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Potential and Strategy of Shale Oil/Gas in Mexico

Gustavo Hernández-García
Planning and Evaluation, Pemex E&P

PLATTS
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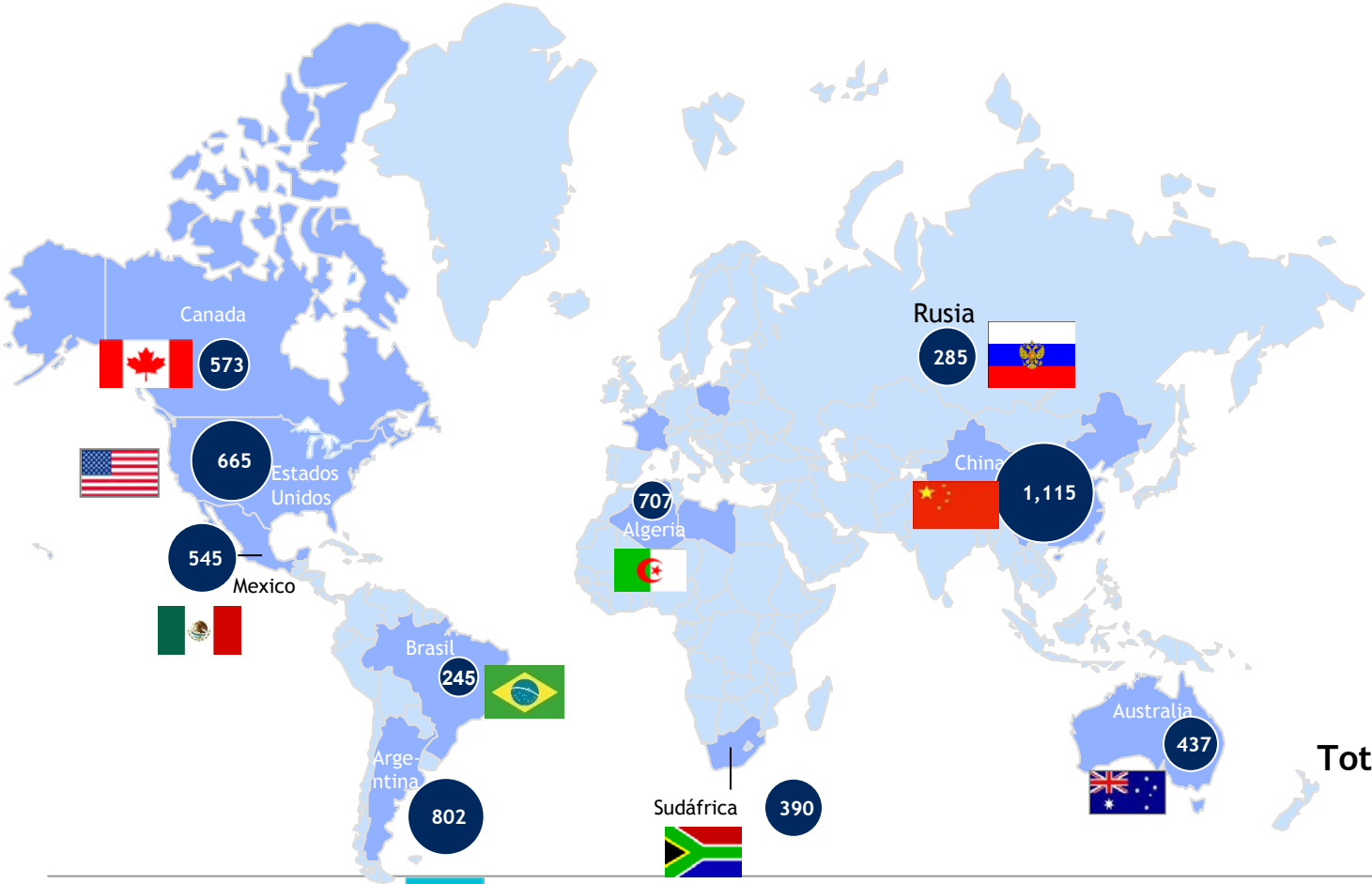
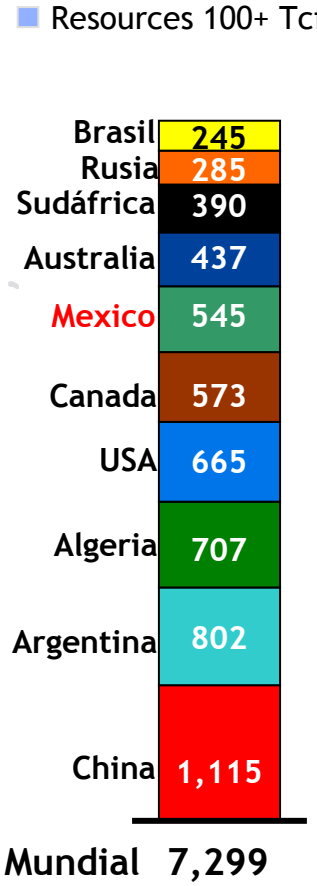
About 76% of the technically recoverable resources of Shale Gas are outside North America

Technically recoverable resources of Shale Gas (Tcf)

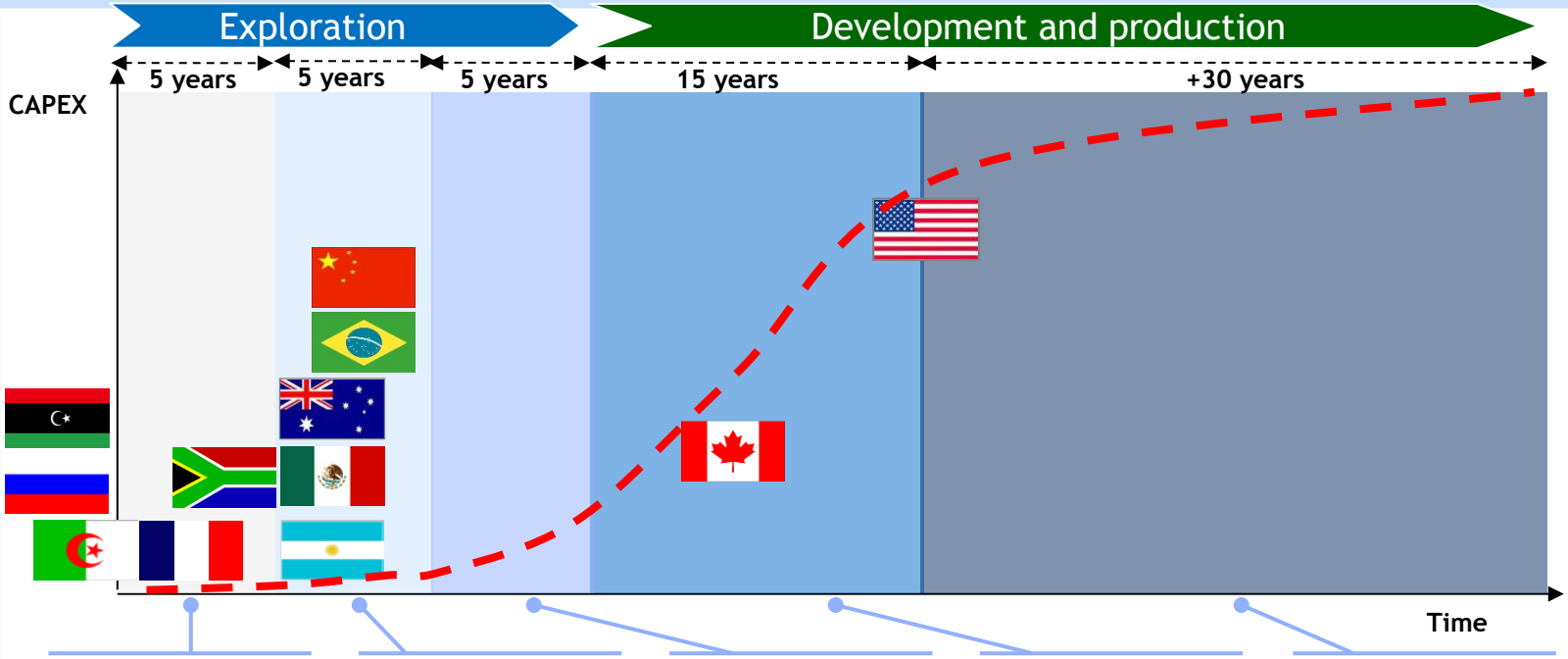




Source: U.S. Energy Information Administartion (EIA)

However, unconventional development in Europe, Asia and Latin America remains behind the United States and Canada

Country evolution on unconventional development curve



'Analysis of basins and plays'

- There are no drilled wells
- Largely "known" basins
- Limited data (reservoir quality, well productivity)

'Reduction of risk'

- Exploratory drilling
- Information acquisition focused in reservoir quality and well productivity

'Pilot Commercial development'

- Secure markets access
- Drilling/well design optimization

'Massive development'

- Progress has been made in the learning curve
- Focus on long term well performance

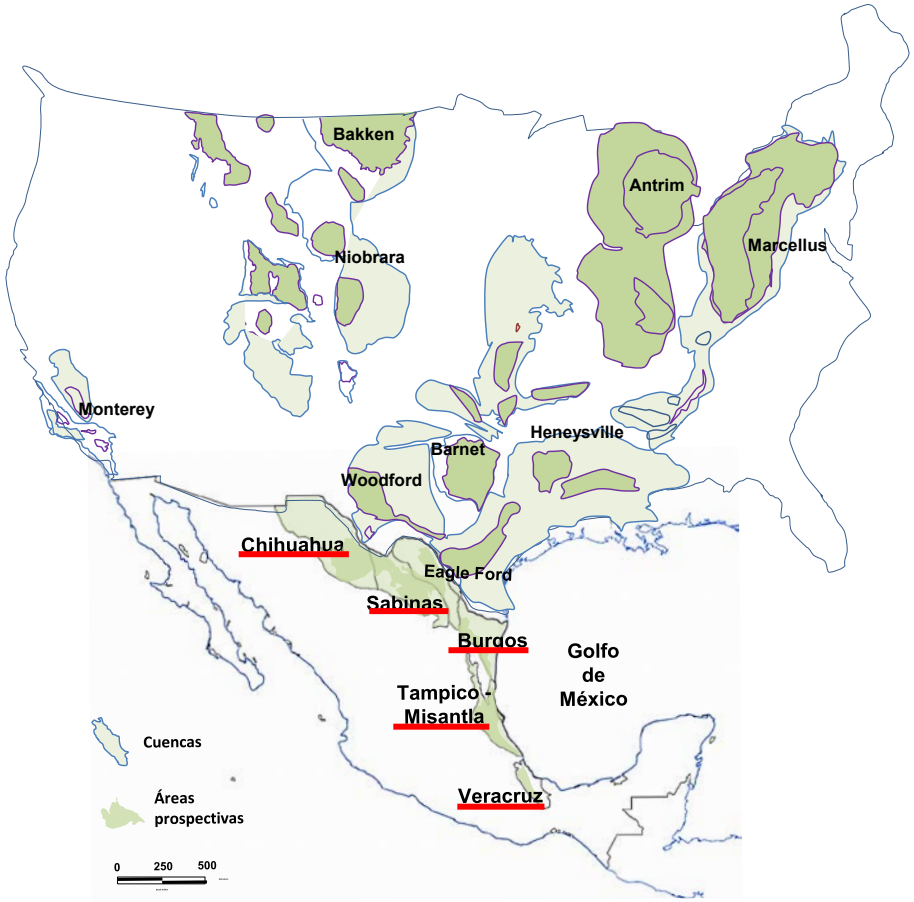
'Consolidation'

- Consolidation / optimization of basins and/or shale oil-gas plays

- **It has taken at least 35 years for the US shale industry to reach its current scale**

Source: McKinsey and Company

Plays of Shale Oil/Gas in USA and Mexico



Map of major Shale Oil/Gas Plays in United States and Mexico

- The major Shale Oil/Gas Plays in the U.S. are: **Bakken, Eagle Ford and Niobrara, which produce oil and gas. Woodford, Marcellus, Barnett and Haynesville are producing mainly gas**
- Some of these plays like Eagle Ford and Woodford have continuity across the border with Mexico, others as Bakken and Haynesville are analogues of Plays in Mexico
- From geological and geochemical analysis, we have identified in Mexico **Six provinces** with potential shale oil/gas plays: **Chihuahua, Sabinas, Burro-Picachos, Burgos, Tampico-Misantla and Veracruz**
- Within these provinces, the stratigraphic levels related to these plays are from Tithonian Upper Jurassic and Turonian Upper Cretaceous ages

Shale Oil/Gas plays in USA had required years to understand the concept

The major Shale Oil/Gas Plays in the U.S. are:

- **Bakken 1985_2010.avi**
- **Eagle Ford 2006_2010.avi**
- **Barnett_1982-2010.avi**

The link to download the animation is:

http://www.eia.gov/pub/oil_gas/natural_gas/analysis_publications/maps/maps.htm

As a result of geophysical, geological and geochemical studies, PEP has estimated an important amount of prospective resources of Shale Oil/Gas

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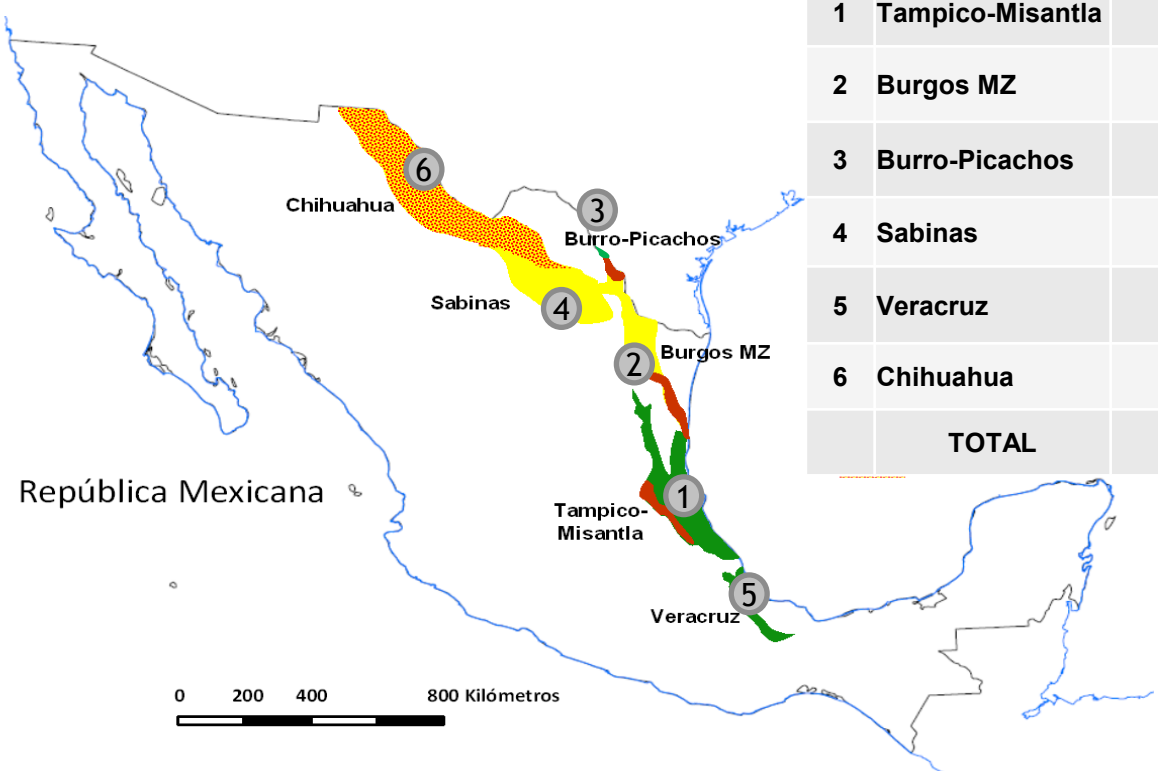
Prioritization of areas

#	Province	Oil (Bbls)	Wet gas (TCF)	Dry gas (TCF)	Billion (BOE)
1	Tampico-Misantla	30.7	20.7	0	34.8
2	Burgos MZ	0	9.5	44.3	10.8
3	Burro-Picachos	0.6	6.6	11.4	4.2
4	Sabinas	0	0	49	9.8
5	Veracruz	0.6	0	0	0.6
6	Chihuahua	In study			
	TOTAL	31.9	36.8	104.7	60.2



Oil
Wet gas
Dry gas
In study

Because of its magnitude the Shale Oil/Gas resources are very important to provide long term supply of hydrocarbons

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Strategic Goals

Goals 2013-2017

- Keep an average oil production between of 2.5 and 3.0 Mbpd
- Keep an average gas production between 5.7 and 6.2 Bcfd
- Restore proven reserves equal to or greater than 100%
- Keeping production costs
- in the first quartile and optimize the costs of discovery and development to bring them to the first quartile
- Achieve goal of zero accidents
- Achieve the goal of being perceived as a socially responsible company

Lines of action

Initiatives

Growth

1. Increase inventory of reserves by new discoveries and reclassification
2. Increase production of hydrocarbons
3. Increase and improve execution capacity

Operating Efficiency

4. Optimize investment
5. Optimize operation expenditures
6. Optimize production distribution and commercialization operations

Modernization of management

7. Modernize the technological management
8. Generate and develop talent
9. Focusing on the organization in terms of business
10. Improve planning, execution and control of projects

Corporate responsibility

11. Continue implementation of best practices in safety and occupational health
12. Promote environmental protection and sustainable development
13. Strengthen quality relationships with the community

Management of Strategy

Strategies

Workflow for exploration and development of unconventional resources

Pemex has implemented a process to reduce the uncertainty of geological models and the potential resource estimate, and focus massive development, taking into account environmental regulations and favoring sustainable development.

Phase 1

Evaluation of prospectivity and resource identification

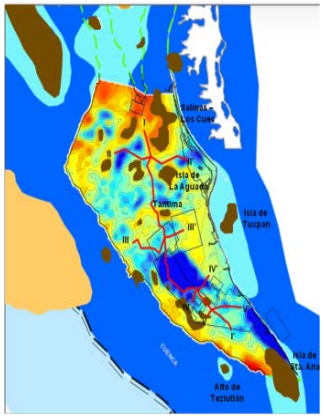
- Regional analysis
- Identification of potential plays
- Ranking of basins Resource estimation
- Generate an exploratory locations portfolio

- Drilling of pilot wells
- Testing of the concept
- Pilot wells evaluation

Phase 2

Geological characterization and uncertainty reduction

- Detailing plays studies
- Identification and delineation of areas with higher productivity

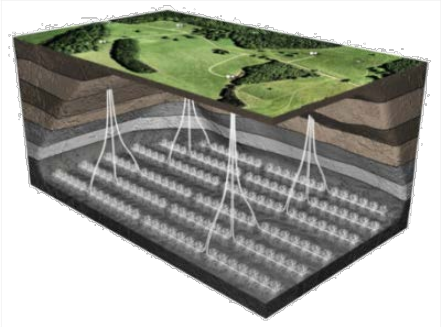


- Drilling assessment and delineation wells
- Reservoir characterization

Phase 3

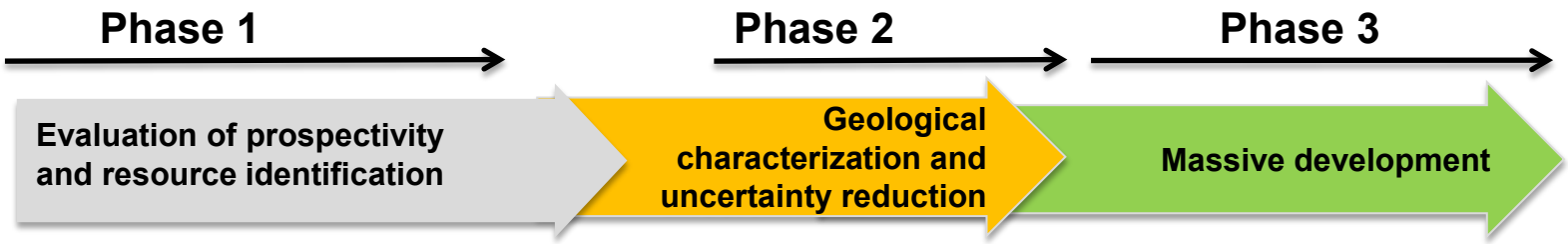
Massive development

- Development plan
- Well fracturing design to increase production
- Cost efficiency
- Sustainable development



- Geochemical and geomechanical data acquisition in wells
- Efficient designs for multifracking during well completions
- Well fracking and production yield monitoring

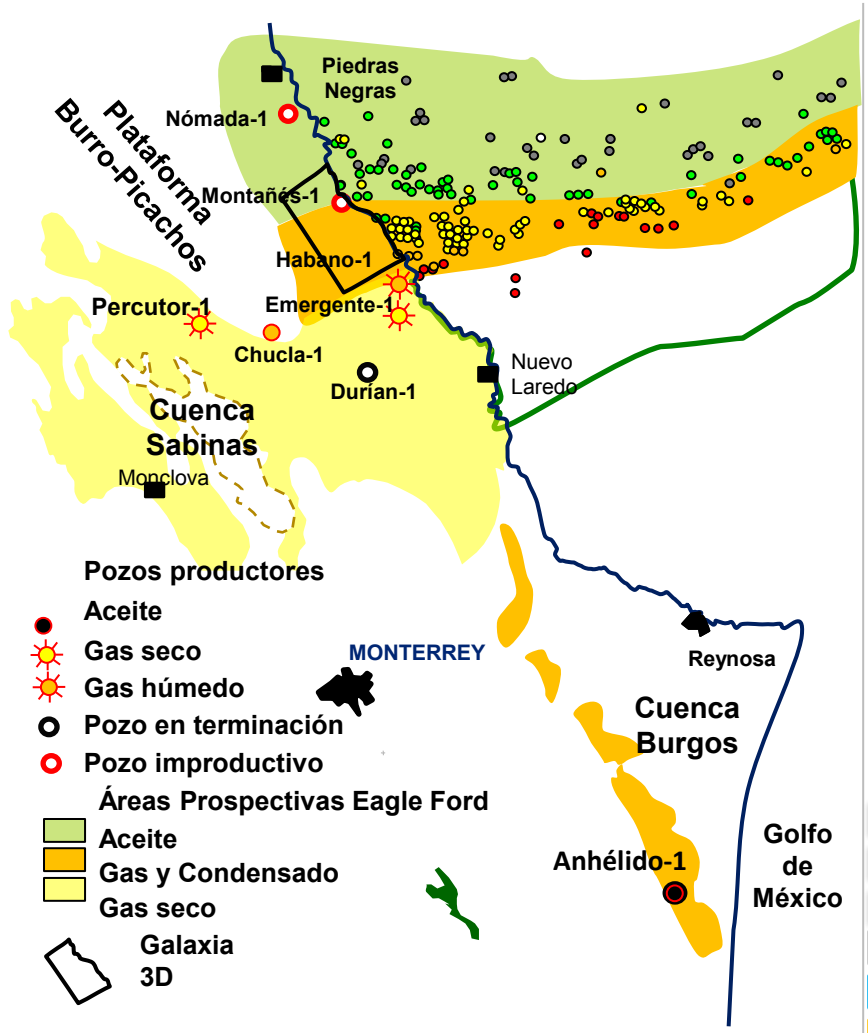
Drilling program to test and delineate the potential of Shale Gas / Oil in Mexico

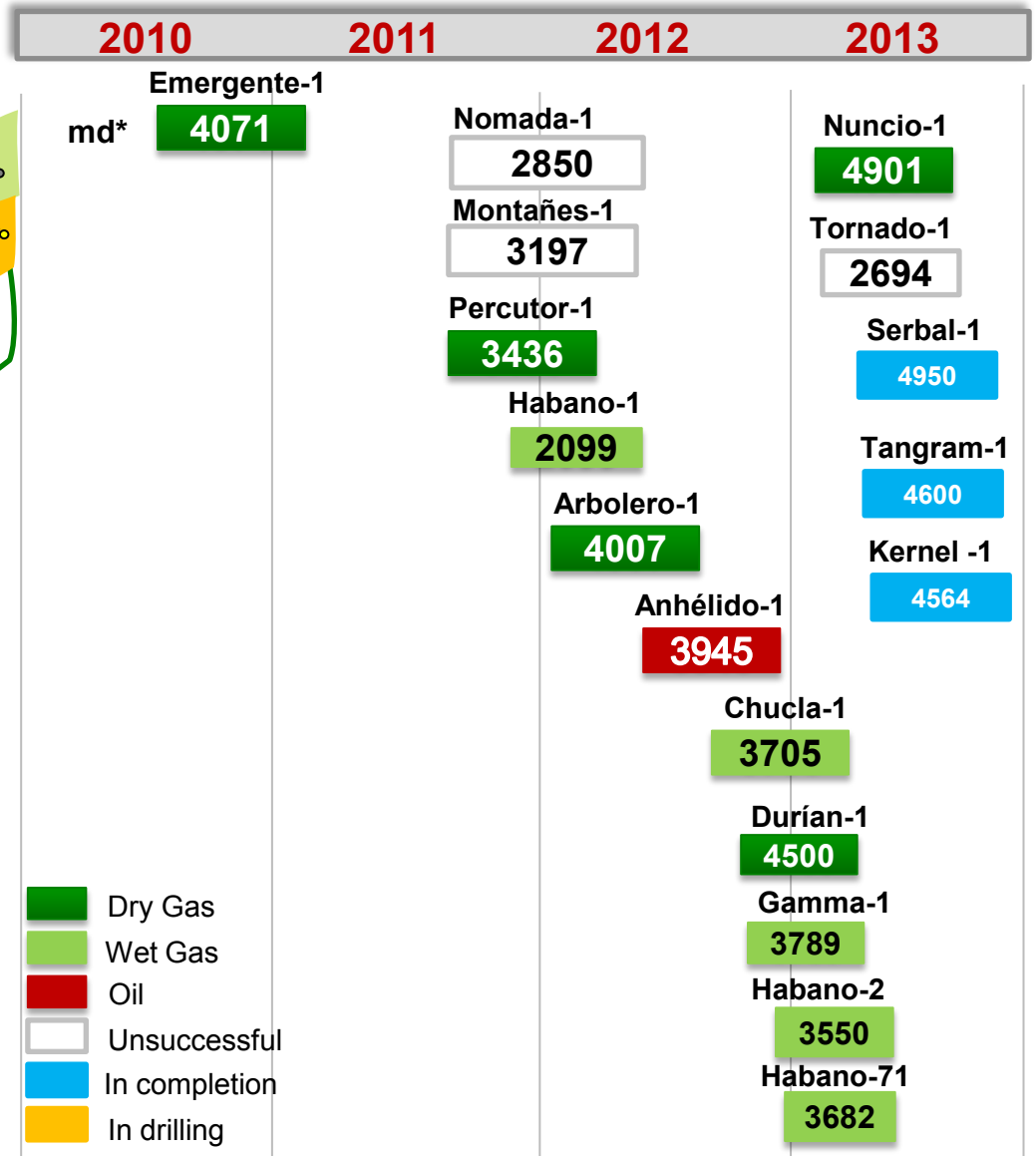


Area/Basin	2010	2011	2012	2013	2014	2015	2016	Unit / Play
Burro Picachos	20 wells						Total of: 175 wells	Eagle Ford, La Casita
Sabinas			30 wells					Eagle Ford, La Casita
Burgos Mesozoico				25 wells				Eagle Ford, Pimienta
Tampico-Misantla			80 wells					Agua Nueva, Pimienta
Veracruz				10 wells				Maltrata
Chihuahua					10 wells			Eagle Ford, Paleozoico

Evaluation period by area or play: 2 - 4 years

Results on drilling and completion of Shale Gas/Oil wells



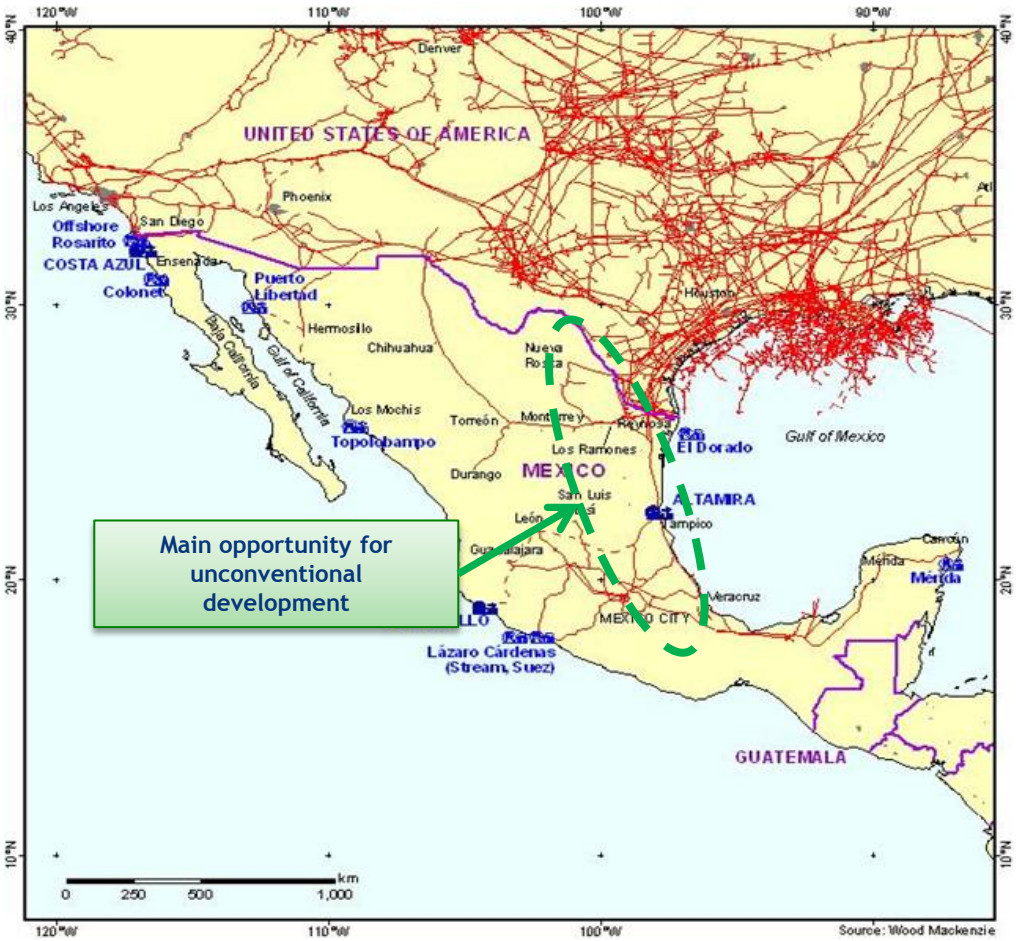


dm*= deviated meters

There are critical issues that will determine the pace of development of these resources

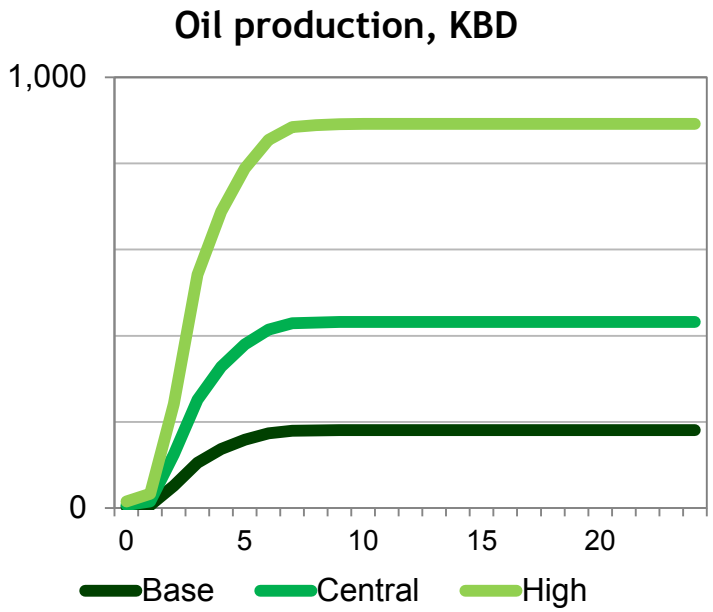
Issues	Impact in Shale Oil/Gas projects
1 Gas price	▪ It is estimated that gas prices remain below 6 Dlls/mbtu, **affecting** consequently the profitability of these projects
2 Well costs	▪ Improvement of well designs and implementation of technologies will reduce drilling well costs
3 Infrastructure	▪ The recollection, transport and distribution pipeline network must be available; adapted or constructed for the gas market
4 Tax regime	▪ A special tax regime is needed to incentive the development of gas projects (conventional and unconventional)
5 Investment	▪ CAPEX allocation will determine the production rate of this resource

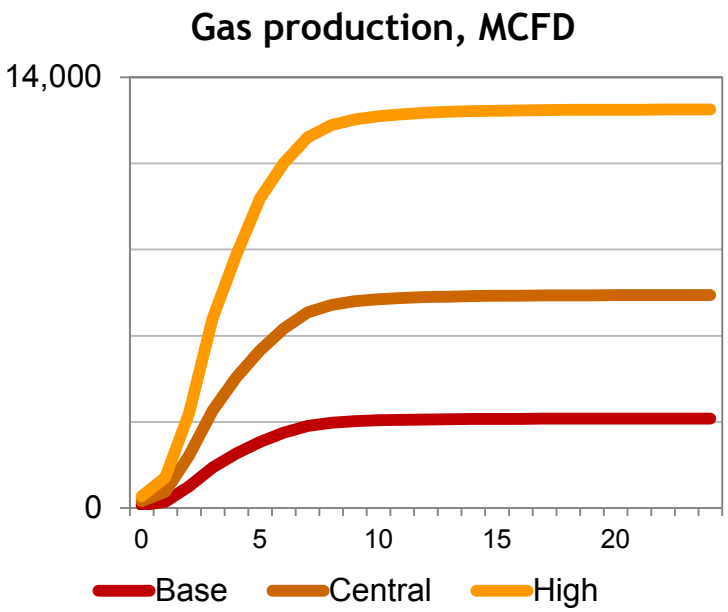
The development of pipeline infrastructure is undoubtedly one of the main challenges



- The existing Shale Oil / Gas plays in the United States benefited from a large underutilized pipeline infrastructure (in the early stages of development)
- Therefore, PEP is analyzing current capacity and physical state of the existing pipelines network, to determine additional infrastructure requirements
- Therefore a better planning will optimize construction of additional processing and pipeline infrastructure before the massive development of the unconventional resources in the identified plays

The monetization of shale gas/oil resources will depend upon the CAPEX allocation and execution capacity



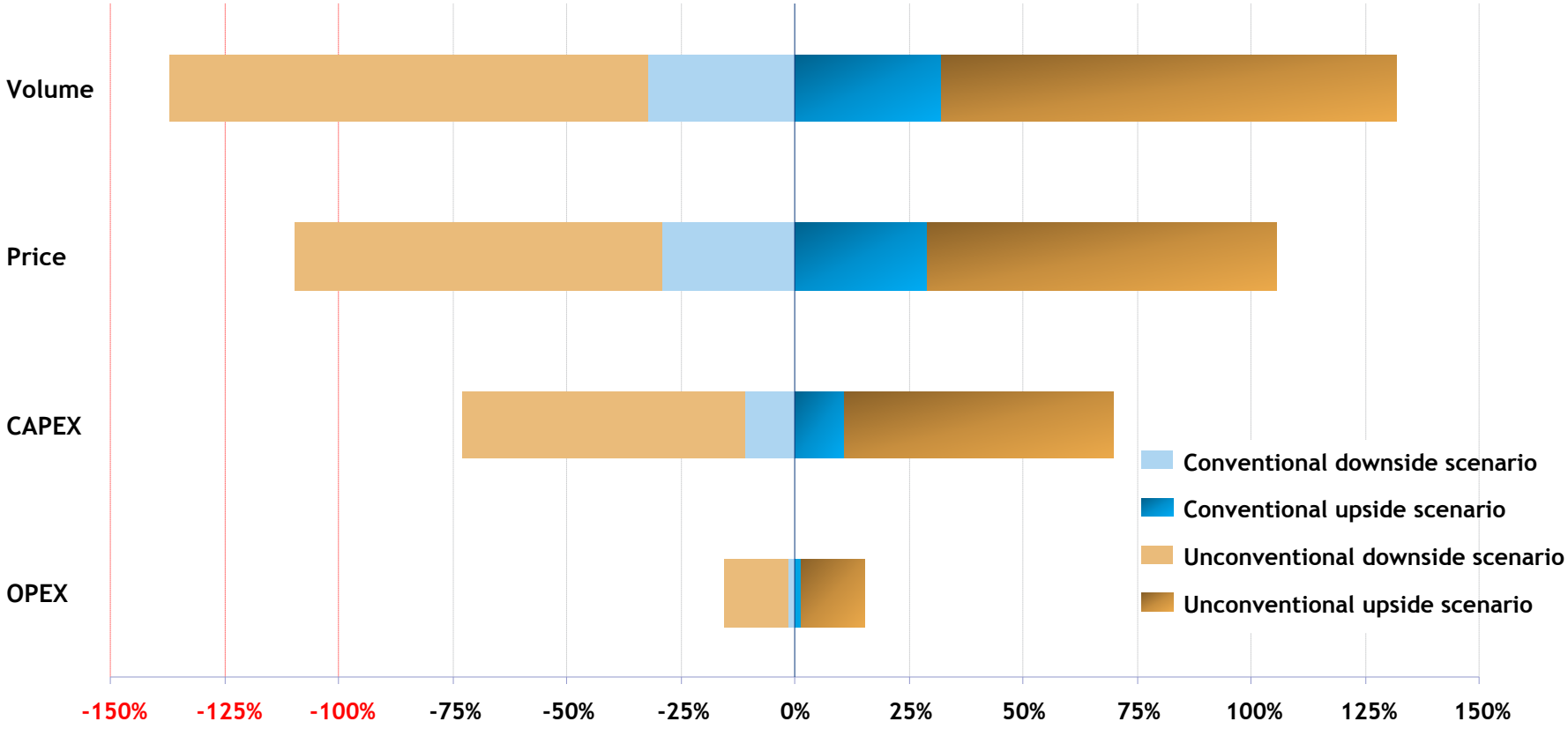


Requirements	
WELLS	> 60,000

Execution must be according to best practices since most unconventional assets are "more marginal" than conventional assets

Developing an unconventional asset is dramatically more sensitive to key uncertainties than a conventional development, and far more at risk of negative returns in downside scenarios

Impact on Total After Tax NPV with a +/- 20% change in



Source: Wood Mackenzie Global Economic Model; Base price assumption: $75 / bl flat in real terms, sensitivities for all variables run at +/- 20% of the base case

Conclusions

- In Mexico, we have identified six provinces with potential oil and gas in shale: Sabinas, Burro-Picachos, Burgos, Tampico-Misantla, Veracruz and Chihuahua, and has established an exploration strategy included and aligned with Business Plan of PEMEX and Execution Program of PEP
- Technically recoverable prospective resources of shale oil and gas amounted to 60.2 billion barrels of oil equivalent
- The development of these resources will depend upon CAPEX allocation and increment of execution capacity
- In addition tax incentives are critical to develop shale gas/oil and contribute to economic growth

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Characterizing Shale Plays - Challenges

- No industry standard for evaluating shale plays:
  - Most attention has been in the last 5-10 years
- Reservoir characteristics are difficult to quantify:
  - Low matrix porosity & permeability
  - Presence of fractures is critical
  - Horizontal drilling and hydraulic fracturing required
  - Effective drainage area is hard to define
  - Commercial boundary is flexible
  - Cost reduction is critical
- Measuring success:
  - Geologic information alone is a poor predictor of well performance
  - Success is judged on well production
  - **With well production comes a lot of uncertainty**