

# Gas Pricing Considerations for Afghanistan

World Bank  
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# Objective

- To introduce and begin to deliberate issues that need to be considered in setting pricing principles in such a way as to promote growth of an efficient gas sector in Afghanistan

# Basic background

- Gas and oil are very different
  - No large “rent” (difference between cost and price) for gas
  - Nearly 10 bcf (0.28 billion m<sup>3</sup>) of gas flared daily worldwide
  - 87% of world’s gas production does not cross borders
  - Half of discovered gas in the world too far from markets to justify infrastructure needed for commercialization
- Gas discoveries take a very long time to develop
- Gas sales require a secure and predictable market for all or most production over project life
- Other gas use alternatives often require huge investments

# Units

Metric	British
1 m <sup>3</sup>	35.315 ft <sup>3</sup>
30 billion m <sup>3</sup> (CM)	1.06 tcf
\$100/'000 m <sup>3</sup>	\$2.83/'000 cf
M	1,000
MM	1 million = 1,000,000
\$100/MCM	\$2.83/MCF ~ \$2.83/MMBtu
1 MMBtu	1.06 GJ, 293 kWh, 252,000 kcal
Afg 1/m <sup>3</sup>	\$0.58/MCF at \$1 = Afg 49

# Natural gas composition

Methane	Dominant component, gas at room temperature
Ethane	Gas at room temperature
Propane	LPG component
Butanes	LPG component
Water	Should be removed
Nitrogen	
CO <sub>2</sub>	Should be removed
H <sub>2</sub> S	Should be removed

# Energy content

- Basic rule of thumb: 1,000 ft<sup>3</sup> or 1 MCF = 1 MMBtu
- Energy content of treated gas  $\neq$  energy content of produced gas
- Need to know gas composition

# Energy content

Higher heating value  
(HHV) in MMBtu/MCF

Methane

1.0

Ethane

1.7

Propane

2.5

Butanes

3.2

# Example of energy content

## Produced gas

N <sub>2</sub>	1.8%
CO <sub>2</sub>	4.5%
H <sub>2</sub> S	2.7%
Methane	88%
Ethane	2.0%
Propane	1.0%

0.94 MMBtu/MCF

## Treated gas

N <sub>2</sub>	1.9%
Methane	94.8%
Ethane	2.2%
Propane	1.1%

1.0 MMBtu/MCF

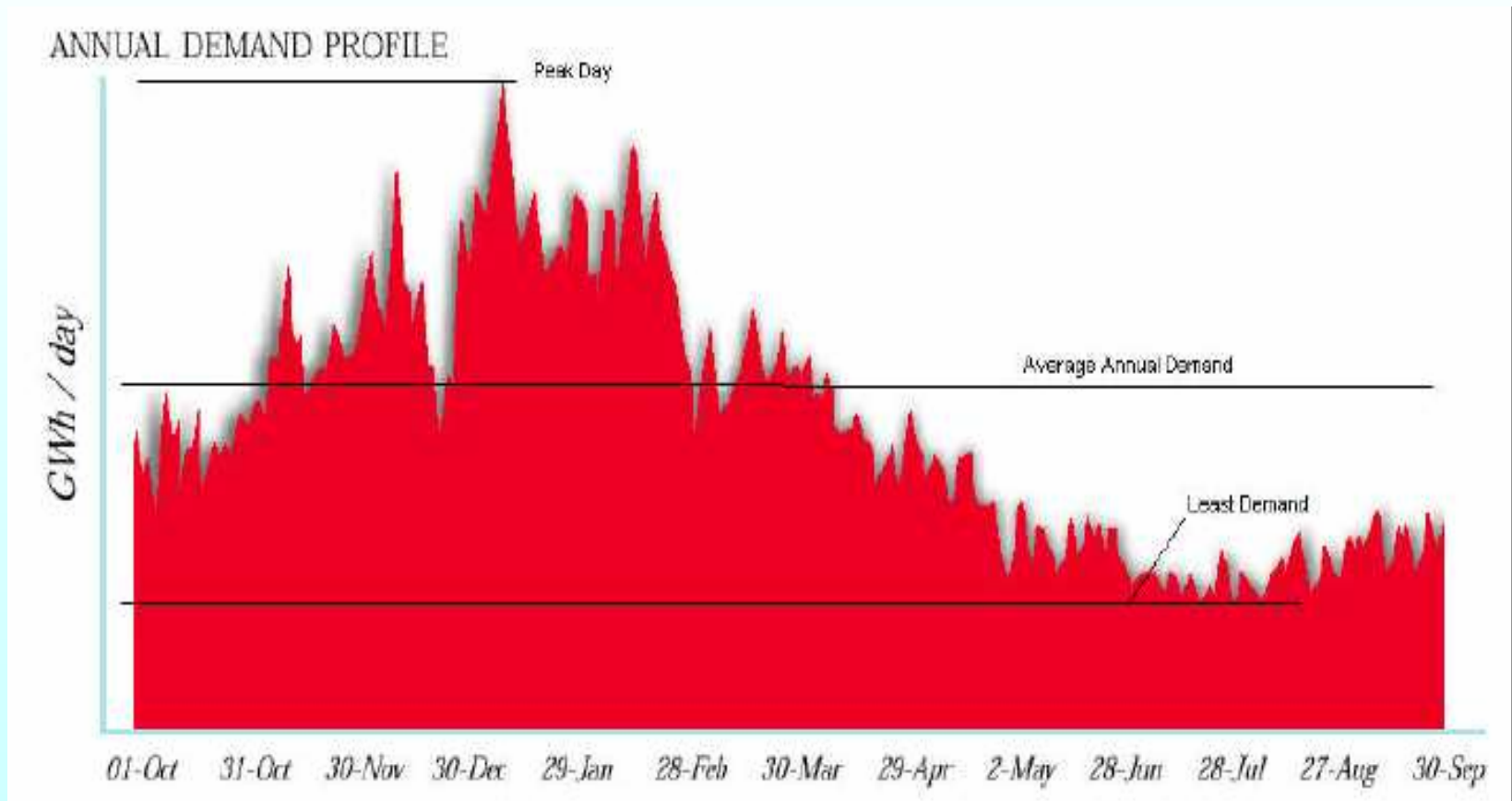
But 1080 cf of  
produced gas is  
needed for 1000 cf  
of treated gas



# Supply chain

- Gas production at the well
  - Constrained by demand
- Gas treatment
  - Remove impurities
  - Possibly separate out heavier fractions
- Transmission (high pressure)
  - Direct off-take by very large users
- Distribution (medium and low pressure)
- Sale

# Consumption variation

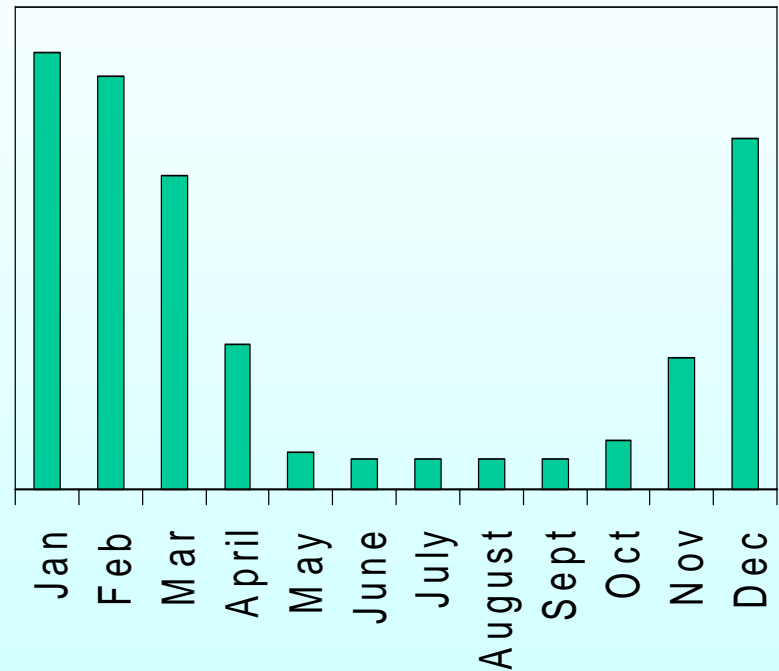


# Load/capacity factors

- Load factor: ratio of average load to peak load
- Capacity factor: ratio of average load to the design capacity
- Key is peak demand
- The higher the capacity factor, the lower the unit cost of gas transport/distribution
- The larger the difference between met peak demand and average load, the lower the capacity factor and higher the unit cost of gas

# Load factor

- Residential users have low load factor: much more gas used in winter, gas used only at certain times of day
- Large industrial users operate 24 hours a day, 7 days a week, resulting in high load factor



**Load factor of 38%**

# If peak demand exceeds capacity

- **Load shedding**: cutting off or curtailing gas delivery to large users to balance demand with limited supply
- **Interruptible service**: some large consumers are able and willing to accept interruptible service  
vs. **firm service**: pay capacity reservation charge (per m<sup>3</sup> per day of reserved capacity) to guarantee supply

# Advantages of large-volume consumers

- Credit-worthy large-volume consumers form market base
- Consumption variation is relatively small, load factor large
- Some able and willing to accept interruptible service in exchange for tariff reduction, reducing system costs
- Less need for costly construction of complex distribution networks in early stages of market development

# Efficient pricing

- Separate pricing of production, transmission (T), distribution (D), and retail
- Tariffs to reflect and recover prudently incurred costs
  - Discourage gold-plating, over-investment
  - Discourage unacceptably high risk (example: economic purchase obligation)
- Ensure quality of service
- Offer incentives for efficiency improvement

# Impact of industry structure

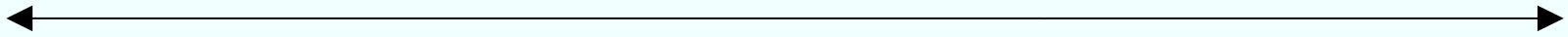
- Vertical integration: regulation of end-user prices
- Separate wholesale companies: large consumers can choose or negotiate
- Competitive retail: commercial and residential customers can also choose
- When does government set tariffs?
  - Transmission and distribution (T&D) are natural monopolies and require regulation
  - Direct negotiation between gas producers and large users or T&D firms is common. Some governments set pricing formulas to attract investors



# End-user price

Lower bound

Upper bound



Total unit cost:  
Cost of production  
+ gas treatment +  
transmission +  
distribution +  
future expansion + depletion premium

Prices of  
substituting  
fuels

# Ceilings on gas price

- Alternatives for consumers
  - Power sector: Electricity generation from hydro, coal, heavy fuel oil, diesel
  - Energy from coal, heating oil, electricity, LPG, kerosene, purchased wood
- Not fuel price alone
  - Lower working capital because no need for storage
  - Higher efficiency
  - No impurities
  - No expensive pollution control devices

# Ceilings on gas price

- Alternatives for consumers
  - Example: Coal at \$15/ton is cheaper than gas at \$1.50/MMBtu, but coal power plants are more expensive & less efficient, potentially making electricity generated from coal more expensive than that from gas
  - If alternatives are cheaper and their supply is unconstrained, then gas may not be purchased

# Examples

- LPG

\$300/ton  $\Rightarrow$  \$6.4/MMBtu, \$650  $\Rightarrow$  \$13.8/MMBtu

- Diesel

Afg 10/liter  $\Rightarrow$  \$ 4.1/MMBtu,

Afg 25/liter  $\Rightarrow$  \$10.2/MMBtu

- Fuel oil

\$15/bbl  $\Rightarrow$  \$2.4/MMBtu, \$25  $\Rightarrow$  \$4.0/MMBtu

- Electricity

2.3 US ¢/kWh  $\Rightarrow$  \$ 6.7/MMBtu,

5 ¢/kWh  $\Rightarrow$  \$14.6/MMBtu

# Ceilings on gas price

- Competitiveness of end-products
  - Even if there are no cheaper alternatives, if the prices of end products manufactured using gas are not competitive, the manufacturing will not take place in a competitive market

# Consider power imports

- Electricity at 2.3 US ¢/kWh
- Combined cycle power plant, 50% efficiency

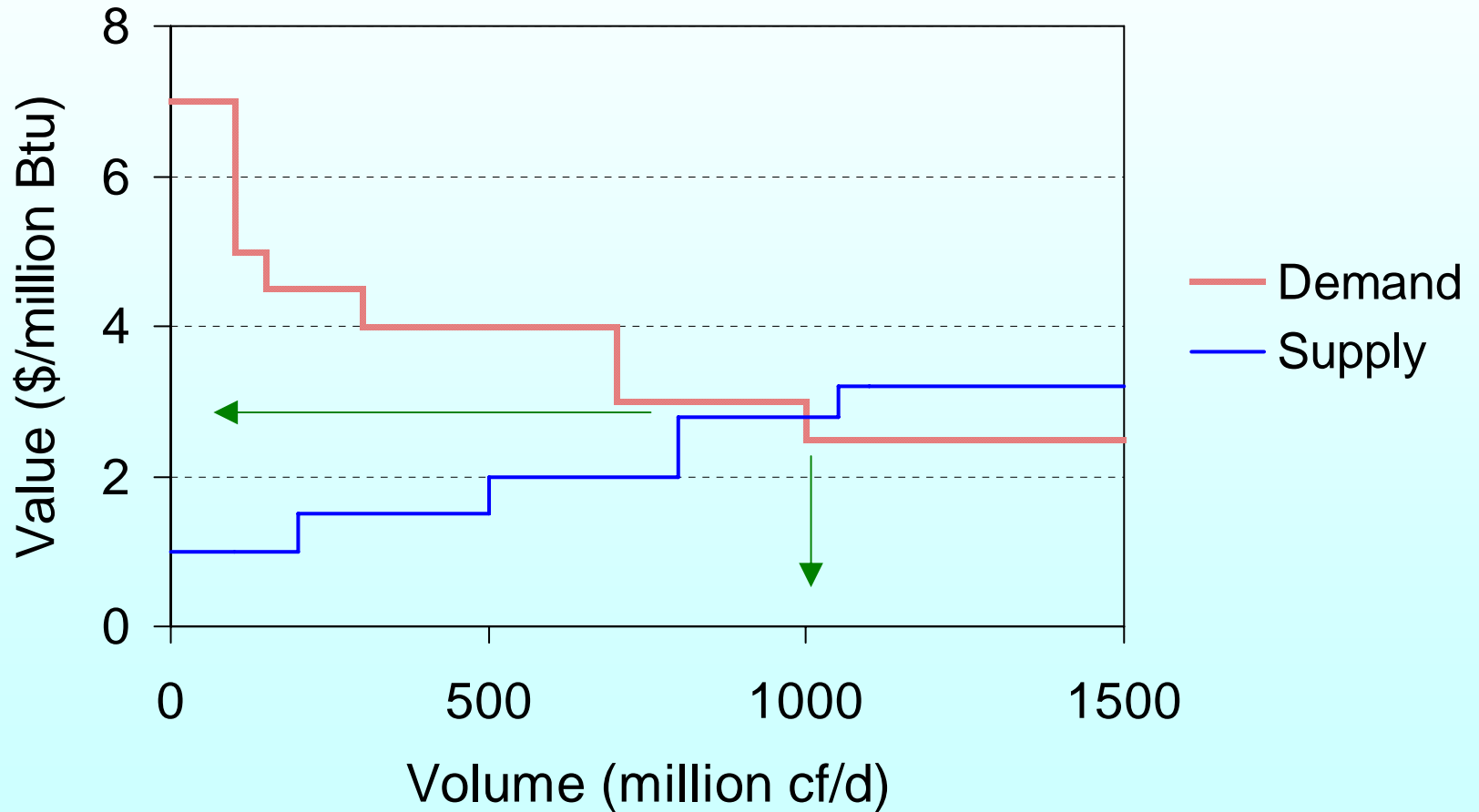
Plant capital                      Gas price at plant gate to  
match 2.3 ¢/kWh

\$/kW	US\$/MMBtu	Afg/m <sup>3</sup>
600	1.5	2.1
800	1.0	1.4
1000	0.5	0.7

# Minimum gas price

- Cost of production + gas treatment + transmission + distribution
- Adequate operation and maintenance
- Future expansion
- Funds for meeting technical, environmental, health, and safety standards
- Reasonable post-tax return to investor
- (Depletion premium)

# Economic price of gas



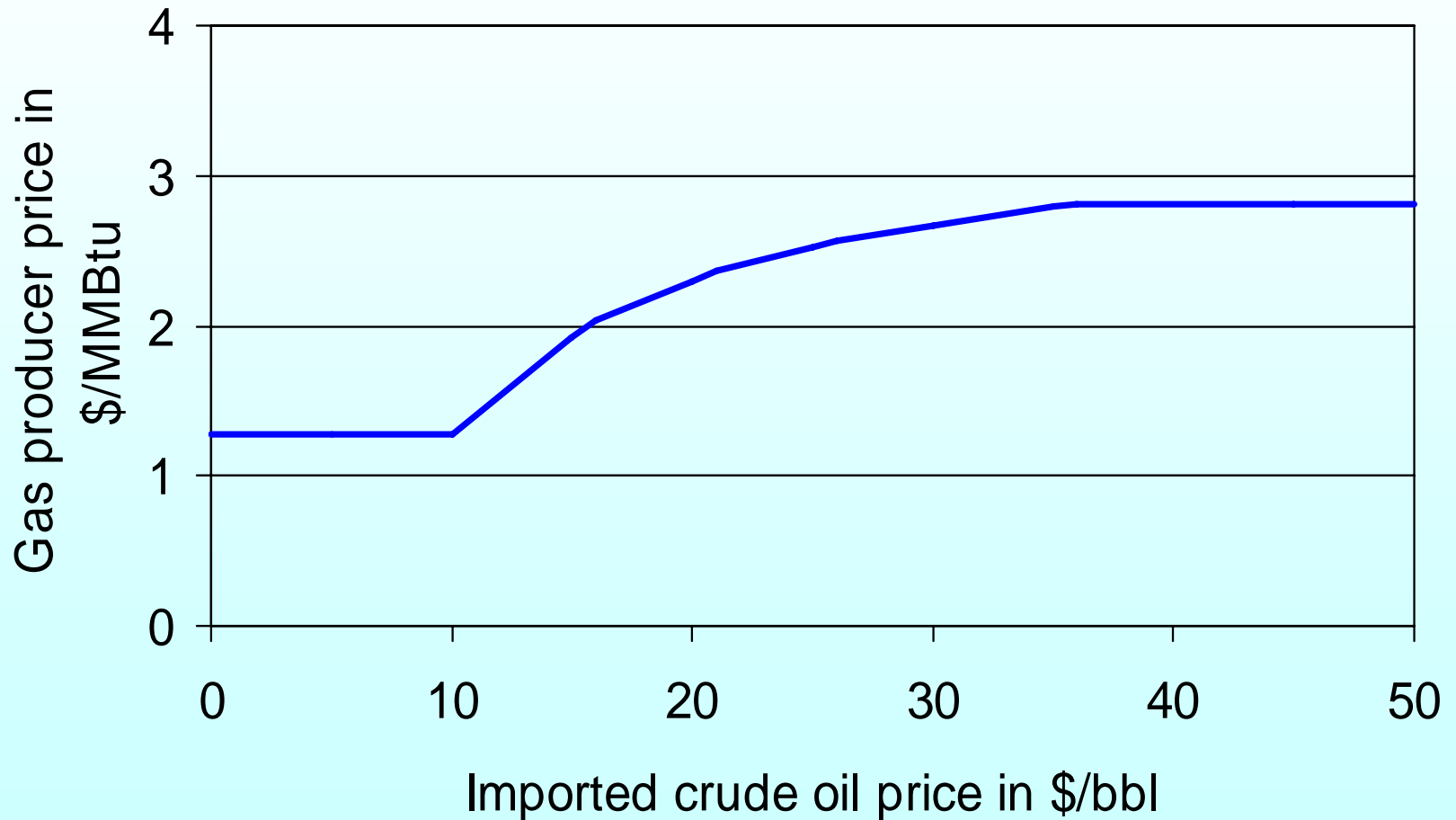


# Wellhead gas pricing: example from Pakistan

- Gas is substituting fuel oil (mainly power generation)
- Gas price based on fuel oil, which is in turn based on imported crude oil price
- Formula: Take 65.5%, 72.5%, or 77.5% of “effective oil price” depending on gas field profitability

Price band (\$/bbl)	Effective oil price (\$/bbl)
< 10	10, floor price
10–16	same as oil price
16.01–21	$16 + 0.5 \times (\text{oil price} - 15)$
21.01–26	$16 + 0.5 \times (21 - 16) + 0.3 \times (\text{oil price} - 21)$
26.01–36	$16 + 0.5 \times (21 - 16) + 0.3 \times (26 - 21) + 0.2 \times (\text{oil price} - 26)$
>36	22, ceiling price

# Gas prices paid to producers in Pakistan



# T&D issues

- Types of access to transmission pipelines
  - No open access
  - Regulated third party access (prices and conditions specified, needed if vertical integration, EU)
  - Negotiated third party access (US)
- Common carriage: one network code for all (example: UK)
- Contract carriage: terms of access specified in individual contracts (USA)

# T&D tariff issues

- Tariffs or their principles require approval by a regulatory agency
- Regulatory agency sometimes sets tariff
- Types of tariffs
  - Distance-related
  - Postal stamp (same for all)
  - Zoning
  - Affected by entry and exit points (complex network)

# Why separate production, transmission, and distribution?

- Avoid potential conflict of interest
- Make it more difficult to shift costs between regulated and unregulated segments
- Enable more precise determination of cost structure
- Easier to introduce competition

# Incentives for cost reduction

- Rate of return (RoR)
  - Based on regulatory assets
- Inflation – efficiency improvement
  - Annual revenue allowance or tariff
  - Periodic review
  - Efficiency gains tend to be high early in the regulatory period because they accrue to the service provider
  - Allow for investment, including steps taken to improve system efficiency, safety or reliability and expansion. Example: “k factor” in Argentina

# Obstacles to investment

- Immature and small market
- Future demand low and uncertain
- Doubts about creditworthiness of major consumers
- Exchange rate volatility
  - Argentina in 2002
- Price volatility
  - Higher the volatility, lower the investment level

# Different approaches

- Long-term contracts with take or pay
- Penalties for non-delivery
- All tariffs determined in US\$ and converted to local currency when customer is billed
- RoR or inflation indexation – efficiency factor



# Issues

- Negotiate wellhead prices between producers and buyers or set according to formulas
- How to allocate gas among competing consumers if gas shortage
- Finding creditworthy large consumers
- How to expand service to small consumers
- How to develop T&D
- Tariff regulation
- Separating out production, transmission, and distribution
- Setting up regulatory accounts (vs. financial)

# Immediate issues

- Address inadequate current revenue
  - How much should prices be adjusted upward and on what basis?
  - How can non-payments be addressed?
- Identify one or more creditworthy large-volume consumers with predictable demand
  - Basis of increased gas production
- Incrementally expand supply to other consumers in the north
  - Metering, billing, bill collection