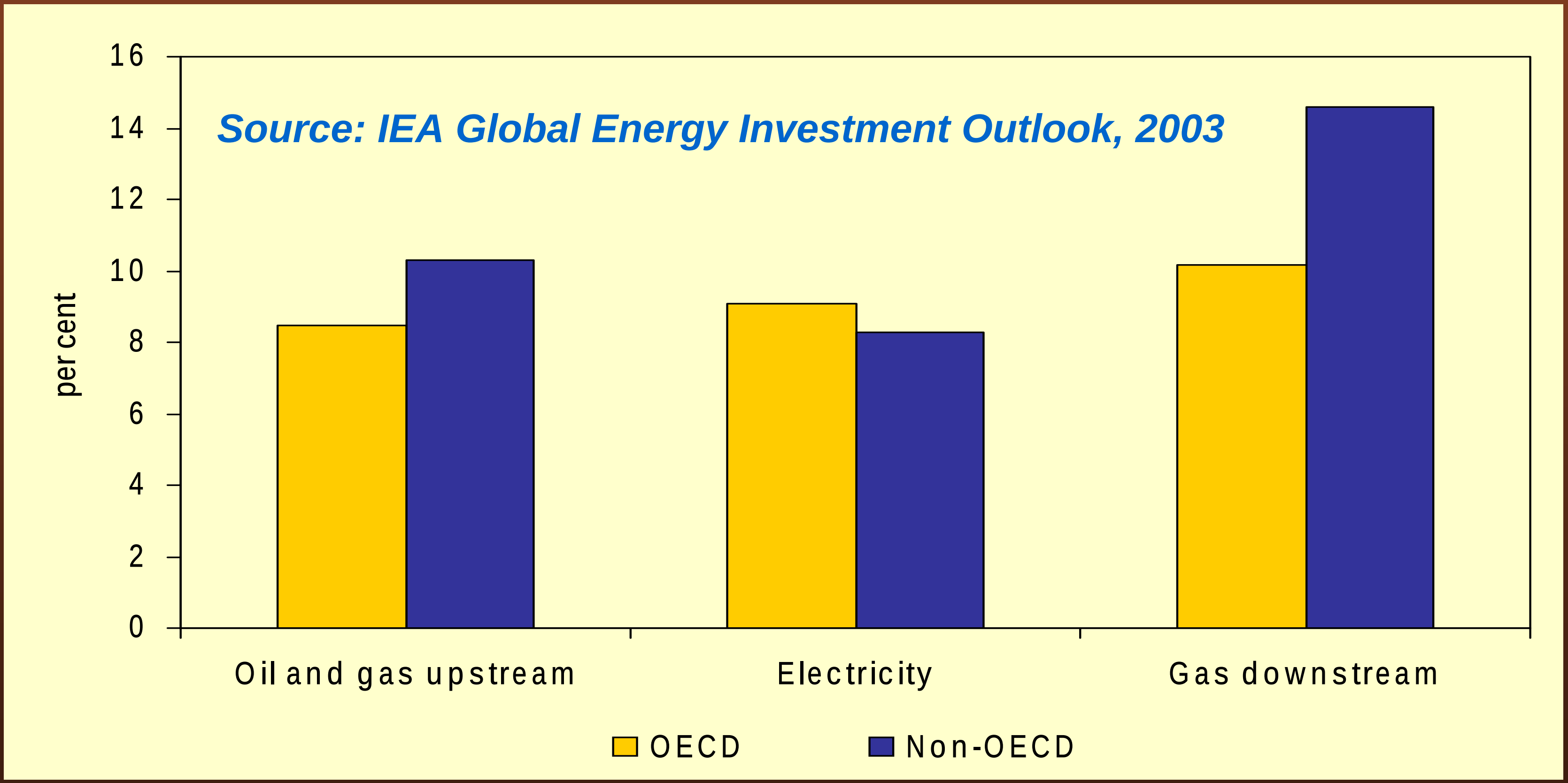
Cleanest Fossil Fuel

Fossil Fuel Emission Levels
- Pounds per Billion Btu of Energy Input

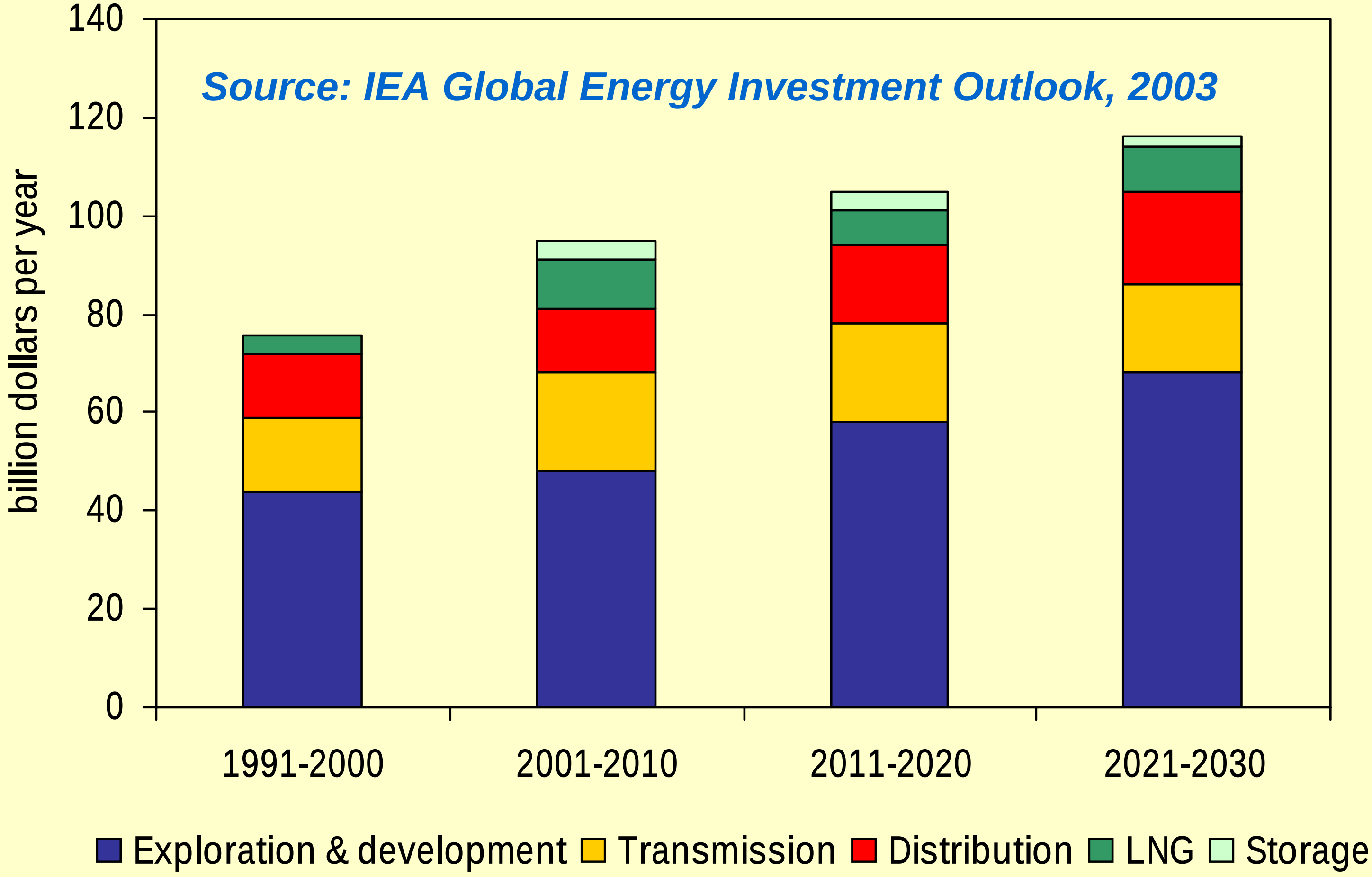
Pollutant	Natural Gas	Oil	Coal
Carbon Dioxide	117,000	164,000	208,000
Carbon Monoxide	40	33	208
Nitrogen Oxides	92	448	457
Sulfur Dioxide	1	1,122	2,591
Particulates	7	84	2,744
Mercury	0.000	0.007	0.016

Source: EIA - Natural Gas Issues and Trends 1998

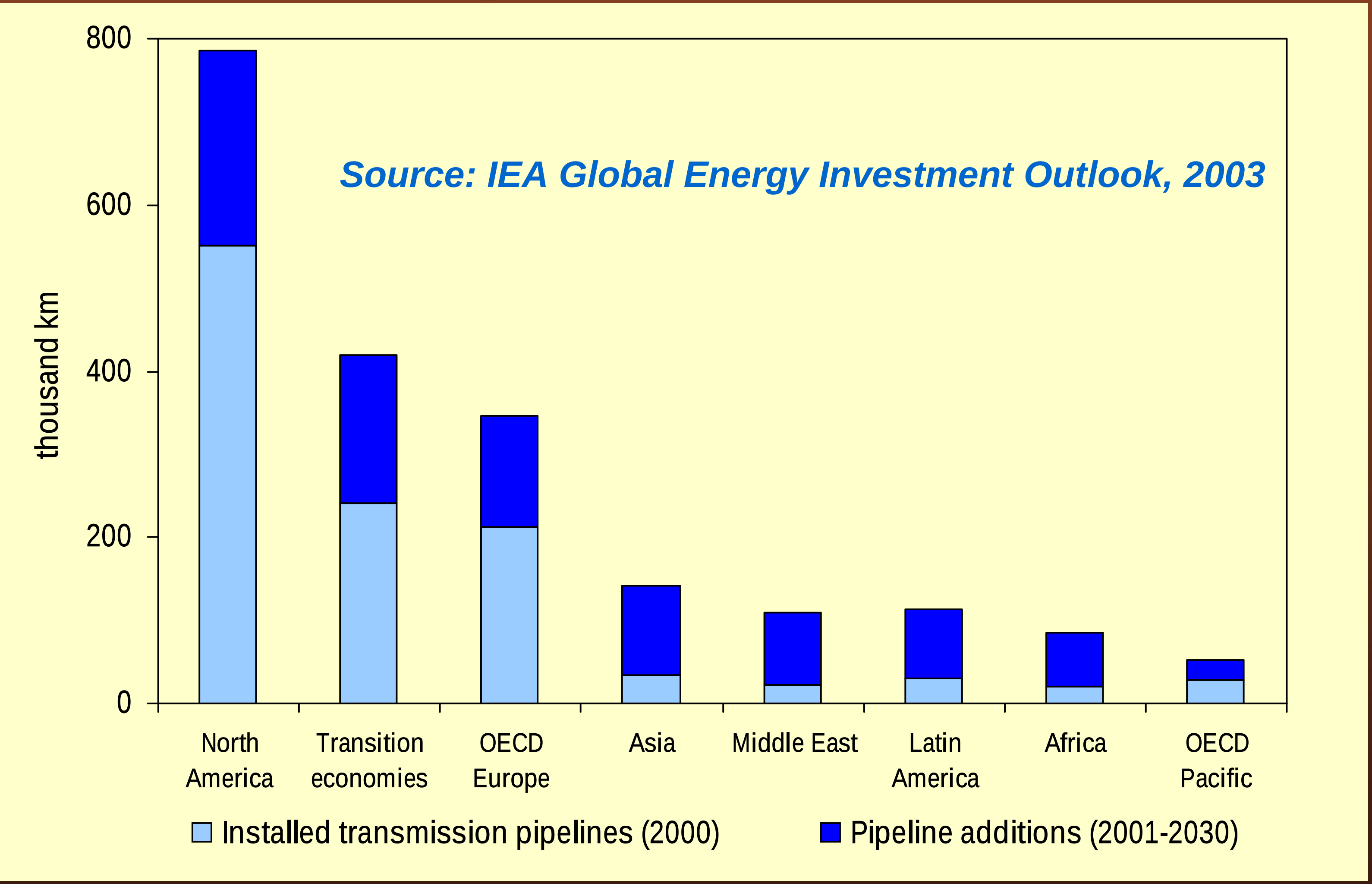
Return on Energy Investment
1993-2002



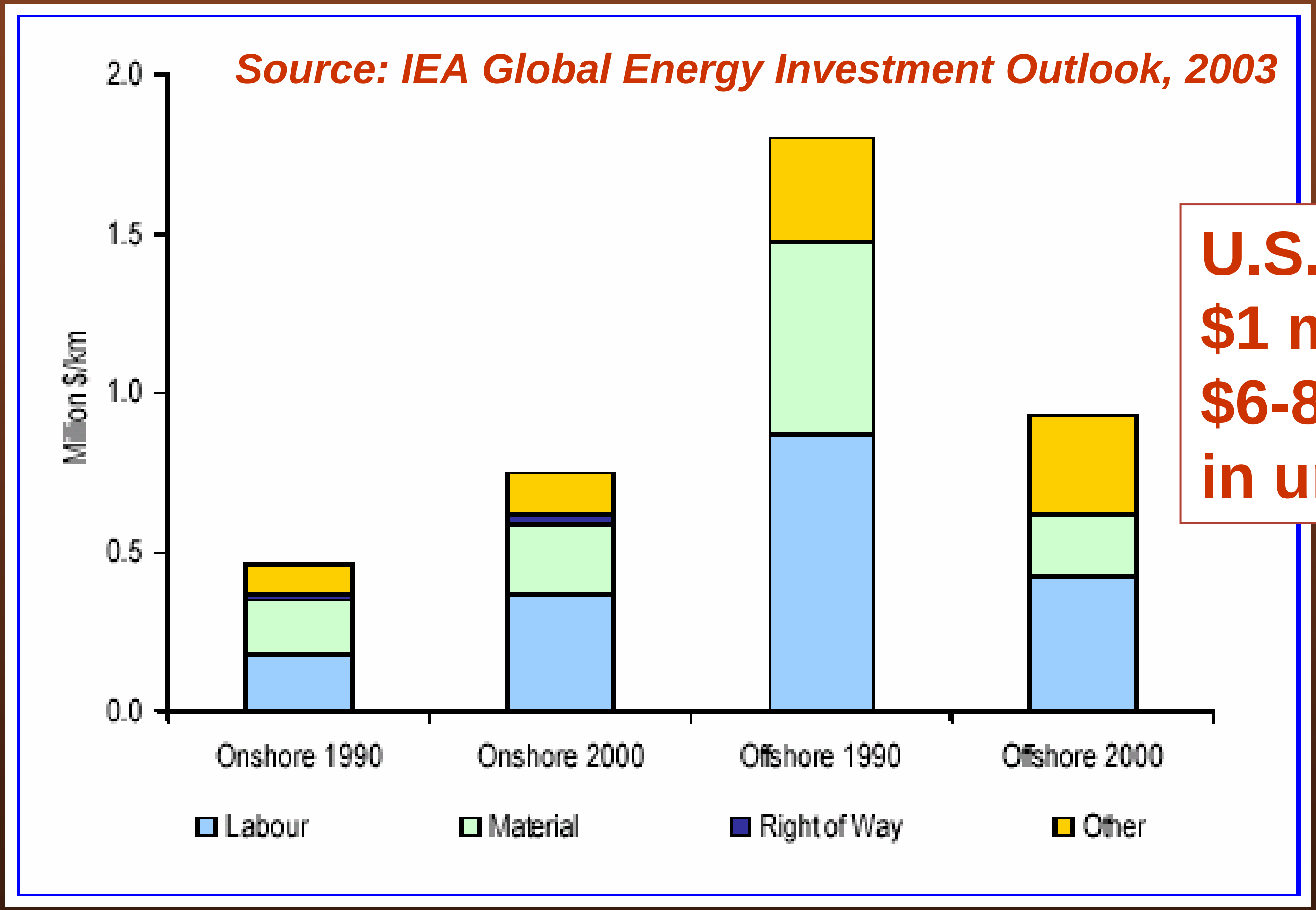
Global Gas Investment



Gas Pipeline Additions



Typical Gas Pipeline Construction Costs, Onshore vs. Offshore



U.S. average:
$1 million/mile
$6-8 million/mile in urban areas

Comparative Gas Pipeline Costs by Size (Diameter)

** Diameter weighted by length*

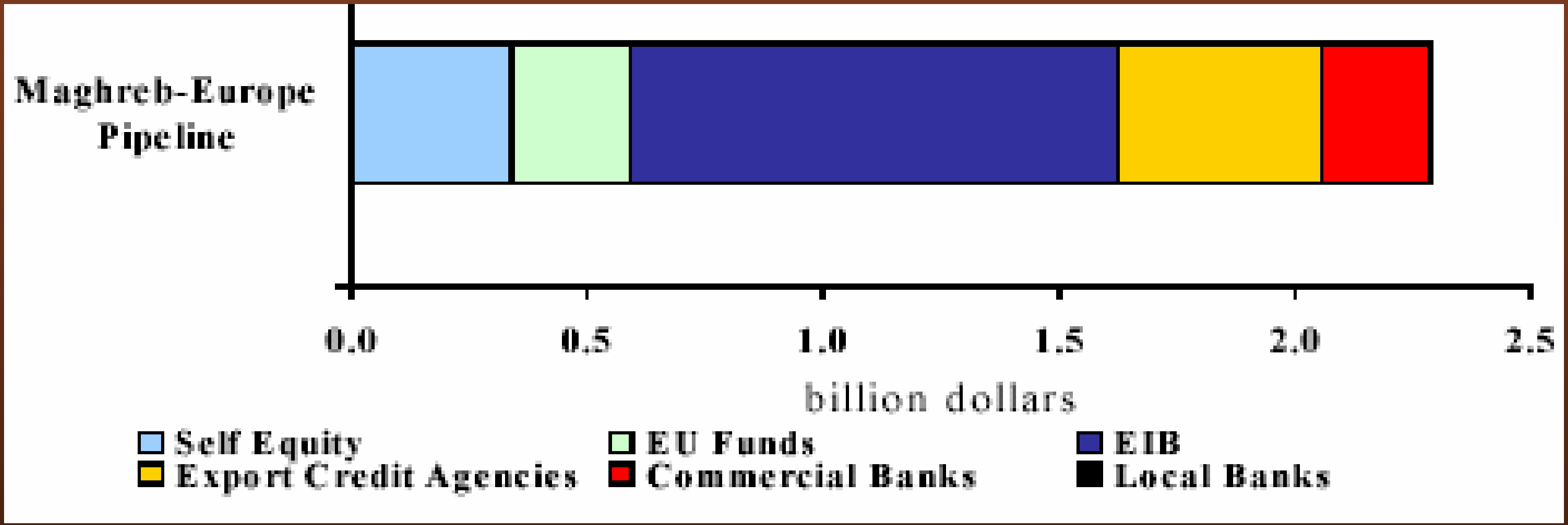
	Weighted Average* Diameter (inches)	Total Length (km)	Unit Cost (M$/inch/km)
United States	24	463,000	26
Korea	28	2,066	21
Russia	36	150,000	14
Ukraine	32	36,700	16
Brazil	23	7,700	20
Argentina	30	12,800	21

Source: IEA Global Energy Investment Outlook, 2003

Example: African Pipelines

Pipeline	Origin Destination	Capacity (bcm)	Length (km)	Year of Operation	Cost (billion $)
GME	Algeria – Spain (via Morocco)	expansion (+3)	1620	2004	0.2
Medgaz	Algeria – Spain	8	1100	2006	1.4
Galsi	Algeria – Italy	8	1470	2008	2.0
Arab Mashreq	Egypt – Jordan	n.a.	248	2004	0.2
Green Stream	Libya-Italy	8	540	2005	1.0
WAGP	Nigeria –Ghana	3	990	2005	0.6
Trans-Saharan	Nigeria -Algeria	10	4000	After 2010	7.0

Example Pipeline Financing: Africa



Example: Lat Am Pipelines

	Length (km)	Diameter (inches)	Capacity (bcm)	Investment (Million $)
Under construction				
Argentina-Uruguaiana Porto Alegre	615	20	4.4	260
Argentina-Uruguay (*Cruz del Sur*)	208	24	2.4	120
Projected				
Argentina-Brazil (*Mercosur*)	3100	36	9.1	1,800
Bolivia-Chile (*Mercosur*)	850	20	2.2	285
Bolivia-Argentina-Paraguay-Brazil (*Gasin*)	5250	n.a.	n.a.	5,000
Peru-Bolivia	900	36	14.6	900
Peru-Brazil	3550	32	11.0	3,215
Venezuela-Colombia	200		2.1	120

Regulated Infrastructure as the Conduit for Supply

Pricing Transportation

RESERVATION (DEMAND)

Fixed cost of investment

- Return on equity
- Taxes
- Long term debt
- A&G, DA, O&M

COMMODITY (USAGE)

Variable cost of operation

- O&M

The challenges:

- Rate-making style
- Pricing new capacity
- Dealing with access for new capacity
- Dealing with market power
- Balancing short term cycles and long term capital requirements

Where applicable:

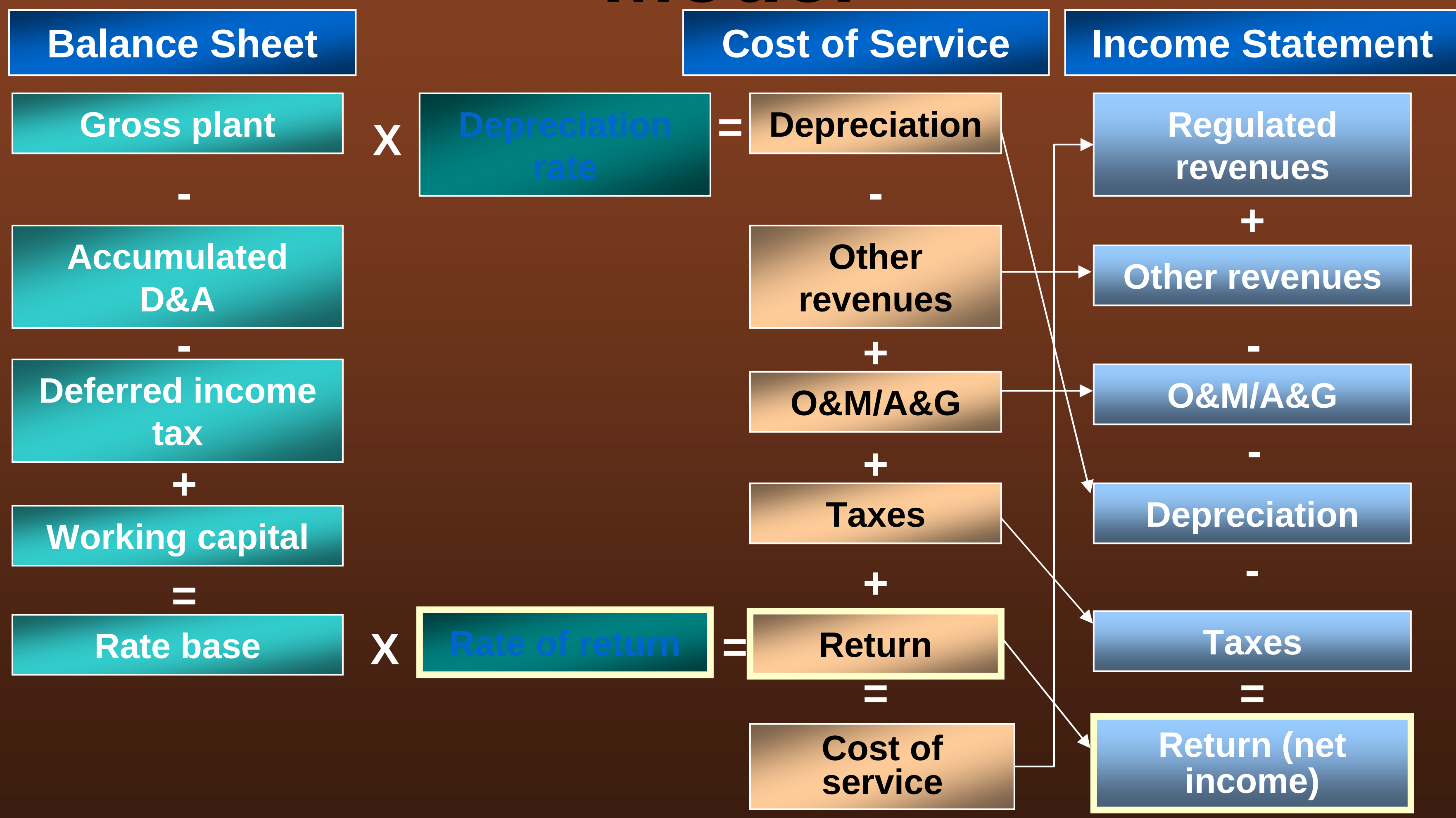
- Setting maximum allowable rates with market transparency
- Determining contestable transportation markets

U.S. - Rate of Return, or Cost of Service

ROR or COS:

- Bottom-up approach to pricing
  - The goal is to disaggregate the costs (unbundled)
  - To avoid arbitrary cost allocations
- Considerations
  - Costly regulation to implement
  - Possibilities of "gold plating"
  - Needs to be complemented with benchmarking
  - Not clear efficiency in income distributional concerns
  - It can lead to discriminatory service obligations

Cost of Service Ratemaking Model



Outside of U.S.: Price Cap

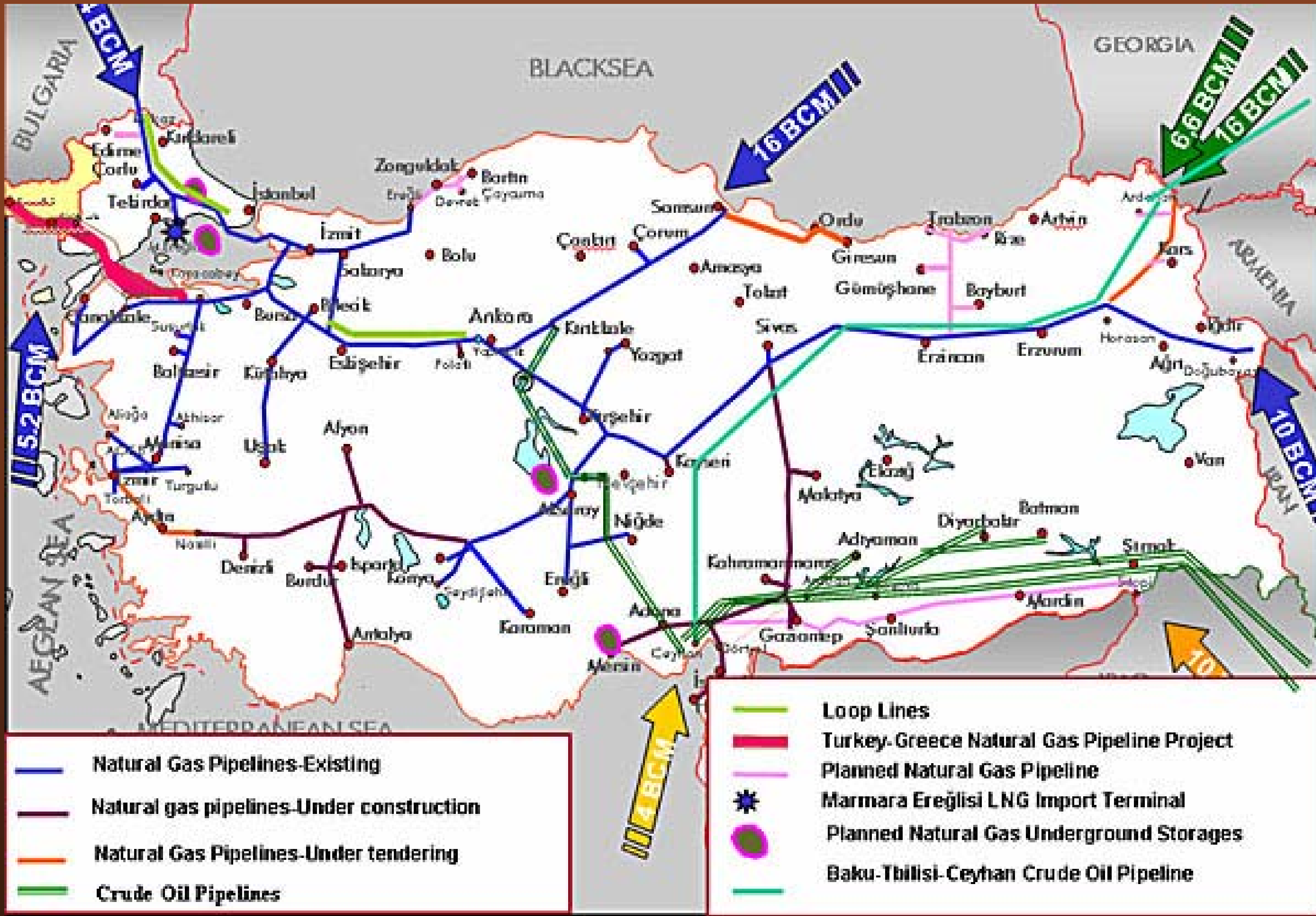
Price cap regulation (CPI-X +/- Z)

- Maximum tariff + adjustments
- In practice it resembles ROR/COS regulation when it includes net present value of future capital outlays
- The cap is on the adjustments: the price rises with inflation measured by CPI minus a productivity growth adjustment (X) +/- adjustments (Z) for unique developments (e.g. environmental or tax laws)
- Often preferred by governments because it may be easier to implement

Price Cap Yardstick

- **Benchmarking/yardstick -** Compensation based on performance of “comparable” firms
  - Provides incentives to cut costs
  - Dampens the effects of information asymmetries
  - Requires resources to develop appropriate yardsticks
  - May not be possible in some situations.
- Statistical benchmarking can reduce information asymmetries; regulatory agencies can share information
- The best comparisons are on some overall dimension
- Publication of overall performance comparisons can put pressure on poorly performing firms

Awarding LDC franchises – Turkish case study


BLACKSEA
GEORGIA
BULGARIA
ARMENIA
IRAN
AEGEAN SEA
MEDITERRANEAN SEA
16 BCM
6.6 BCM
16 BCM
5.2 BCM
10 BCM
4 BCM
Kırklareli
Edirne
Çorlu
Tekirdağ
İstanbul
Zonguldak
Bartın
Samsun
Ordu
Trabzon
Artvin
Rize
Giresun
Gümüşhane
Bayburt
Çankırı
Çorum
Amasya
Tokat
Sivas
Erzincan
Erzurum
Kars
Iğdır
Ağrı
Van
İzmit
Sakarya
Bolu
Bilecik
Bursa
Ankara
Kırıkkale
Yozgat
Eskişehir
Kütahya
Balıkesir
Çanakkale
Manisa
İzmir
Turgutlu
Aydın
Uşak
Afyon
Kırşehir
Kayseri
Malatya
Elazığ
Aksaray
Niğde
Denizli
Burdur
Isparta
Konya
Ereğli
Karaman
Antalya
Mersin
Adana
Gaziantep
Şanlıurfa
Mardin
Adıyaman
Kahramanmaraş
Diyarbakır
Batman
Şırnak
Loop Lines
Turkey-Greece Natural Gas Pipeline Project
Planned Natural Gas Pipeline
Marmara Ereğlisi LNG Import Terminal
Planned Natural Gas Underground Storages
Baku-Tbilisi-Ceyhan Crude Oil Pipeline
Natural Gas Pipelines-Existing
Natural gas pipelines-Under construction
Natural Gas Pipelines-Under tendering
Crude Oil Pipelines

General Requirements

- Qualified companies submit bids on distribution tariff
  - 3 lowest offer further discounts
  - Lowest distribution tariff wins bid (fixed for the first 8 years)
- Must start construction in 6 months
- Must start gas delivery in 18 months
- Must connect everyone in 5 years
- 30-year franchise

Prequalification of Bidders

- financial viability - equity, balance sheets and income statements and documents and letters of intent showing how the investment shall be financed
- experience of the bidder or the firms which will provide design, construction and operation services to the bidder, in the natural gas sector and other sectors.

Case study – City of Erzurum

- ~375,000 residents
- Average January temperature -11°C
- 81 active industrial plants
  - mostly small to medium enterprises
  - 40 non-operational
- New industrial park
- Mining opportunities
- $1.2 billion of GDP

Case study – City of Erzurum

- Five qualified bidders
- Eventual winner’s first bid was 0.078 cent/kWh, or 0.242 $/MMBtu
- After further discounting, 0.046 cent/kWh, or 0.143 $/MMBtu
- $180 fee per connection (-$30 for the meter)

Case study – City of Erzurum

- Investment
  - $4.8 million in 2004 for 122 km of pipe + other facilities
  - 2005-33: $11.2 million for 261 km of pipe + other facilities
- 40,000 residential customers by 2005, consuming 86 MMcm/year
- 42 MMcm/year C&I load
- 6.4 bcm cumulative 2004-2033

Awarding LDC franchises – Northern Ireland case study

based on

Regulation in New Natural Gas Markets – The Northern Ireland Experience **by Peter Lehmann, Note No. 179 Public Policy for the Private Sector, The World Bank Group**

General Characteristics

- Drivers
  - Environmental reasons
  - Desire to attract investors
  - Conversion of a power plant to NG
- 600,000 households
  - 250,000 in greater Belfast
- Small C&I market
- Combined license for distribution & supply

Monopoly in transportation

- Exclusive distribution license for 20 years
  - to attract investors
  - to mitigate market, financial and technical risks
  - to optimize network construction
  - to simplify regulation & supervision

Development obligations

- Licensed LDC
  - to complete network in 12 years
  - to perform in each district in a specific order and within a specific timeframe
  - to install a pipe within 50 m of 90% of the homes in each district (challenged by the LDC)
- Challenges: monitoring & penalties

Distribution tariff

- Consumer rate = NG supply charge + distribution tariff
- Standard approaches are not appropriate
  - asset base starts from zero → high tariffs early on, BUT
  - need low rates to persuade consumers to switch to NG early on

Distribution tariff

- Expected 8.5% real pretax return on cash flows over 20 years
- Problem: uncertainty of forecasts
  - capital and O&M costs
  - sale levels
  - mixture of residential and C&I users
- Solution: reforecast every 5 years

Distribution tariff

- LDC will retain any gains or bear any losses based on revised forecast → incentive for market development
- Prices to be adjusted such that NPV stays the same as the original NPV
- Controversy: allocation of costs across different consumer segments

Competition in supply

- Avoided in a new market
- There are benefits to having an integrated network development approach
- It is difficult for regulators & LDC to allocate costs to transport & supply
- LDC got 4-5 years of monopoly supply status for small users and 2-3 years for larger users

Prices to final users

- No regulation for the first 5 years
- Counting on competition between fuels (NG v LPG v heating oil)
- After 5 years, regulator may decide on a price formula for small users (<7 million cubic feet a year)

Today

- LDC signed up 93,000 customers since 1996
- Growing at 20% a year
- Invested almost $500 million in infrastructure (~3,000 km of pipe)
- Not expected to go cash positive until 2006 – 10 years after the investment started

Awarding LDC franchises – Mexico case study

based on

Designing Natural Gas Distribution Concessions in a Megacity: Tradeoffs between Scale Economies and Information Disclosure in Mexico City by Juan Rosellon & Jonathan Halpern, World Bank, Latin America and the Caribbean Region, Finance, Private Sector, and Infrastructure Sector Unit

General characteristics

- Bid-based concessions
  - winner is the lowest average revenue for the first five-year period
  - minimum coverage: 350,000 for Federal District and 300,000 in State of Mexico consumers at the end of 5 years
  - $1 billion in investment commitments

General characteristics

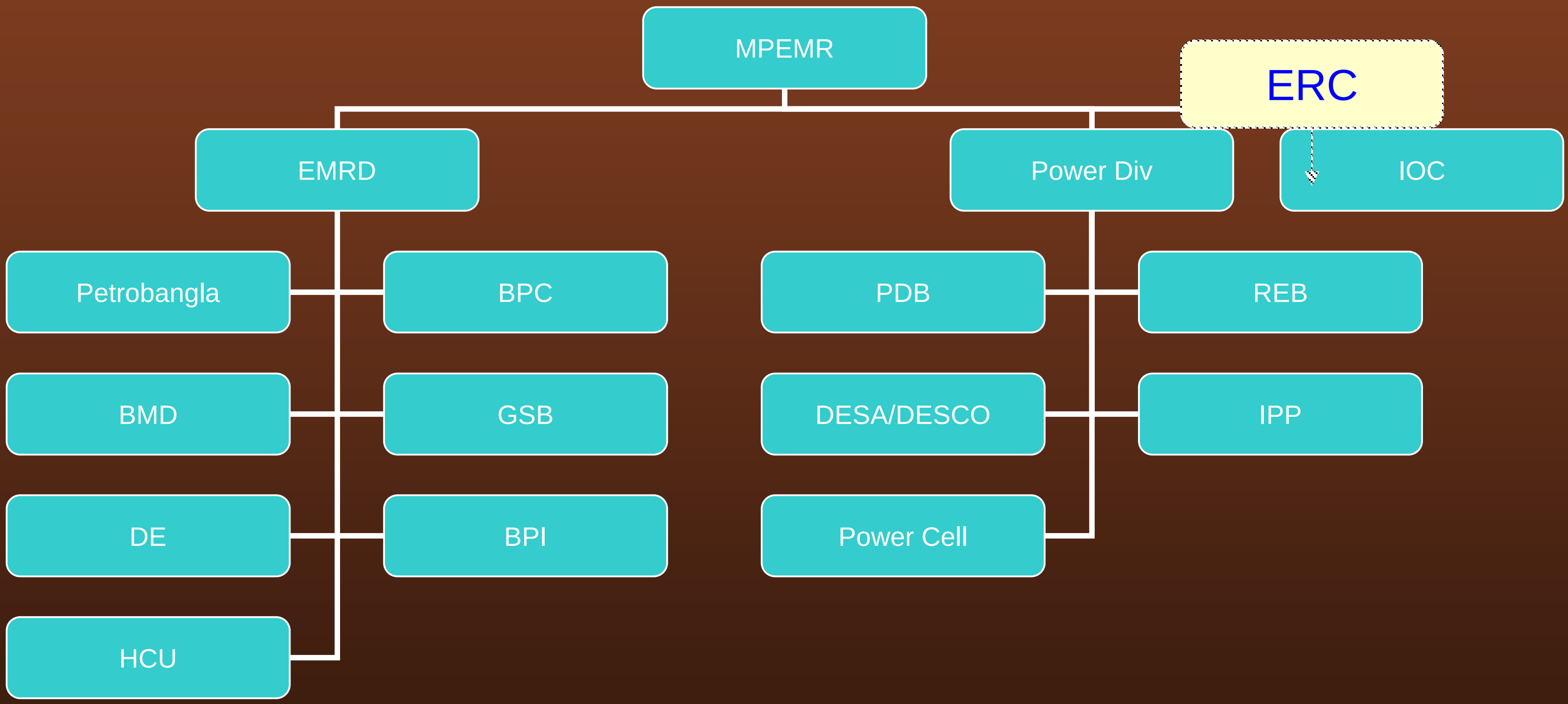
- 12 years exclusivity for distribution but not for marketing
  - average revenue yield price caps for distribution tariff
  - marketing price is not regulated unless there is no competition → acquisition price methodology

Winning Bids

- coverage commitments of almost 440,000 consumers in the Federal District and 370,000 in the State of Mexico after 5 years, and
- $0.5 billion in investment after 10 years.
- Average revenue cap is $0.6/MMBtu in FD > $0.38/MMBtu national avg

Natural gas in Bangladesh

Bangladesh Energy Sector



Petrobangla

Exploration & Production

Transmission

Marketing

CNG/LPG

Mining

Pipeline Network


RMS Station


Jamuna Bridge Pipeline


Pipeline Construction

1,800 km high pressure transmission line of 8 inch to 30 inch diameter operating at 960 psig, supported by ~1,500 km of intermediate pressure pipelines and ~11,000 km of service pipelines

Marketing and Consumption

Customer Base of Marketing Companies

- Titas Gas T & D Co. Ltd

TGTDCL 907963

- Bakhrabad Gas Systems Ltd

BGSL 271265

- Jalalabad Gas T & D System Ltd

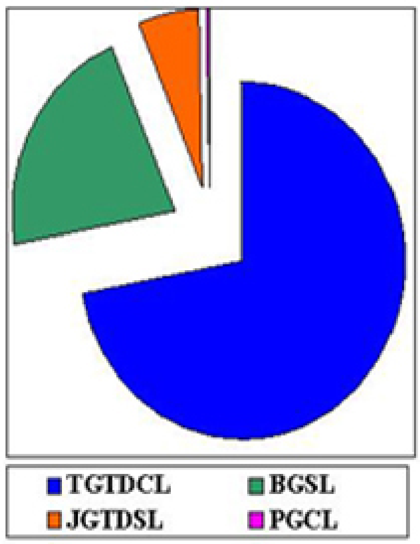
JGTDSL 76924

- Pashchimanchal Gas Co. Ltd

PGCL 3810

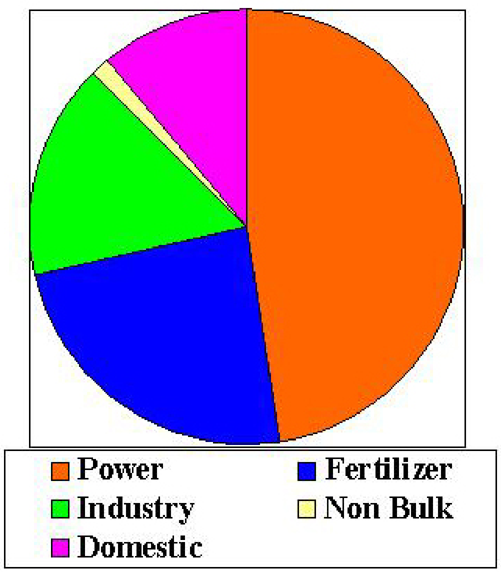
Total 1,259,962

As on end June 2003

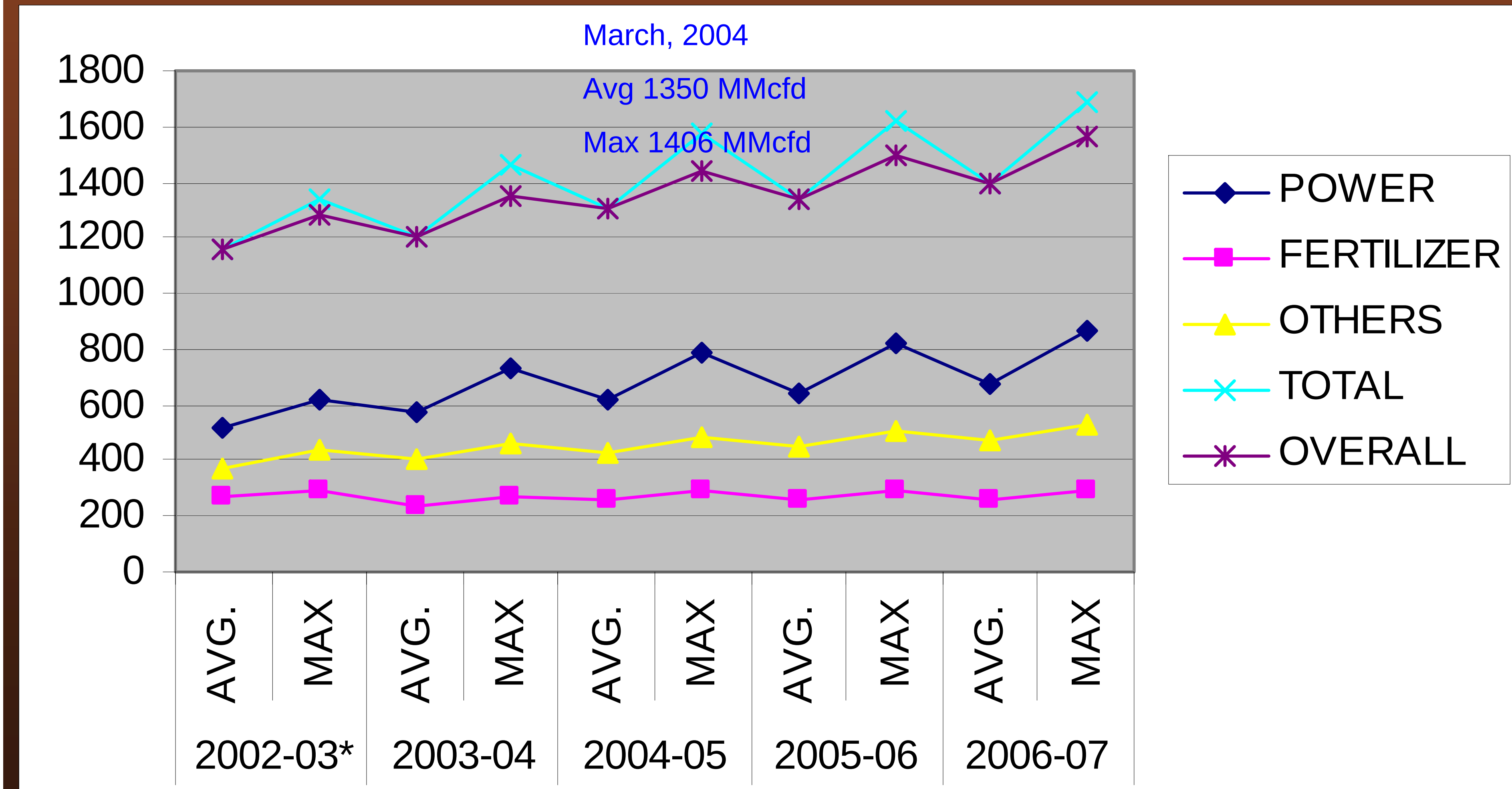


Gas Consumption by Category

	mmcm	Bcf
Power	5395	191
Fertilizer	2715	96
Industry	1805	64
Non Bulk	165	6
Domestic	1268	45
Total	11350	401



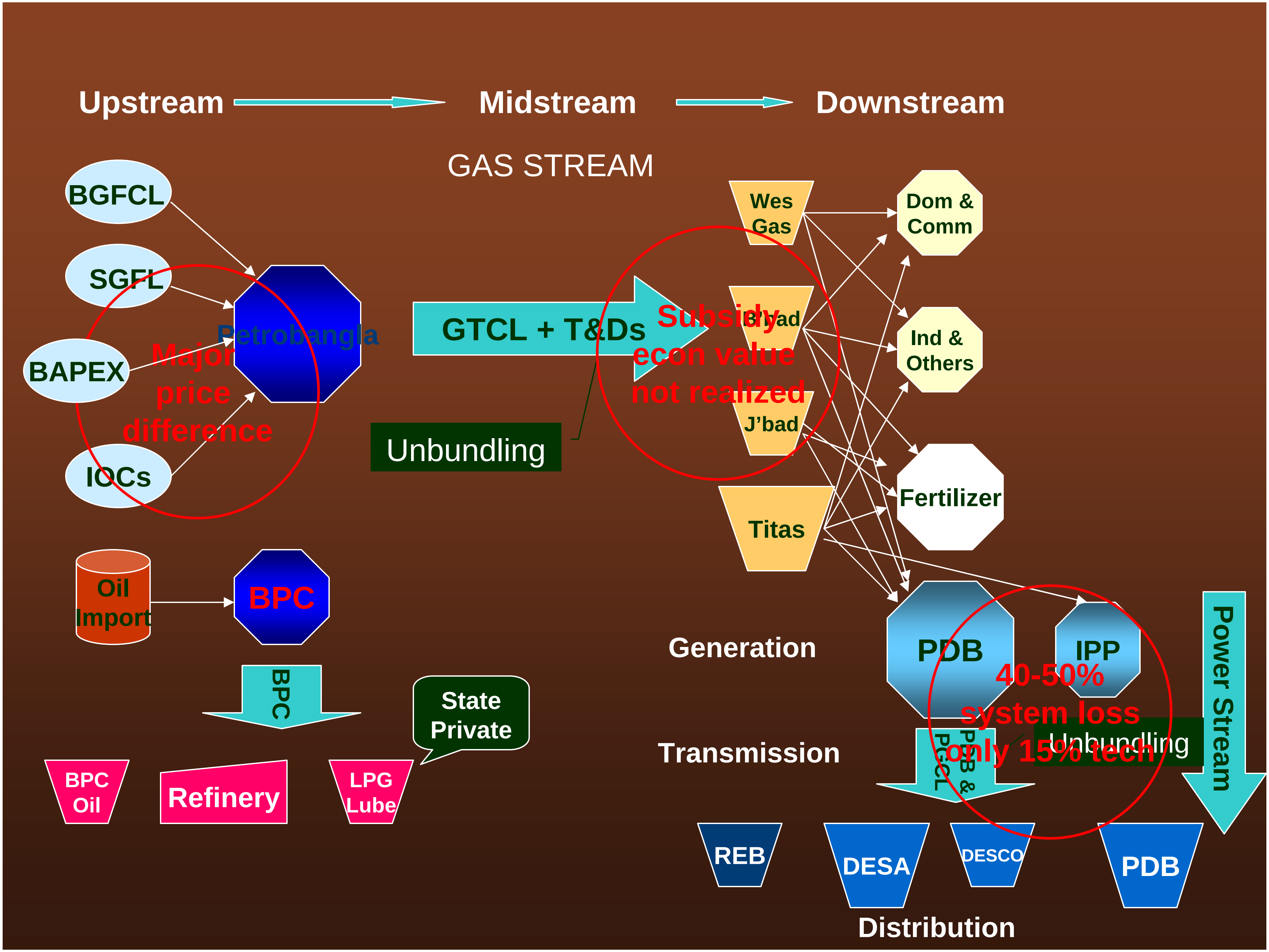
Gas Demand Forecast



Gas Tariff

Weighted average gas price $1.5/Mcf

Yr	Pow er	Ferti	Indust	Com	Tea Estat e	CAP. POWR/ CNGV	Brick Field (SE'NA L)	Metere d (Dom)	Single Burner (Dom)	Double Burner (Dom)
1968	1.2	1.20	2.52	6.00	-	-	-	6.00	6.00	10
1974	3.7	3.72	7.20	12.00	-	-	-	12.00	15.00	28
1980	7.7	7.75	18.00	19.00	-	-	-	18.00	22.00	40
1985	15.6	15.6	43.20	54.24	-	-	61.20	40.80	60.00	110
1990	37.9	32.8	80.42	126.5	95.6	-	-	74.75	115.0	195
1994	47.5	41.3	103.0	147.5	113	-	128.28	82.12	160.0	250
2000	62.9	54.6	136.3	194.4	150	-	169.65	108.0	215.0	330
2003	70.0	60.0	140.0	220.0	140	100/70	120.00	220.0	325.0	375
* TAKA/MCF 1 US$ = Tk. 60 (2004)										



Upstream
Midstream
Downstream
GAS STREAM
BGFCL
SGFL
BAPEX
IOCs
Petrobangla
Major price difference
GTCL + T&Ds
Subsidy econ value not realized
Unbundling
Wes Gas
B'bad
J'bad
Titas
Dom & Comm
Ind & Others
Fertilizer
Oil Import
BPC
BPC
State Private
BPC Oil
Refinery
LPG Lube
Generation
PDB
IPP
40-50% system loss only 15% tech
Transmission
PDB & PGCL
Unbundling
Power Stream
REB
DESA
DESCO
PDB
Distribution

Gas Sector Problems

- Major difference between gas purchased from IOCs and sale price in local market
- Poor regulation and market structure
- Short term surplus gas by IOCs
- Major dispute on cost recovery calculations
- Scarce foreign currency; as a result, 3-6 months payment delay by PB
- No incentive for IOCs to drill (R/P of 30+ years)
- Mid-term supply shortage, immediate need to drill
- BD doesn’t have high risk investment money or newer technology

Gas Sector Reform Strategy

- Formation of regulatory commission
- Converting all companies under Petrobangla under Company Act 1994, reducing the role of PB as monitor
- Corporatize PB and redefine role
- Cost reflective tariff setting
- Unbundling transmission and distribution
- Promote private participation in transmission (limited) and distribution under a regulated market

Economics of CNG
The case of Bangladesh

What is CNG?

- NG pressurized and stored in welding bottle-like tanks at pressures up to 3,600 psig.
- Typically, same composition as pipeline quality natural gas
- Often used as a vehicle fuel, delivered to an engine as low-pressure vapor (up to 300 psig).
- Note that LPG and LNG are also common transport fuels.

Bangladesh situation

- >15 tcf of proven natural gas reserves
- Domestic consumption preferred
  - Power generation, industrial (fertilizer, etc.) and CNG
- CNG is chosen
  - to create demand for NG
  - to clean the air of Dhaka

General assumptions

- Standard Bangladeshi car (1300 cc with A/C) or equivalent (for electric car)
- 20-year study period
- Load – 10,000 km/year or 200,000 km in 20 years

Diesel assumptions

- Vehicle cost – US$ 10,000
- Fuel efficiency of 10 km per liter
- Diesel/gasoline costs specific to Bangladesh - US$0.48 per liter
- Diesel/gasoline distribution costs as prevailing in the country – 0.5 cents per liter

CNG assumptions

- Standard gasoline car is converted at a cost of US$ 700
- Per vehicle compressor station investment cost is US$ 300
- Compressor station maintenance per year is 5% of initial investment
- Compression cost 20% of natural gas cost
- Fuel efficiency of 10 km per m3
- Transmission using new infrastructure (US$ 0.3/MMBtu)
- Distribution using new infrastructure (US$ 0.6/MMBtu)

EV assumptions

- An electric car costs $12,500
- Fuel efficiency of 5 km per kWh
- Power plant efficiency of 50%
- Generation costs are 1 cent per kWh
- Transmission costs are 1 cent per kWh
- Distribution costs are 2 cents per kWh
- Electricity consumption – 12 kWh per 80 km
- Battery replacement costs US$ 1000 every three years
- Operation and maintenance half that of standard vehicles

GTL assumptions

- 1 billion dollar investment for a 50,000 bbl/d GTL plant gives US$ 2000 per vehicle investment cost
- Operation and maintenance costs are 5% of the initial investment

Life cycle costs of different vehicles / fuels

Conventional diesel or gasoline			CNG	EV	GTL	Cost of NG ($/MM Btu)
$30 oil	$40 oil	$50 oil				
$13,123	$13,872	$14,622	$13,277	$15,494 $12,994	$14,693	$1.5
			$14,210	$15,750 $13,250	$15,853	$3.5

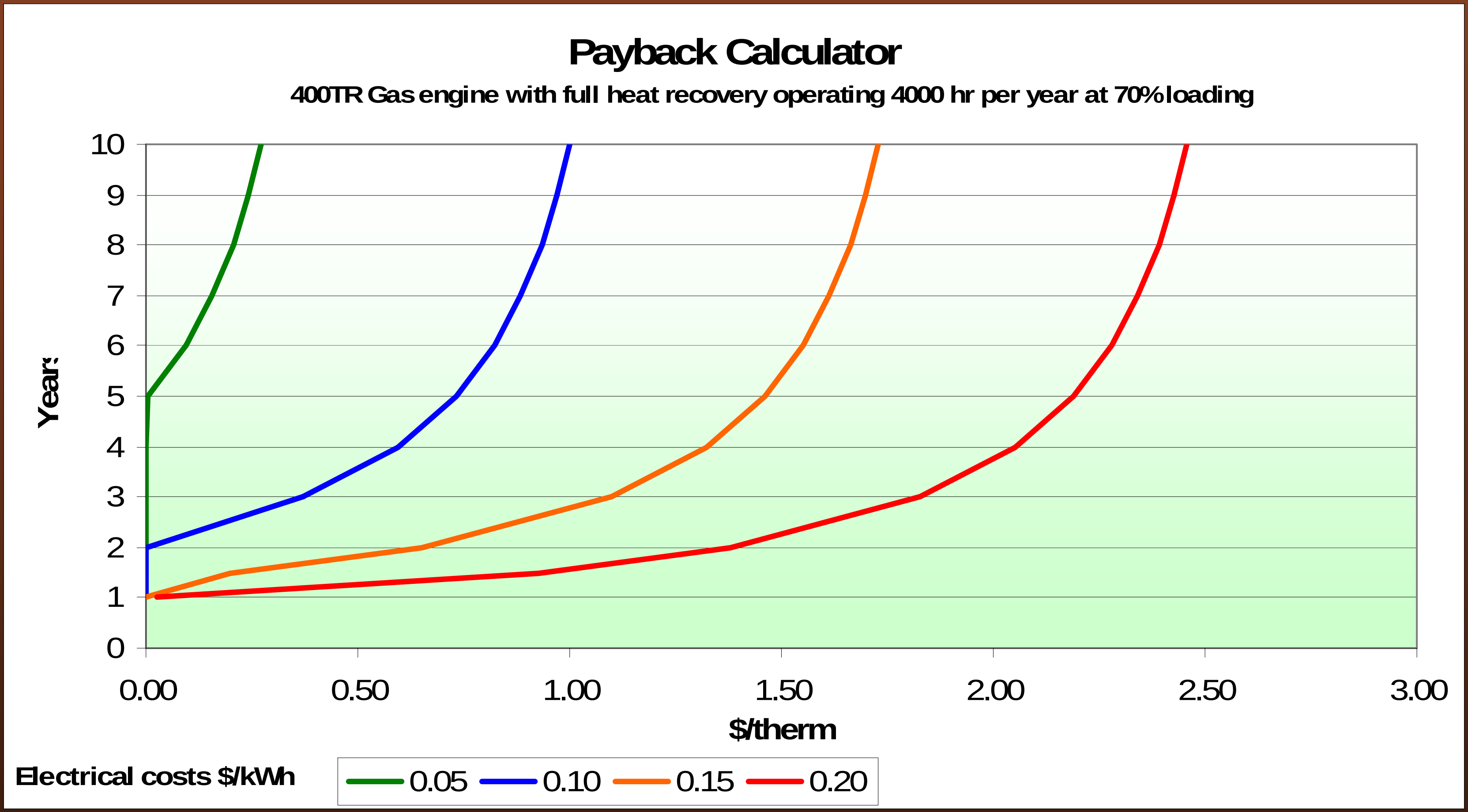
Preliminary results !

Gas cooling

- Commercial & Industrial
  - Absorption
  - Engine-driven
  - Steam-turbine
- Residential

www.gasairconditioning.org

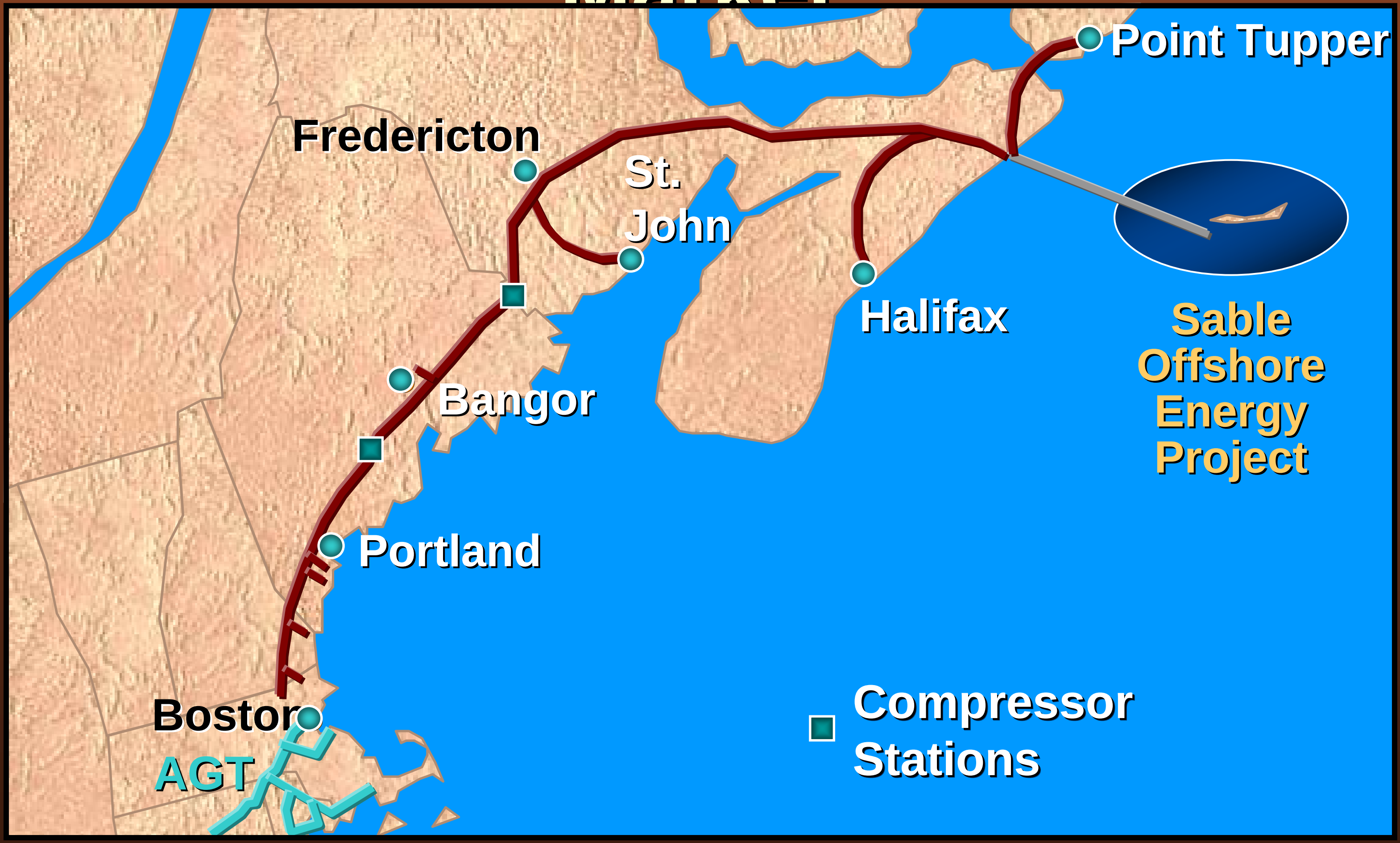
Gas cooling



Source: www.gasairconditioning.org

Two North American Pipeline Development Case Studies

Maritimes & Northeast Pipeline: New Gas Production to Established Market



Maritimes & Northeast Pipeline

- Cost of $1.2 billion
- Pipeline length of 1,086 km (663 miles)
- Capacity of 530,000 MMBtu/d
- Placed into service December 1, 1999
- Rate (toll) of $1.20 per MMBtu
- Owners
  - Duke Energy: 37.5%
  - Westcoast Energy: 37.5%
  - ExxonMobil: 12.5%
  - Nova Scotia Power: 12.5%

Maritimes & Northeast Pipeline

- Debt/equity structure of 75%/25%
- Debt
  - US$521.4 million fully amortizing
  - Canadian $712.3 million with 36% balloon payment
  - All debt maturing on November 30, 2009
- Lead banks are
  - Bank of America
  - The Canadian Imperial Bank of Commerce

Maritimes & Northeast Pipeline

- M&NE was the only natural gas pipeline linking the Sable fields to natural gas markets
  - Because of its importance, Mobil agreed to capacity Backstop Agreements
- Backstop Agreements by Mobil
  - Mobil agreed to purchase approximately 175 MMBtu/d of unsubscribed firm capacity in both Canada and U.S. for 20 years
- Due to the Backstop Agreements, there was no cross default between the physical assets or partnership interests in the U.S. and Canada

Maritimes & Northeast Pipelines (M&NE) Ownership Structure

Alliance Pipeline System: Unlocking Remote Supply for Established Market

Alliance Pipeline

- Cost of $3.1 billion
- Largest project financed in North America
- Pipeline length of 1,860 miles
- Capacity of 1,600,000 MMBtu/d
- Placed into service December 1, 2000
- Rates (tolls)
  - $0.82 per MMBtu for rich gas
  - $0.73 per MMBtu for lean gas

Alliance Pipeline

- Owners
  - Fort Chicago Energy Partners: 26%
  - Westcoast Energy: 23.6%
  - Enbridge Inc.: 21.4%
  - The Williams Companies, Inc.: 14.6%
  - El Paso Corporation (The Coastal Corporation): 14.4%

Alliance Pipeline

- Debt/equity structure of 70%/30%
- Debt
  - US$961.5 million with balloon payment
  - Canadian $1.6 billion with balloon payment
  - All debt maturing on December 21, 2008
- Lead banks were
  - Bank of Montreal
  - The Bank of Nova Scotia
  - The Chase Manhattan Bank
  - Royal Bank of Scotland

Alliance Pipeline Ownership Structure