



Developments in Natural Gas & LNG

Challenges for Sustainable Operations of Cross Country Pipeline

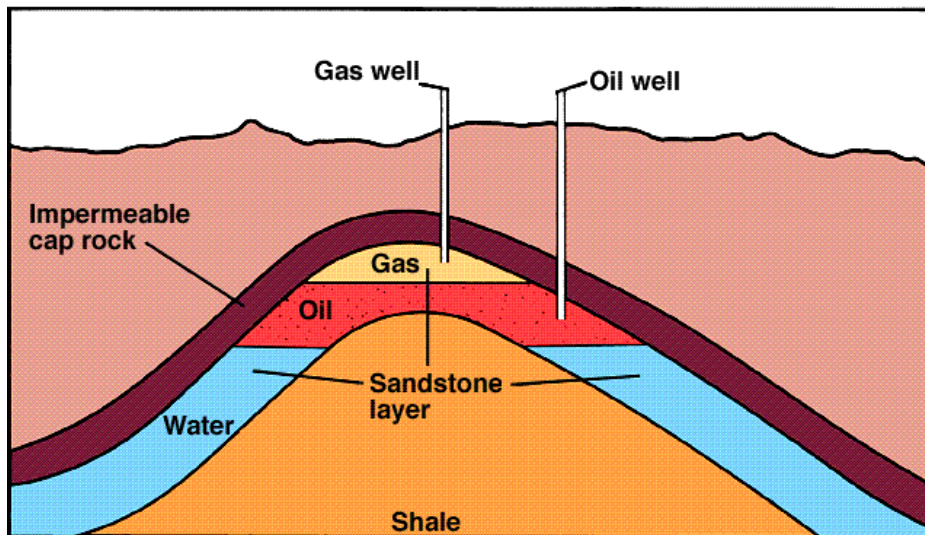
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Developments in Natural gas Introduction

Crude Oil and Natural Gas Pool



- Accumulations of dead marine organisms on the ocean floor were covered by sediments.
- Muddy rock gradually formed rock (shale) containing dispersed oil.
- Sandstone formed on top of shale, thus oil pools began to form.
- Natural gas forms on top of oil.
- Primary component of natural gas is methane(CH_4).
- Transportation in 3 forms

Liquid



Gas



Hydrate



Developments in Natural gas Introduction

- Natural Gas was a nuisance initially when it is coming as a associate gas due to Hazardous in nature and transportation issues..
- Latter developed better utilization of natural gas as Fuel (Power / Steam generation) & Feed (Fertilizer / sponge Iron).
- Extraction of C2, C3, C4, C5, C6 for better value addition.
- Effective use of all modes of transportation;
 - Inter Continental - LNG/ Pipelines.
 - Intra State - Cross country pipelines
 - Intercity - CNG/PNG

Advantages

Ample supplies (125 years)

High net energy yield

Low cost (with huge subsidies)

Less air pollution than other fossil fuels

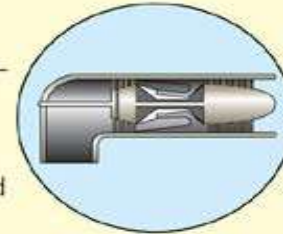
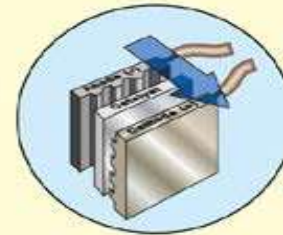
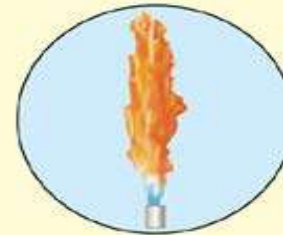
Lower CO₂ emissions than other fossil fuels

Moderate environmental impact

Easily transported by pipeline

Low land use

Good fuel for fuel cells and gas turbines



Disadvantages

Nonrenewable resource

Releases CO₂ when burned

Methane (a greenhouse gas) can leak from pipelines

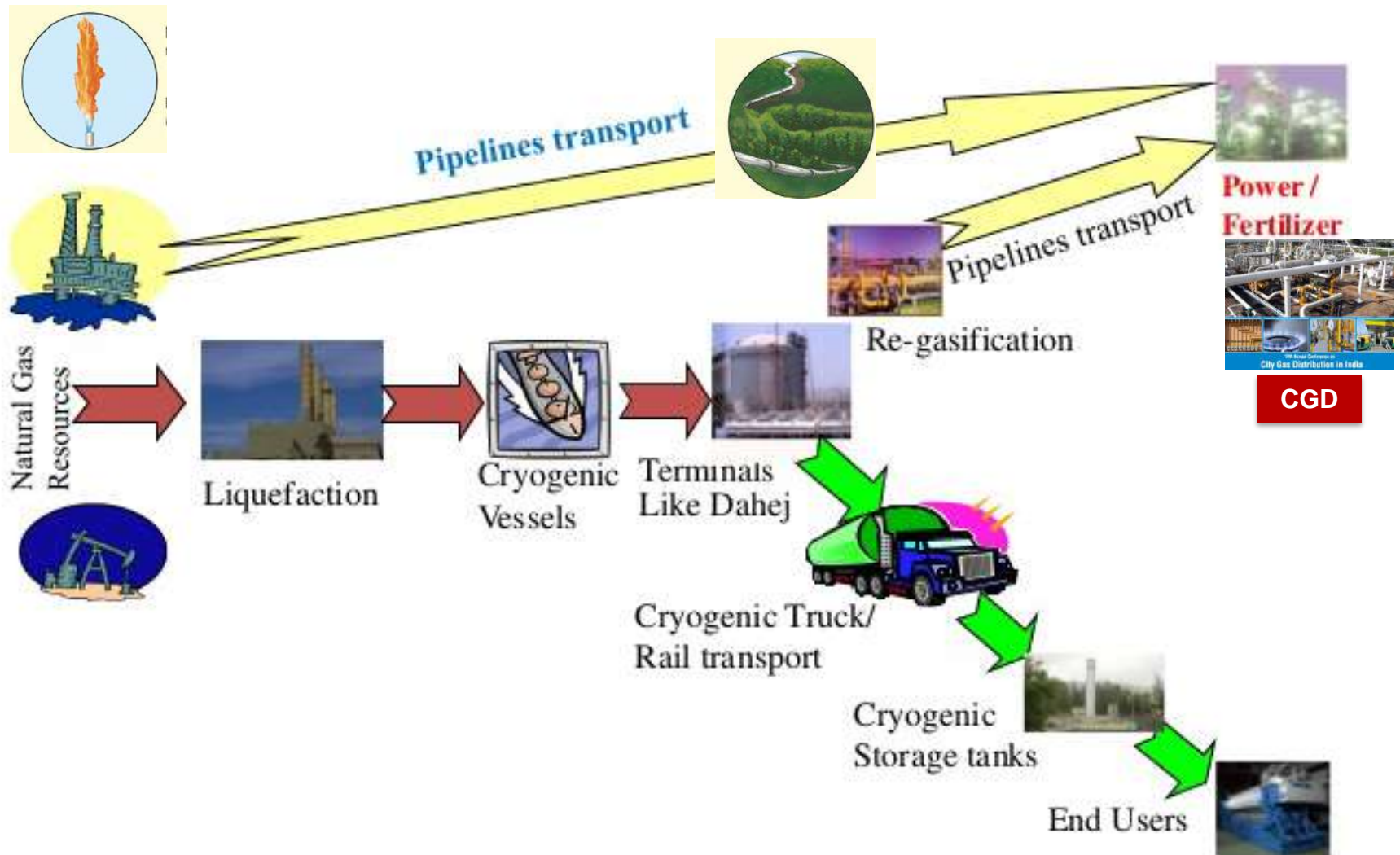
Difficult to transfer from one country to another

Shipped across ocean as highly explosive LNG

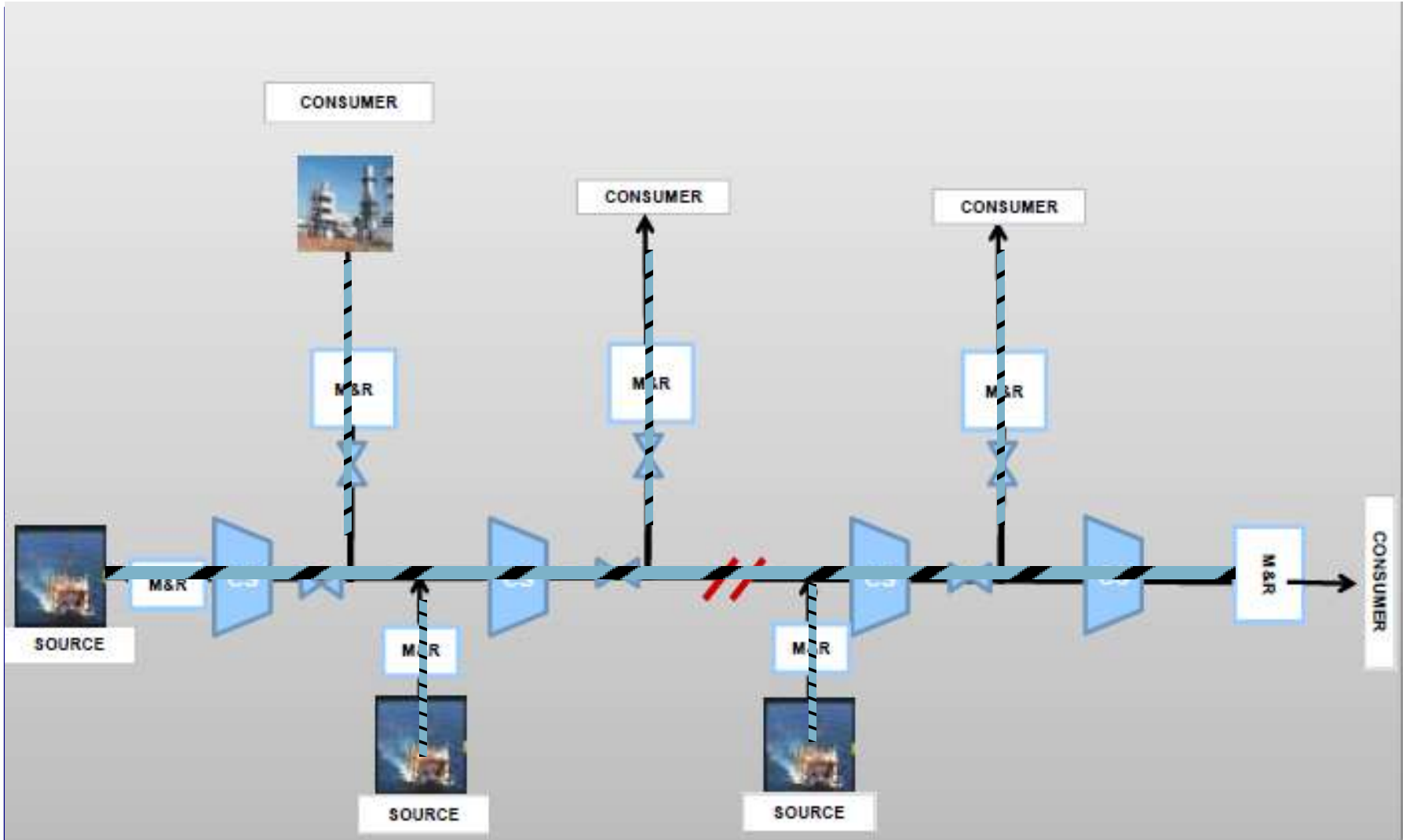
Sometimes burned off and wasted at wells because of low price

Requires pipelines

Developments in Natural gas Typical Gas Transportation

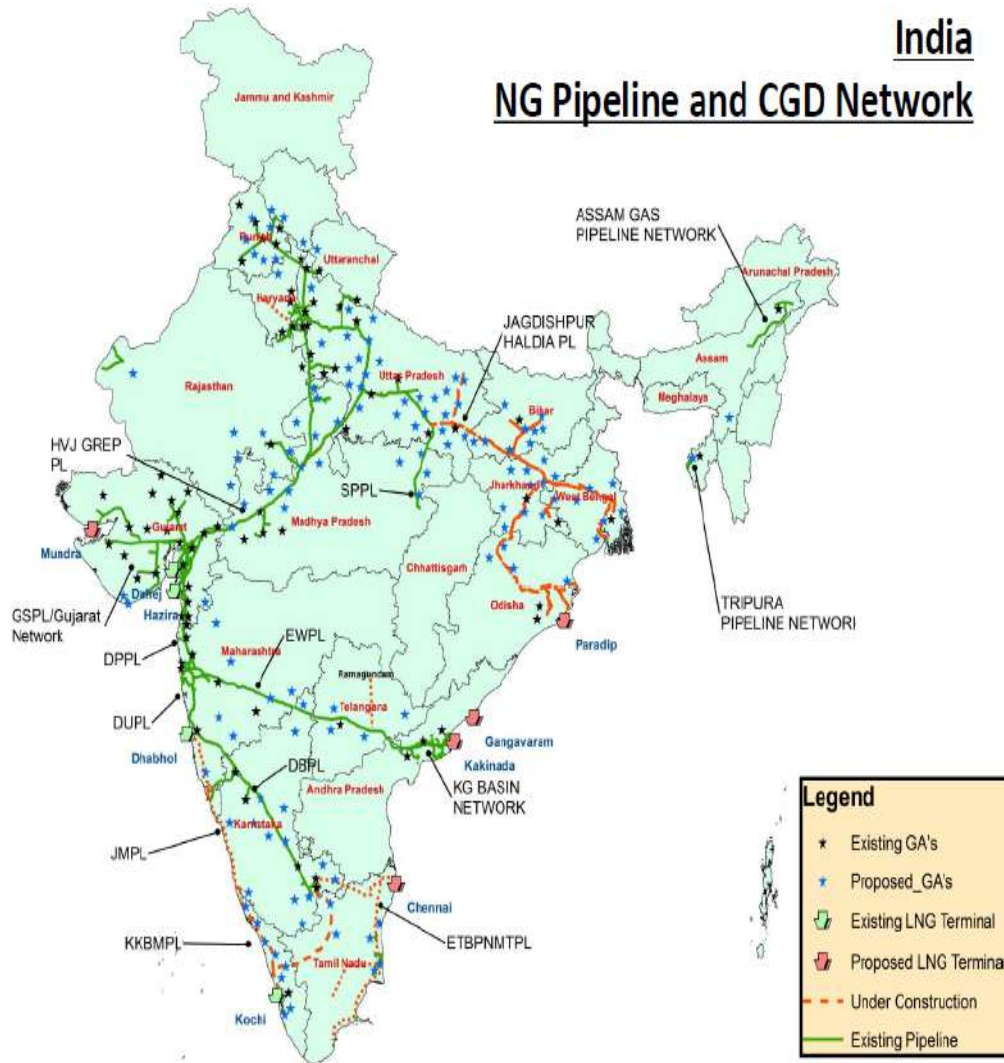


Typical Cross Country Configuration



Gas Pipeline Network

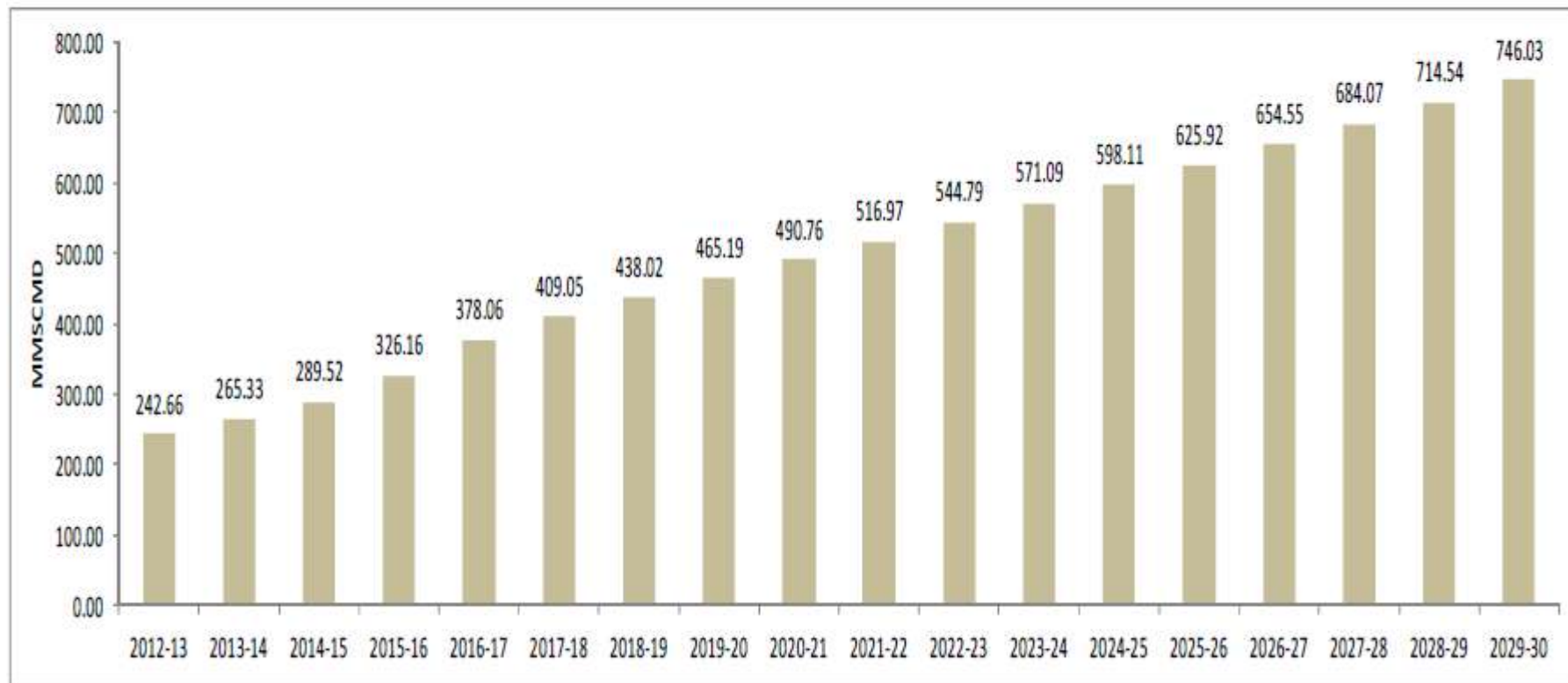
India NG Pipeline and CGD Network



- Existing Natural Gas Pipelines 16,240 KM.
- FY 16-17, India's domestic gas consumption was ~156 MMSCMD.
- Up coming NG pipeline in next 3 years – 10258 KM.
- PNGRB's "Vision 2030"
 - ✓ the overall gas demand is expected to touch ~746 MMSCMD.
 - ✓ India will have 32,787 KM of pipeline network infrastructure with 815 MMSCMD capacity.
 - ✓ City Gas Distribution CGD expected to increase to 85 MMSCMD
- India is going to become Gas based economy..

Consolidated demand forecast for all Sectors

Figure 7 Consolidated demand growth trajectory



Gas demand forecast for City Gas Distribution (CGD)

Figure 5 Gas demand from CGD sector: 2012-13 to 2029-30



India is going to become Gas based economy

- **Present scenario turned from Seller to Buyer's market**
- **High Competitiveness in Transportation needs focus on**
 - **Safety and Integrity**
 - **Gas Quality Assurance**
 - **Reliable supplies**

Table 1 Primary energy mix for India

Source	2010	2025
Coal	53%	50%
Oil	30%	25%
Gas	11%	20%
Hydro	5%	2%
Nuclear	1%	3%
	100%	100%

Major Challenges in Pipeline Operation

- ✓ **Safety of Stakeholders, Team members, and General public**
- ✓ **Creating awareness among stakeholders**
- ✓ **Internal and External Corrosion of Pipelines**
- ✓ **Ensuring Statutory and Regulatory compliances**
- ✓ **Encroachment of Pipelines**
- ✓ **Uninterrupted gas deliveries**
- ✓ **Efficiency in Pipeline transportation**
 - **System Use Gas (SUG)**
 - **Transmission Losses**



Sustainable Operations - Life Cycle



From Concept to Operations

1 – Route Selection

- Satellite Imagery
- Immersive Video
- GIS Optimisation
- Public consultation

2 - Design

- Higher Utilisation
- Working Stress Design 80% SMYS
- Strain Based design
- Limit States Design
- Reliability Methods
- Improved Geo technics
- Dense Phase Flow

3-Materials -

- High Strength Steels
- Pipe Manufacture
- Fracture control
- Composite Materials
- Non ferrous materials
- Post yield response
- Weldability
- Defect Assessment
- Coatings

4 Construction Methods

- Semi-Fully Automatic Welding
- Improved Inspection Installation Methods
- Crossings
- Trenchless construction
- Buoyancy control
- Hydrotesting and Commissioning

5 Operations

- SCADA
- Automation and Control
- Ultrasonic metering
- Pipe cleaning
- Use of drag reducing additives
- Intelligent Pigging
- Risk & Integrity management

Pipeline Life Cycle

Slip Ups

In spite of following all the Standards/Guidelines, there are always some slip ups during:

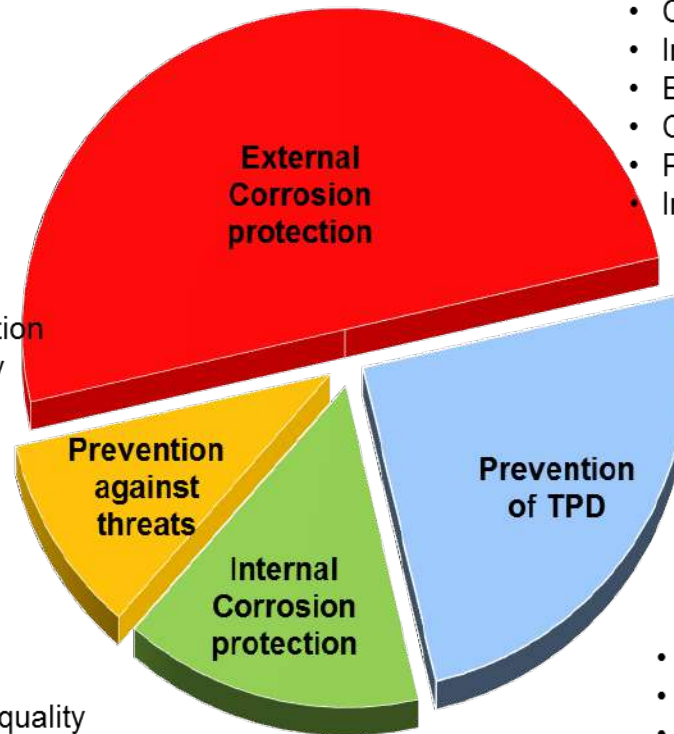
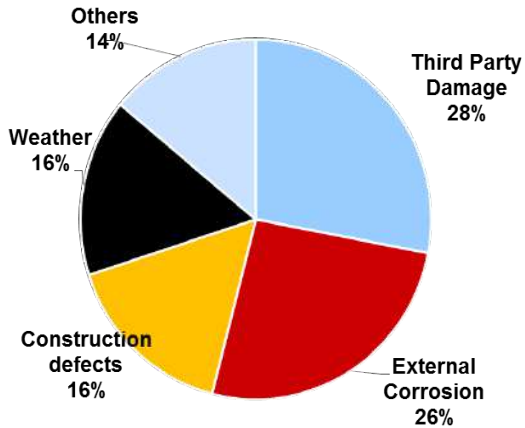
- Design
- Construction
- Commissioning
- Operation



⑩ But consequential effect predominantly is visible during Operation Phase, hence Effective Asset Integrity management shall be in place

Safety & Integrity

Typical Pipeline Failure statistics
Source: 9th EGIG report

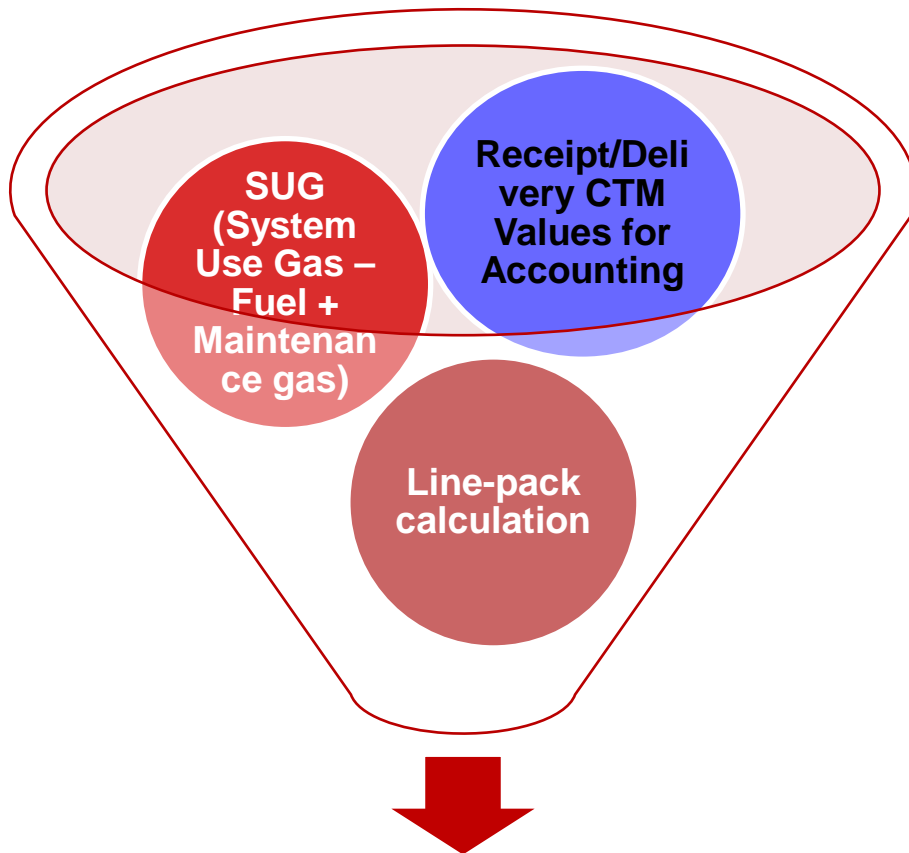


- Cathodic Protection
- Inline Inspection
- Bell Hole inspection
- CIPL/DCVG surveys
- Polarisation cells and grounding anodes
- Interference survey

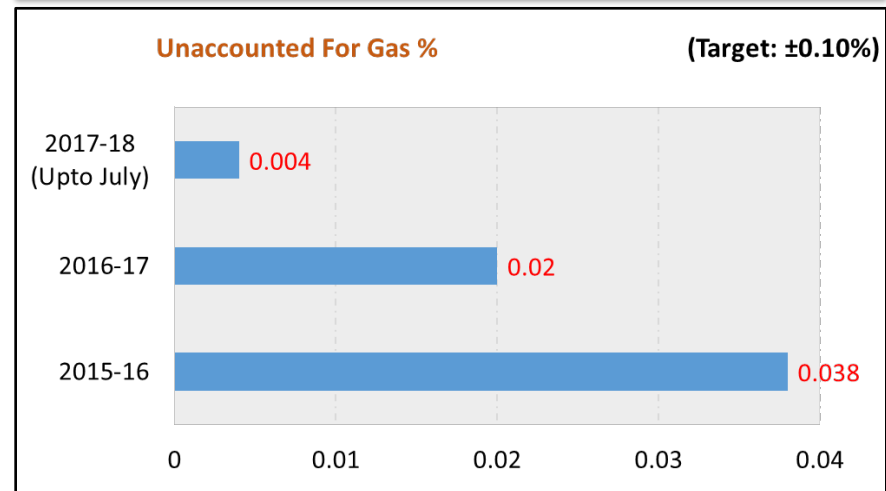
- River bank protection
- Bathymetry survey
- Maintenance of assets
- SOP/SMP
- Material Quality checks
- Cleaning Pigging
- Monitoring of gas quality
- Weight loss coupons

- PIDS
- Patrolling – Aerial / walk/ Road
- Public Awareness programme
- Prohibited area status

Efficiency (Accounting – SUG/ UFG)



- Major Opex of Pipeline is Fuel Consumption.
- UFG reflects leakage losses and Accuracy.
- For better efficiency, focus on Optimized Fuel Consumption / Control & Recirculation.
- Typical efficient operation figures represented below.

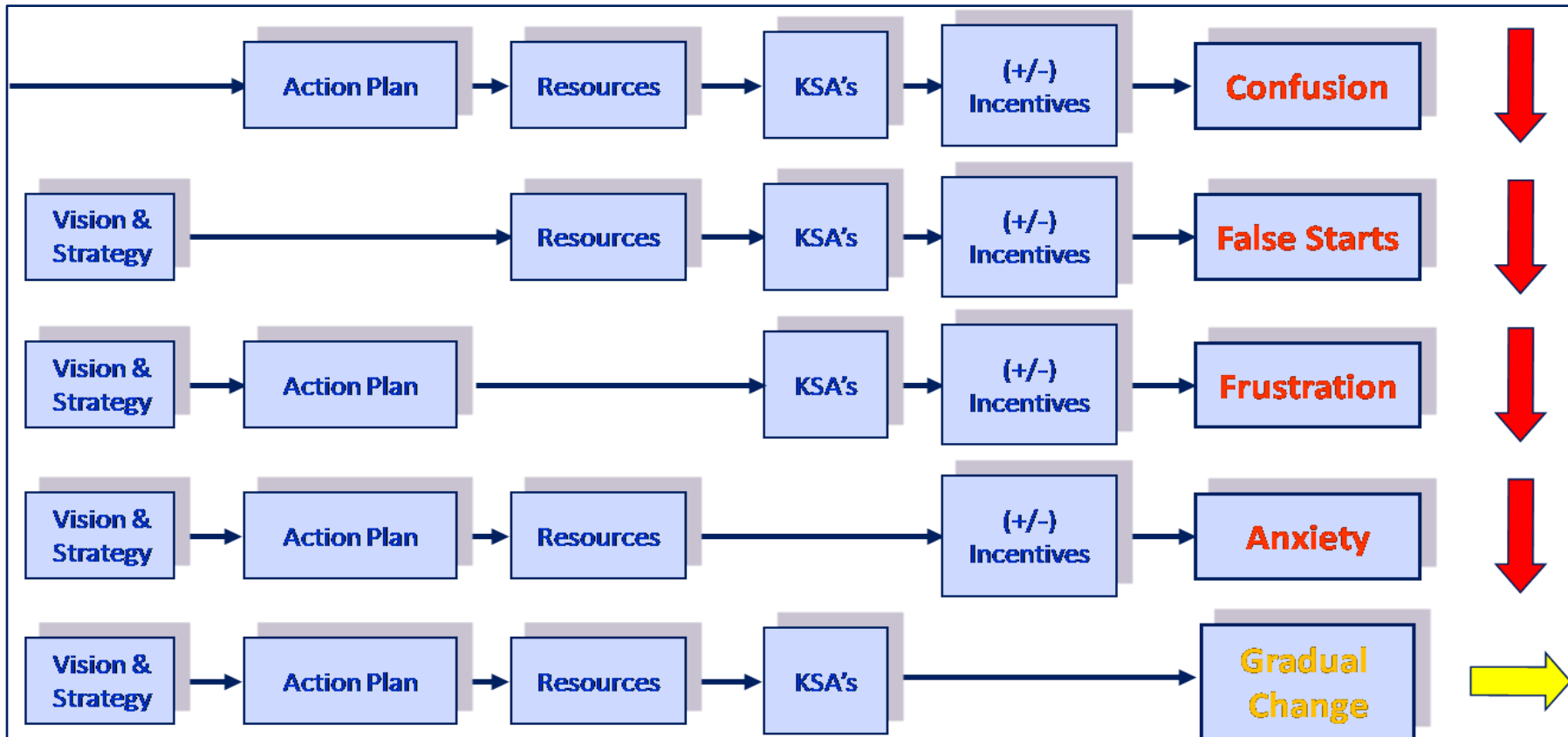


Way forward

- **Conducive atmosphere for Grid development**
- **Common corridor concept for utilities**
- **Safety awareness**
- **Cost competitiveness**
- **Periodic Interaction among pipeline operators**
- **Sharing of common assets**



Sustainable Operations Resources (People & Competency)



KSA = Knowledge, Skills, & Abilities