Gas Pricing Considerations for Afghanistan

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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^3) 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^3	35.315 ft^3
30 billion m^3 (CM)	1.06 tcf
\$100/'000 m^3	\$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^3	\$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_2	Should be removed
H_2S	Should be removed

Energy content

- Basic rule of thumb: 1,000 ft^3 or 1 MCF = 1 MMBtu
- Energy content of treated gas ≠ 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_2	1.8%
CO_2	4.5%
H_2S	2.7%
Methane	88%
Ethane	2.0%
Propane	1.0%

0.94 MMBtu/MCF

Treated gas	
N_2	1.9%
Methane	94.8%
Ethane	2.2%
Propane	1.1%

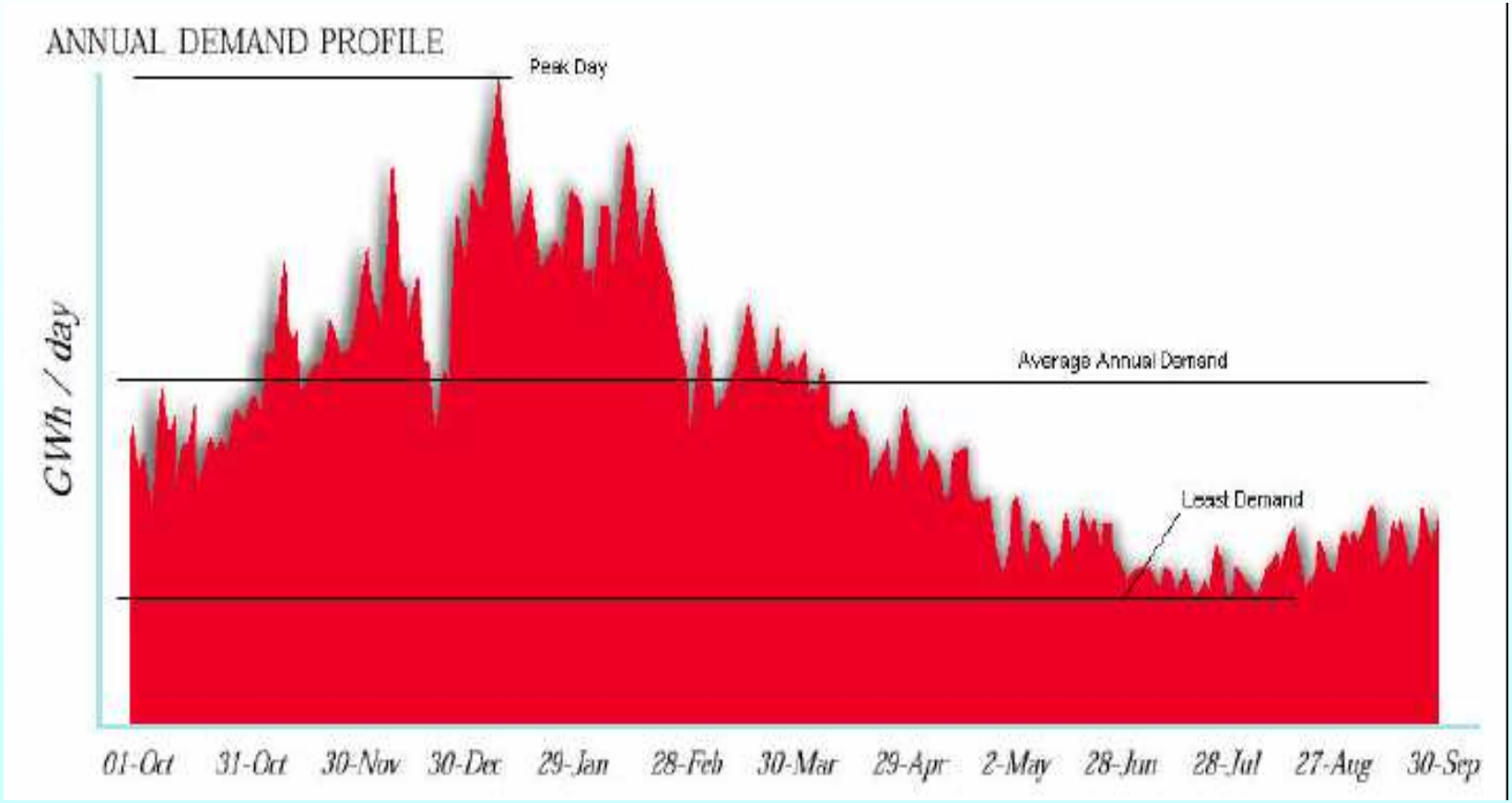
1.0 MMBtu/MCF

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

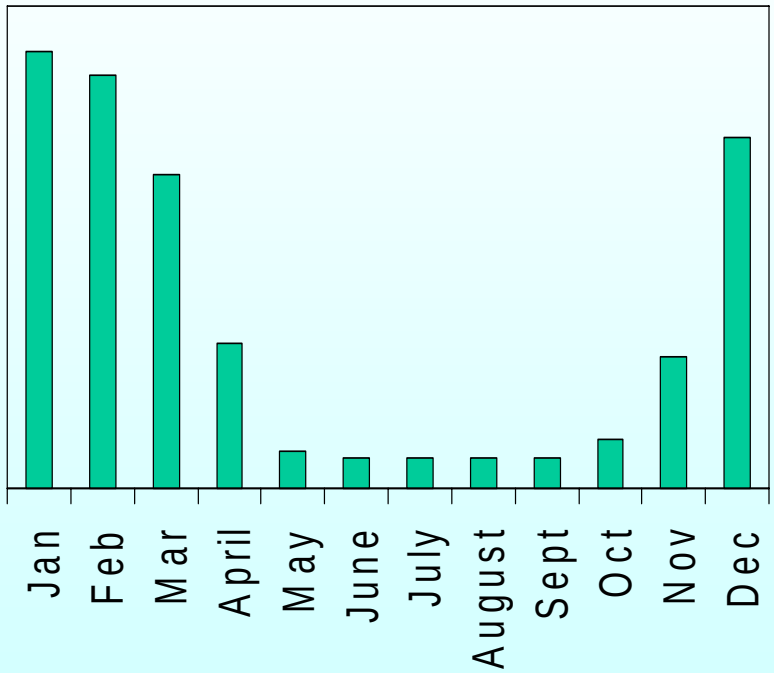


Load/capacity factors

- 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^3 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

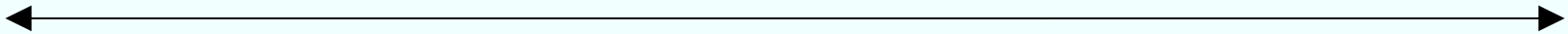
- Separate pricing of production, transmission (T), distribution (D), and retail
- Tariffs to reflect and recover prudently incurred costs
  - Discourage gold-plating, over-investment
  - Discourage unacceptably high risk (example: economic purchase obligation)
- Ensure quality of service
- Offer incentives 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 ⇒ $6.4/MMBtu, $650 ⇒ $13.8/MMBtu

- Diesel

  Afg 10/liter ⇒ $ 4.1/MMBtu,
  Afg 25/liter ⇒ $10.2/MMBtu

- Fuel oil

  $15/bbl ⇒ $2.4/MMBtu, $25 ⇒ $4.0/MMBtu

- Electricity

  2.3 US ¢/kWh ⇒ $ 6.7/MMBtu,
  5 ¢/kWh ⇒ $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

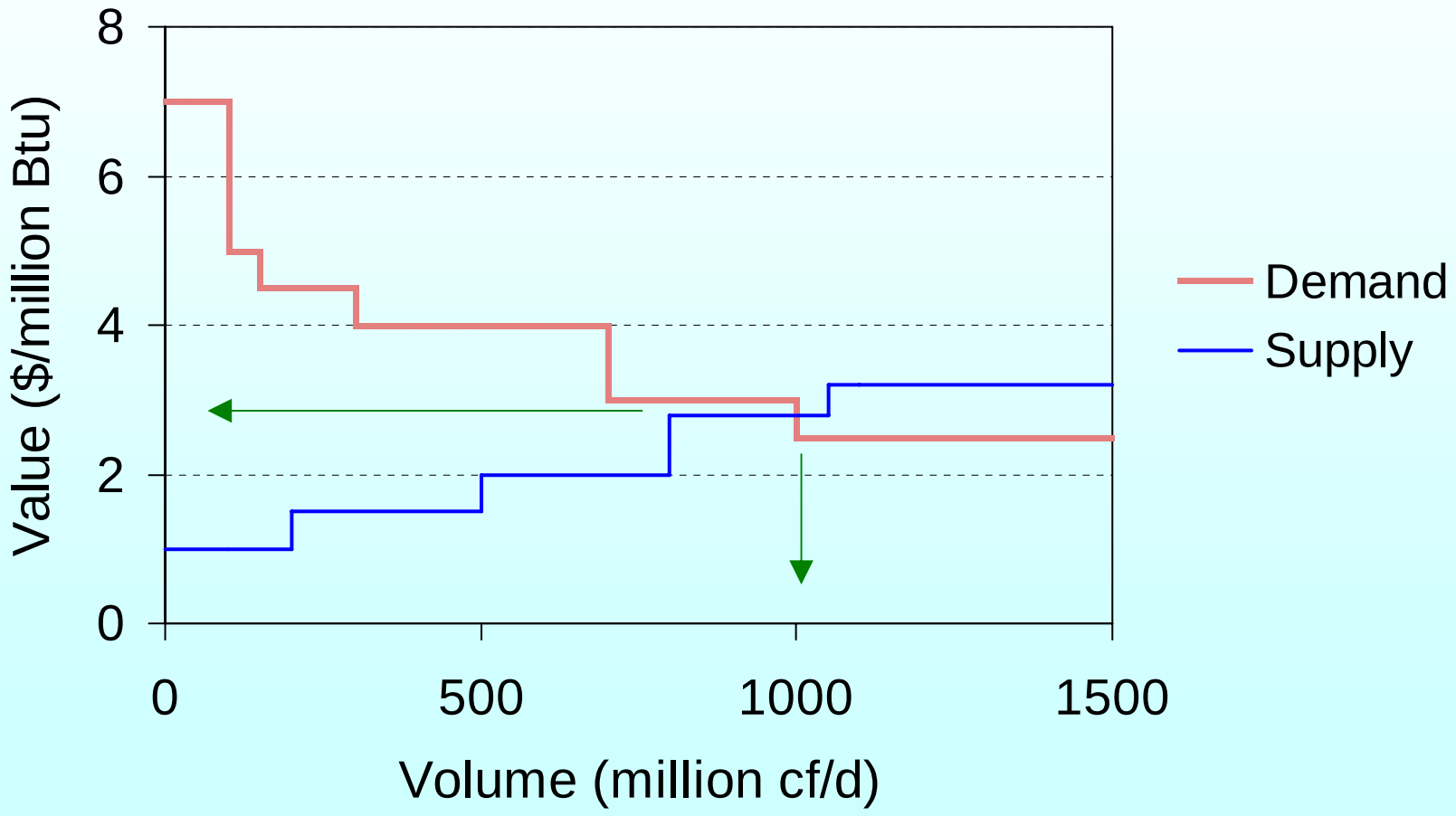
- Electricity at 2.3 US ¢/kWh
- Combined cycle power plant, 50% efficiency

Plant capital	Gas price at plant gate to match 2.3 ¢/kWh	
$/kW	US$/MMBtu	Afg/m³
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

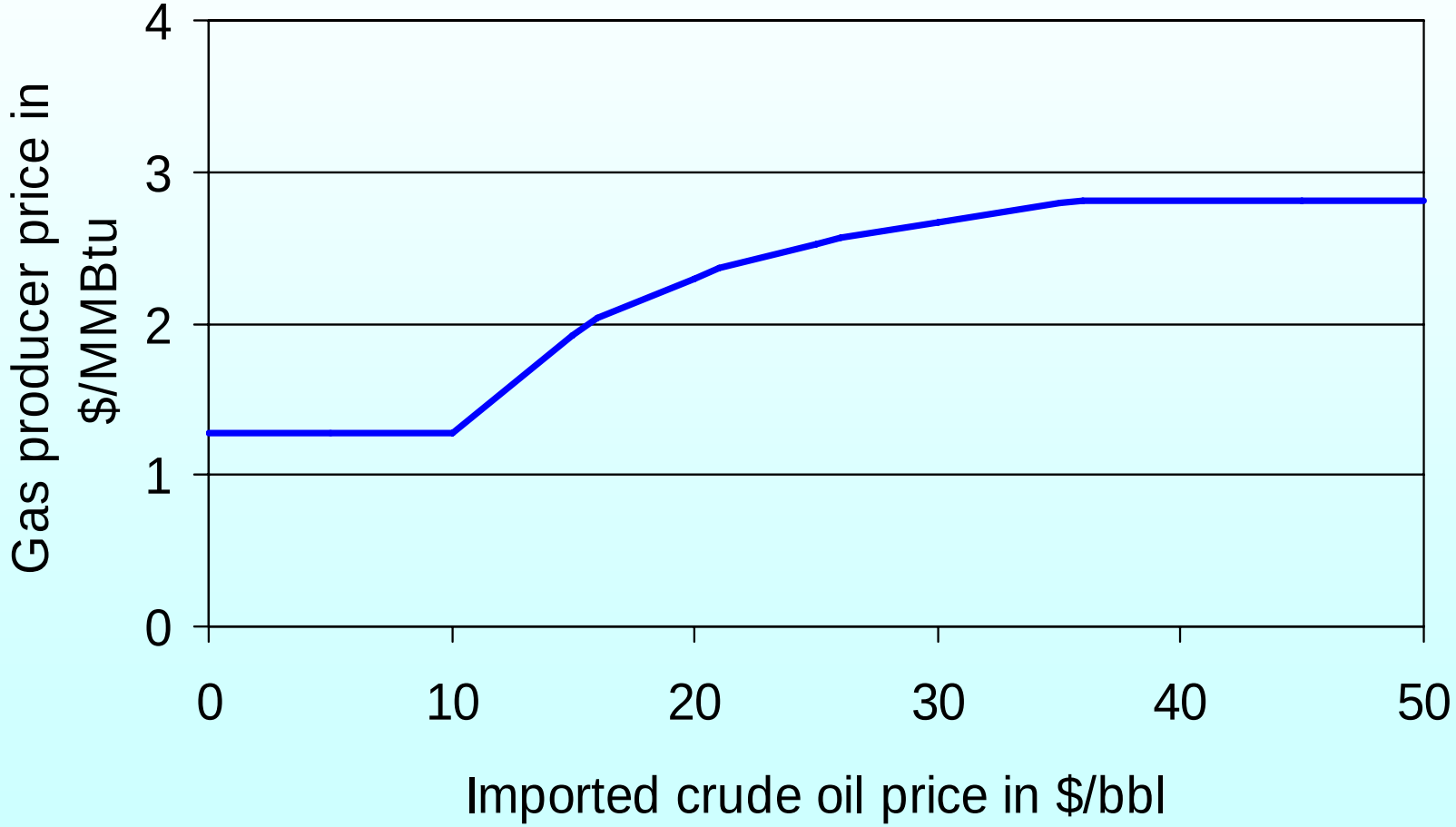


Wellhead gas pricing: example from Pakistan

- 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+0.5x(oil price–15)
21.01–26	16+0.5x(21–16)+0.3x(oil price–21)
26.01–36	16+0.5x(21–16)+0.3x(26–21) +0.2x(oil price–26)
>36	22, ceiling price

Gas prices paid to producers in Pakistan



Note: Taking 72.5% of the effective oil price

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