



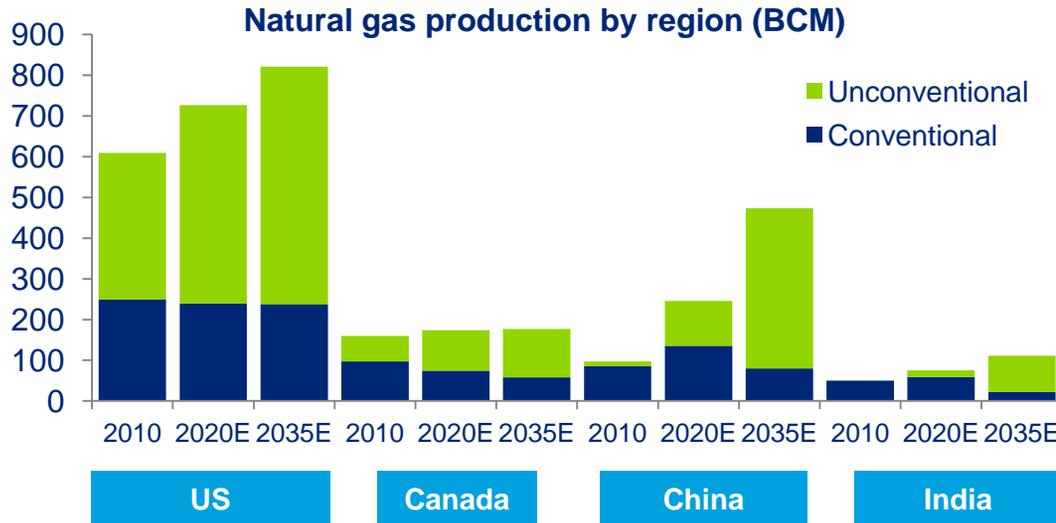
Emergence of unconventional gas in India
Challenges and Opportunities

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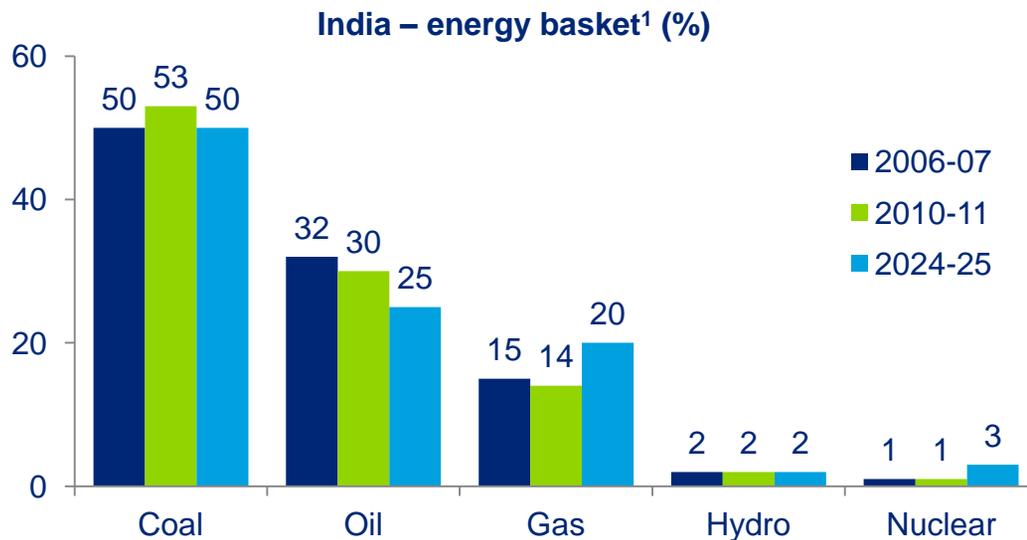
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Unconventional gas landscape

Significant shift from conventional to unconventional sources of natural gas production



Globally, the share of unconventional gas is expected to increase. It will rise in the U.S., Canada, China and India as well as in other countries



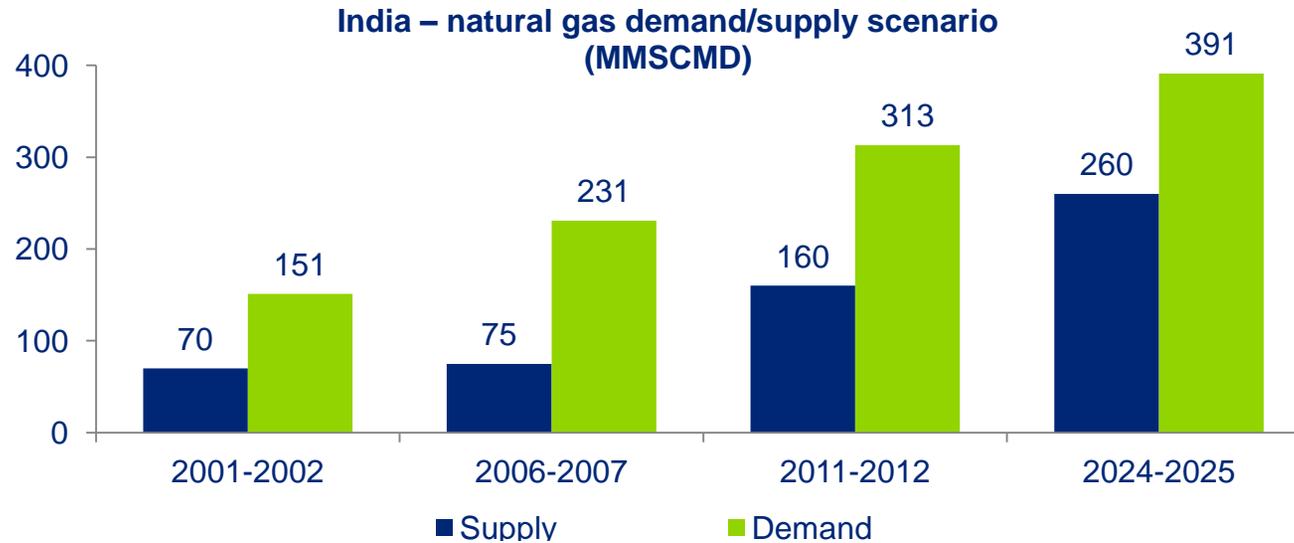
- Given the increased awareness to reduce the carbon footprint, natural gas is expected to emerge as the most preferred fuel in India
- The use of natural gas in India's energy basket will increase to 20% by 2025
- Unlocking domestic unconventional gas potential could help India meet its growing energy demand. However, it needs to be developed profitably and in an environmentally acceptable manner

¹Up to 2011 from Technical Note on Energy, Planning Commission, Govt. of India (1998-99). Beyond this period the figures have been extrapolated

Source: IEA-World energy outlook 2011, Golden Rules for a Golden Age of Gas, World Energy Council – India Energy Book - 2012

India

Natural gas demand/supply scenario

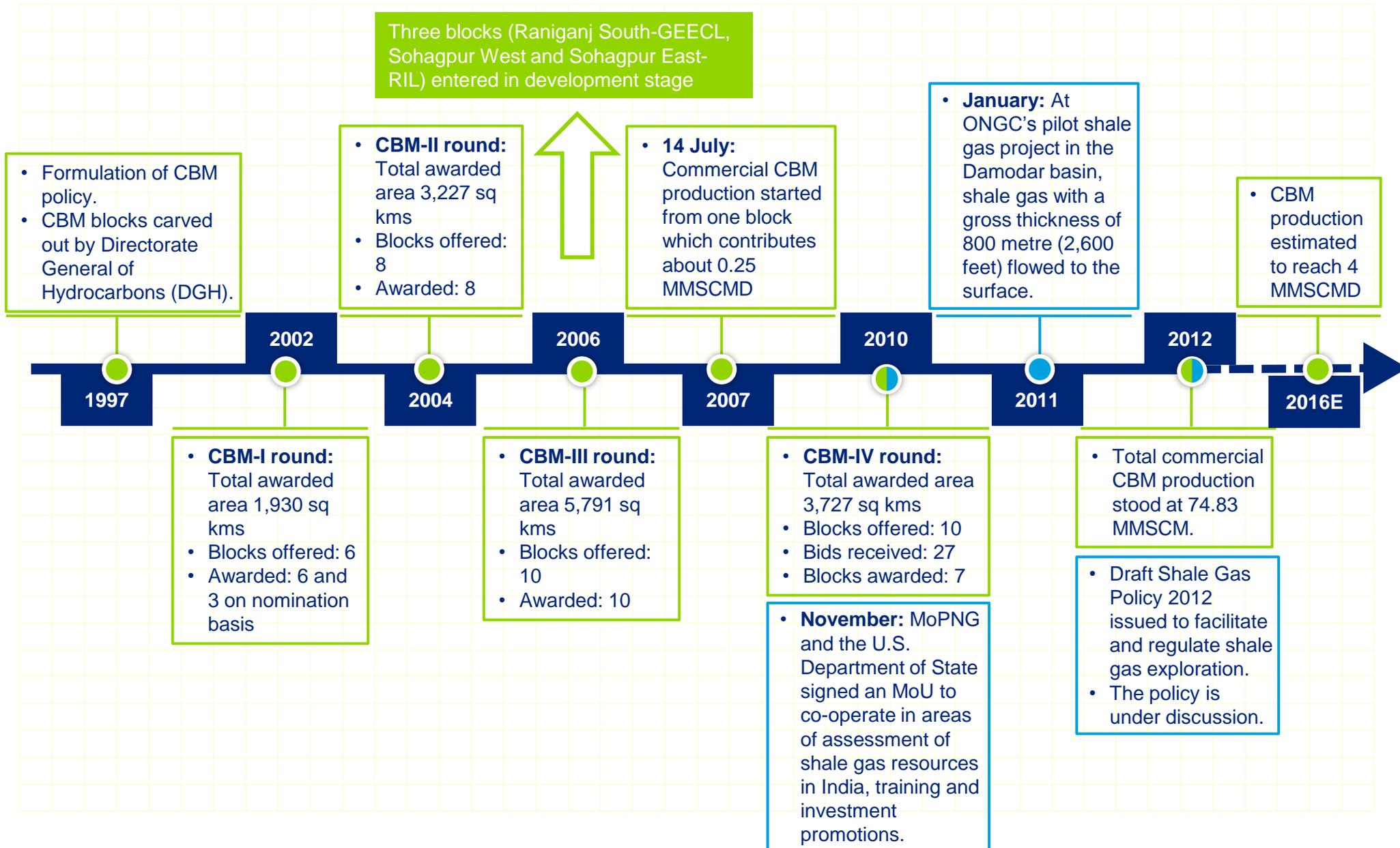


- In India, shortage of natural gas supply is likely to continue during FY2013–FY2025, increasing the country's dependence on imports and unconventional sources of natural gas
- Significant sources of unconventional gas such as Shale gas, Coal Bed Methane (CBM), Tight gas and Gas Hydrates is likely to play an important supplemental role in bridging the shortfall
- Currently, India is exploiting only 52% of its CBM resources and only 20% of the shale gas resources
- Tight gas and Gas Hydrate are yet to find a place in the country's energy basket

Source: IEA, DGH

Major milestones

India's unconventional gas journey



Source: DGH, CMPDI – Development of CBM in India, [Domain-b](#), [Money control](#)

Major milestones – CBM

- Total CBM exploration area: 26,000 sq kms
- Prognosticated CBM resources: ~92 TCF (2,608 BCM)¹
- Till date four CBM bidding rounds resulting in the award of 33 blocks covering an area of 17,200 sq kms and 63.85 TCF (1,810 BCM) of resources
- CBM-IV round:
 - 4 blocks, viz., Rajmahal (E) ,Talchir, IB Valley and Sohagpur (NE) awarded to Essar
 - One block (Mannargudi) to GEECL and 2 blocks (Satpura & Assam) to Arrow-Tata-OIL consortium
- Total CBM commercial production as of February 2012 stood at 74.83 MMSCM, much less than 19,971.25 MMSCM of natural gas production from conventional sources
- CBM production is estimated to reach 4 MMSCMD by 2016

Current status of CBM blocks awarded till date

Date	No. of Blocks	Area (Sq.Km.)
West Bengal	4	1308
Jharkhand	7	2454
Madhya Pradesh	7	3701
Rajasthan	4	3972
Chhattisgarh	3	1917
Andhra Pradesh	2	1136
Maharashtra	1	503
Gujarat	1	790
Orissa	2	766
Tamil Nadu	1	766
Assam	1	113
Total	33	17,246

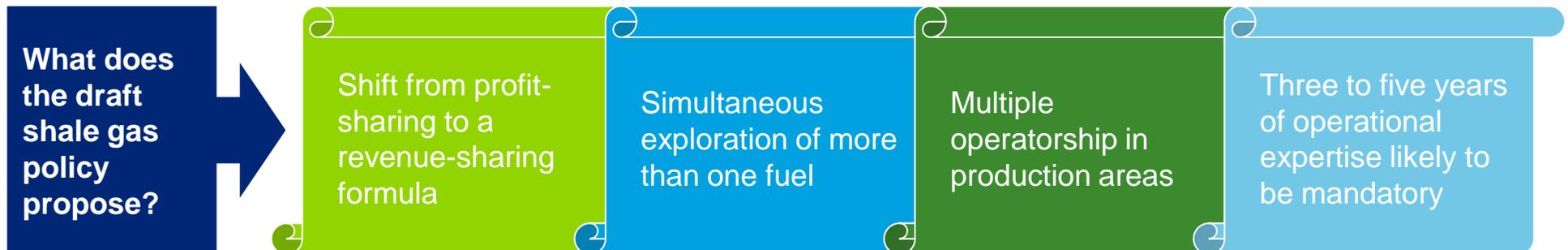
¹According to the Energy Information Administration (EIA)

Source: DGH, Energy Information Administration (EIA)

Major milestones – Shale

- Shale gas production at a nascent stage in India
- Shale gas-in-place: 290 TCF with technically recoverable resource of 63 TCF
- DGH under MoPNG has initiated steps to:
 - Identify prospective areas for shale gas exploration and acquisition of additional geoscientific data
 - Formulation of policy for Shale Oil & Gas exploration
 - Launch first Shale Oil & Gas round
- Draft Shale Gas policy on licensing under discussion
- Proposal to conduct first shale gas licensing round in 2013

Basin	Resource
Cambay Basin (Older and Younger Cambay Shale)	20 TCF
Krishna Godavari Basin (Kommugudem and Raghavpuram Shale)	27 TCF
Cauvery Basin (Andimadam and Sattapadi Shales)	9 TCF
Damodar basins (Barren Measure)	7 TCF
Assam-Arakan (northeast)	
Indo-Gangetic basin	



Source: DGH, Energy Information Administration (EIA), Yale.edu

Major milestones – Tight Gas and Gas Hydrates

Tight Gas

- An established and promising unconventional resource
- Usually associated with existing oil fields as bypassed zones or unexplored/unidentified areas in the same field or in unexplored areas
- Parameter to classify a tight gas reservoir: permeability below or equal to 0.01mD

Prospective tight gas resource potential

Bhuvanagiri Formation (permeability of 0.033 mD) and Albian Andimadam sandstone in the Cauvery basin

Mandapeta sandstone (permeability of 0.01 mD) in Krishna-Godavari basin

Mukta and Bassen formations (Mumbai offshore)

Wadu pay unit in Mandhali member (lower Eocene)

Cambay and Vindhyan Basin

Gas hydrates

Resource estimate:

- India holds prognosticated 1,894 TCM of gas hydrate resources
- National Gas Hydrate Program (NGHP) estimates the Krishna-Godavari basin to hold rich gas hydrate deposits within fractured shales

Key challenges:

- Lack of proven technology to exploit methane from gas hydrate on a commercial scale
- Low gas production rate
- Managing excess water
- Environmental hazards

Source: DGH, [Economic times](#), [Cprm.gov](#)

Potential opportunity areas

Potential opportunity areas

CBM and Shale

CBM - Sunrise sector

- Is an alternative supplementary source of clean energy and a viable alternative to CNG
- Can be used as automotive fuel and help in reducing pollution levels
- Provides opportunity to earn carbon credits under the Clean Development mechanism
- Provides opportunities for investment in gas transportation infrastructure
- Provides the opportunity for R&D and development of new CBM technologies

Shale gas – key for achieving energy security

Will reduce India's dependence on energy imports

Provides business opportunities for service providers, operators and equipment companies

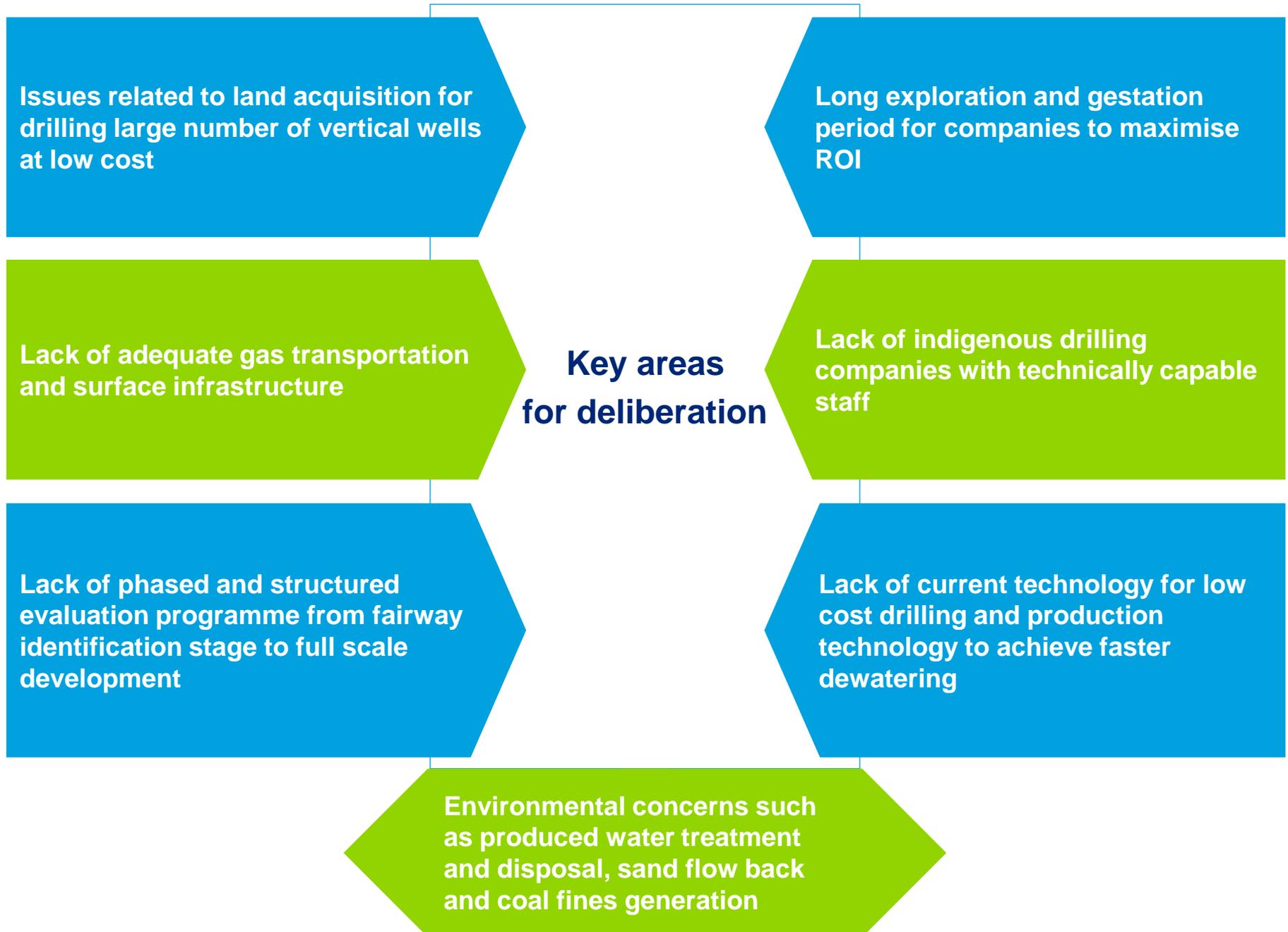
Provides opportunity to develop gas based power stations as it is relatively cheaper than coal based power stations

Collaborate with U.S. companies to import shale gas exploration technology and skills

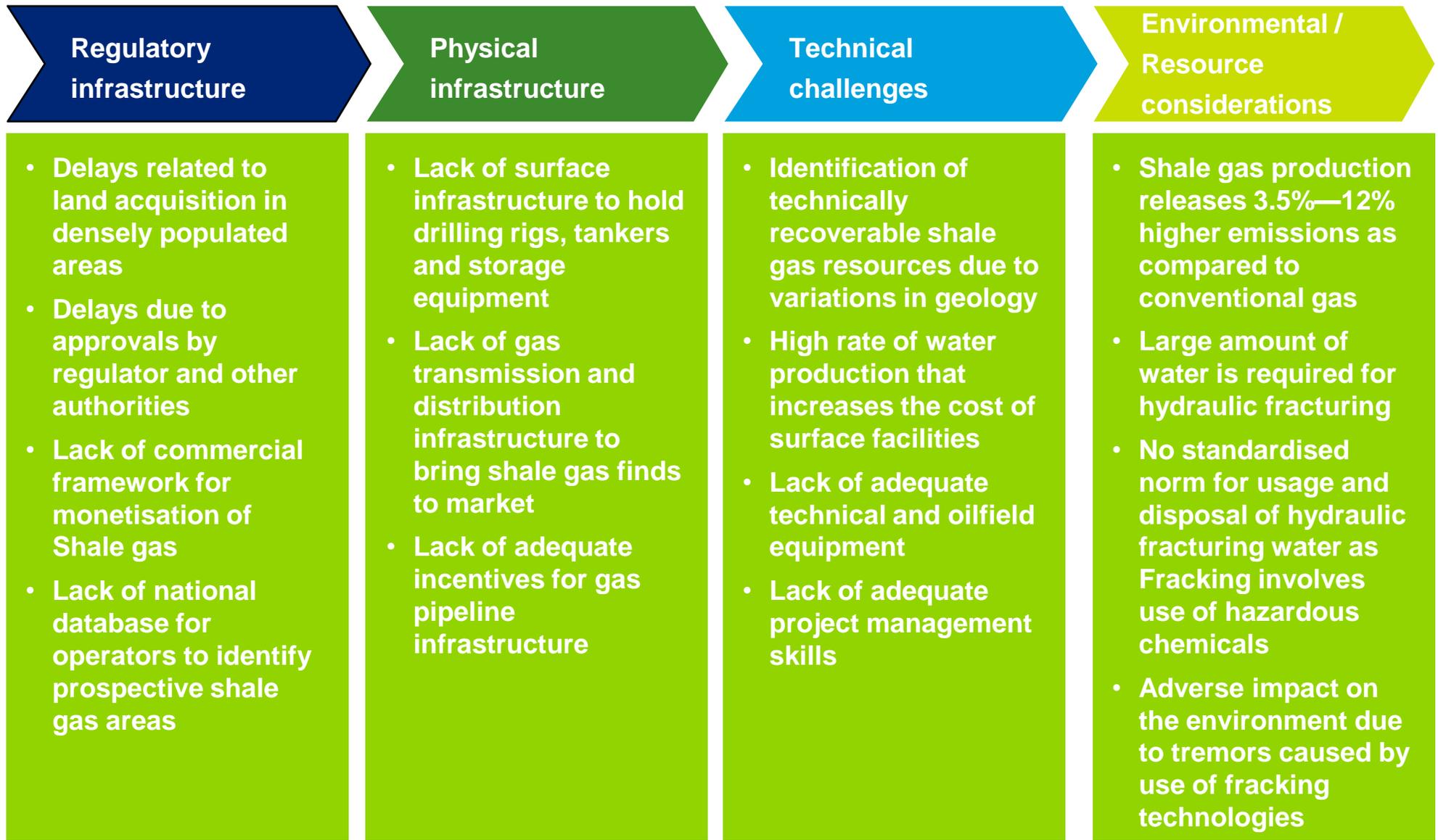
Source: CSIS - Prospects for Shale Gas Development in Asia, [Projectsmonitor](#)

Key areas for deliberation

CBM



Shale gas – Key areas for deliberation



Source: <http://cbey.yale.edu/news/206/58/Is-Shale-Gas-the-Answer-to-India-s-Energy-Challenges>, <http://businesstoday.intoday.in/story/india-energy-woes--shale-gas-policy/1/193221.html>



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