



**APERC Annual Conference  
Tokyo, 26 March 2014**

# **Pathways to shale gas development in APEC:**

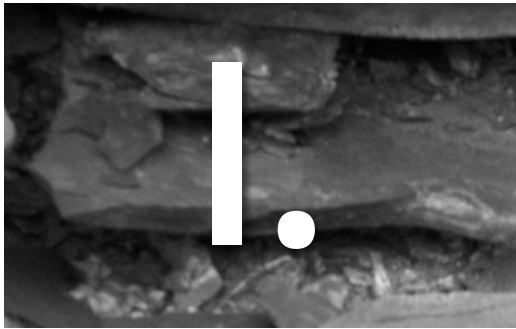
**Barriers and opportunities for shale gas and liquids  
development beyond the United States**

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- I. **APERC's report**  
*Pathways to shale gas development in Asia Pacific*
- II. **APEC in the global natural gas landscape**
- III. **The United States experience as an input for policymaking**
- IV. **Towards a policy framework for shale gas development**
- V. **Preliminary barriers and opportunities by economy**
- VI. **Final thoughts**





# Background

- Cognizant of the role of **natural gas to reduce carbon emissions**, APEC Energy Leaders instructed in June 2010 the elaboration of an **Unconventional Gas Census to evaluate the potential of unconventional resources** and recommended cooperative actions that could increase natural gas output and trade in Asia Pacific.
  - On January 2013, the APEC Unconventional Natural Gas Census was released to foster a better understanding of the shale gas, tight gas and coalbed methane resources in Asia Pacific.
- The need for an energy transition with lower carbon intensity, the decline of conventional natural gas supplies and the concentration of proved reserves in a small number of economies (Iran, Russia and Qatar alone holding roughly 50%), make **unconventional production likely to grow in the following years**.
  - While these unconventional resources present a larger and more extensive distribution than conventional natural gas reserves, their development involves greater technical complexity and costs.

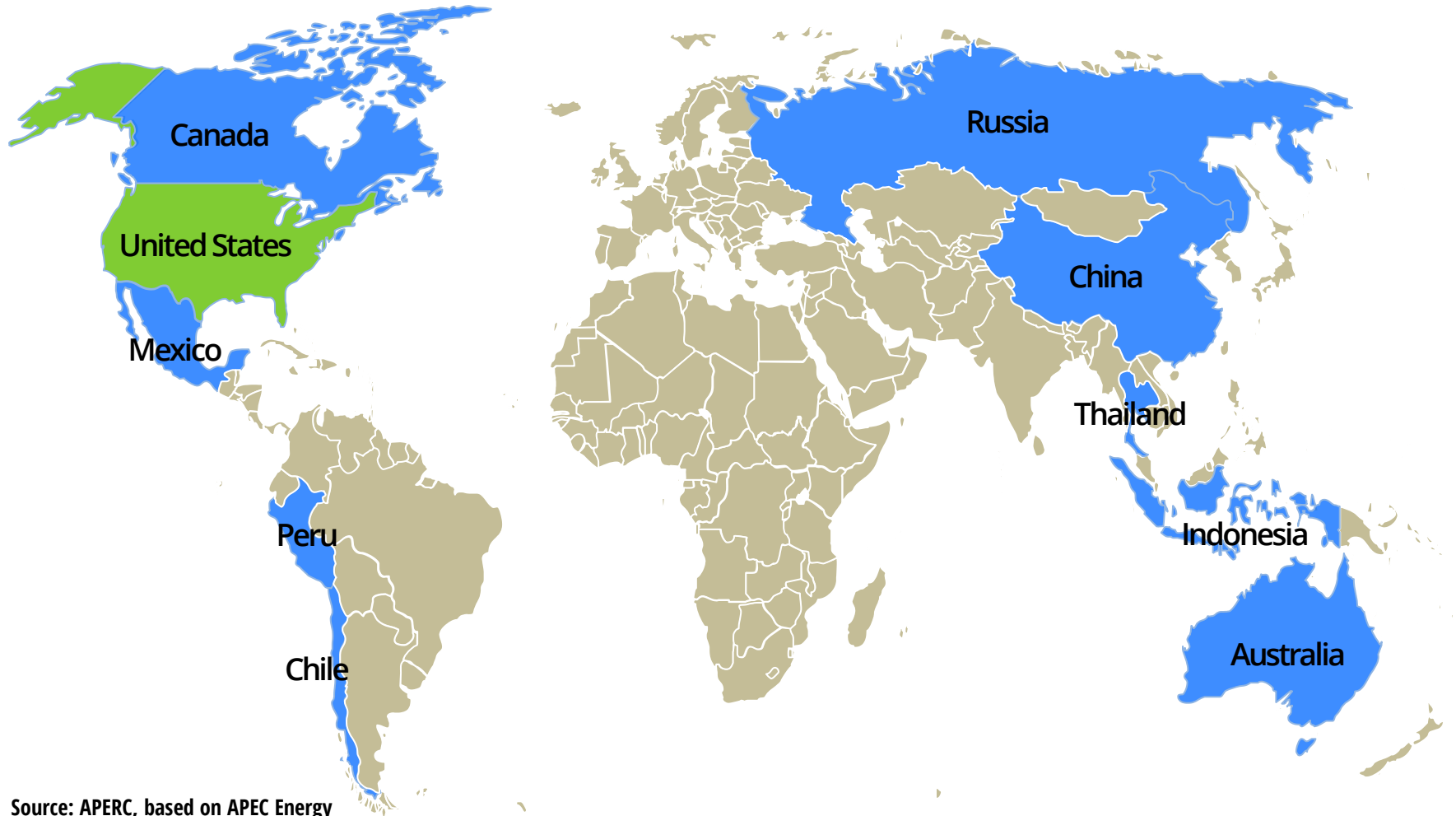


# Aims

- **To outline a set of policy recommendations conducive to the development of shale gas** in a number of APEC economies considered to hold such resources.
- **To develop a policy framework** on the basis of the United States shale gas 'revolution' **with a number of key success factors** in response to the most likely barriers faced **in the development of shale gas production.**
- **To develop economy-based analyses** on shale gas development.
- To provide an opportunity for the future establishment of **mechanisms favorable to the sustainable production of shale gas** hinging on APEC economic strengths and APERC's energy cooperation capabilities.

# Scope:

## 10 APEC economies holding shale gas resources...



Source: APERC, based on APEC Energy Working Group (2013) and EIA (2013).



# Scope:

...but six of them selected for this research

- **Six** economies selected:
  1. **Australia**
  2. **Canada**
  3. **Chile**
  4. **China**
  5. **Indonesia**
  6. **Mexico**
- **United States** used as a main reference, not for economy-based analysis.
- **Three economies excluded:**
  - Peru
  - Russia
  - Thailand
- **The project is entirely focused on shale gas (and liquids).**
- **The project is not technical but policy-oriented.**

# Next steps



**Strengthen our project  
with the inputs gained  
from the Workshop and  
the Conference**



**Refine our policy  
framework and analysis  
for each APEC economy  
in our report**



**Release our report  
(June) and disseminate  
its results, with possible  
follow-up activities in  
the economies analyzed**







II.



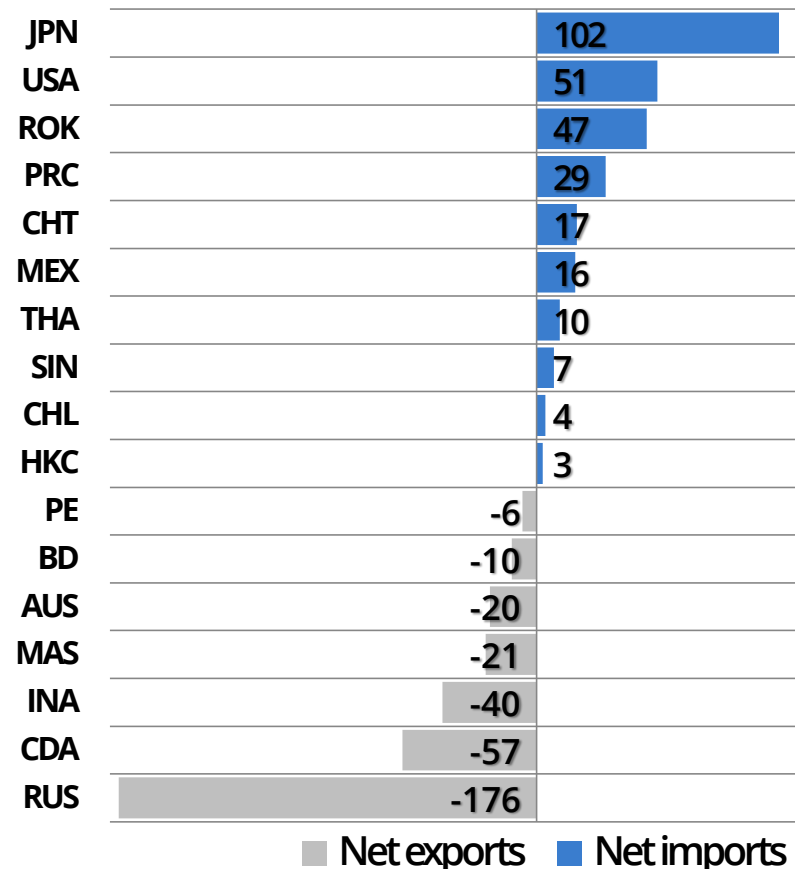
APEC in the global  
natural gas landscape



# APEC's natural gas overview

- On a global basis, APEC:
  - Represents **nearly 60% of the primary demand**.
  - Concentrates **70% of LNG imports**.
  - Accounts for **almost 60% of production**.
  - Holds **37% of proved reserves**.
  - As a whole, **is a net gas exporter region**.
  - With the exception of Hong Kong and Singapore, **the 19 remaining APEC economies are gas producers**, although in many cases at insufficient levels to meet their respective demand.

**APEC net gas balance by economy, 2011  
(billion cubic meters)**



Source: EDMC (2014); for Vietnam, IEA (2012)

# Natural gas profile by economy

Net trade position	Domestic gas production	
	Present	Not present
No trade	New Zealand Papua New Guinea The Philippines Viet Nam	
Importer	<b>Chile</b> <b>China</b> Chinese Taipei Japan Korea <b>Mexico</b> Thailand <b>United States</b>	Hong Kong, China Singapore
Exporter	<b>Australia</b> Brunei Darussalam <b>Canada</b> <b>Indonesia</b> Malaysia Peru Russia	

Classification based on 2011 values.  
Source: EDMC (2014); for Vietnam, IEA (2012).

# A huge amount of potential shale gas resources to be developed

- The size of the shale gas resource base potentially available in APEC makes its development very attractive to strengthen domestic natural gas supply.

Economy/region	Natural gas production 2011	Natural gas proved reserves* 2011	Shale gas technically recoverable resources estimation		Variation of estimated shale gas resources over proved reserves
			APEC Unconventional Natural Gas Census, 2013	EIA, 2013	
			billion cubic meters		
Australia	49.7	789	11,300	12,374	14.7
Canada	147.1	1,727	2,550	16,226	8.4
Chile	1.4	98	-	1,359	12.9
China	106.2	3,030	25,100	31,573	9.4
Indonesia	91.1	3,994	-	1,303	-0.7
Mexico	46.4	490	8,410	15,433	30.5
Peru	13.1	353	2,070	-	4.9
Russia	614.4	47,572	-	8,127	-0.8
Thailand	34.5	300	-	142	-0.5
United States	590.1	7,717	16,410	16,056	1.1
<b>Total</b>	<b>1,694</b>	<b>66,070</b>	<b>65,840</b>	<b>102,592</b>	<b>0.6</b>
<b>World</b>	<b>3,126</b>	<b>187,289</b>	<b>65,840</b>	<b>203,910</b>	<b>0.1</b>
<b>APEC as % of world**</b>	<b>54%</b>	<b>35%</b>	<b>-</b>	<b>50%</b>	<b>-</b>

\*At January 1 2012

\*\*Refers to the 10 APEC economies shown in this Table. For EIA (2013) column, world total refers to 42 economies assessed.

Source: EDMC (2014); APEC Energy Working Group (2013), EIA (2013), IEA (2012) and Oil and Gas Journal (2012).



III.



The United States  
experience as an input for  
policymaking





# The shale gas 'revolution'

- **From 2000 to 2011, shale gas production grew 25-fold**, passing from 9 bcm to 222 bcm, roughly equivalent to an average rate of 34% per year.
- **Shale gas passed from nearly 2% in 2000 to roughly 34% by 2011** in the total gas production.
- **The share of gas imports decreased from 15% in 2000 to 6% by 2012.**
- **The Henry Hub price fell** from 4.2 USD per million BTU in 2000 and 8.9 USD per million BTU at its peak in 2008 **to 2.8 USD per million BTU by 2012.**

# Unconventional gas development has led to an unconventional paradigm

Shale gas production in the United States has been driven by the following characteristics:

1. Access to large land acreage;
2. Comprehensive geological data with unrestricted access;
3. Technology and expertise to identify more accurately the best producing resources; and adapt to the highly divergent geological characteristics of shale;
4. More intensive drilling to sustain aggregate production levels;
5. More water to perform the hydraulic fracturing necessary;
6. More gas processing and water treatment equipment on site;
7. Gas-to-market infrastructure;
8. Scalability and repeatability of technology-driven operations;
9. Modular operations (use of well pads), efficient supply chains and auxiliary services;
10. Straightforward capitalization through well-developed equity and debt markets.





IV.



Towards a policy framework  
for shale gas development





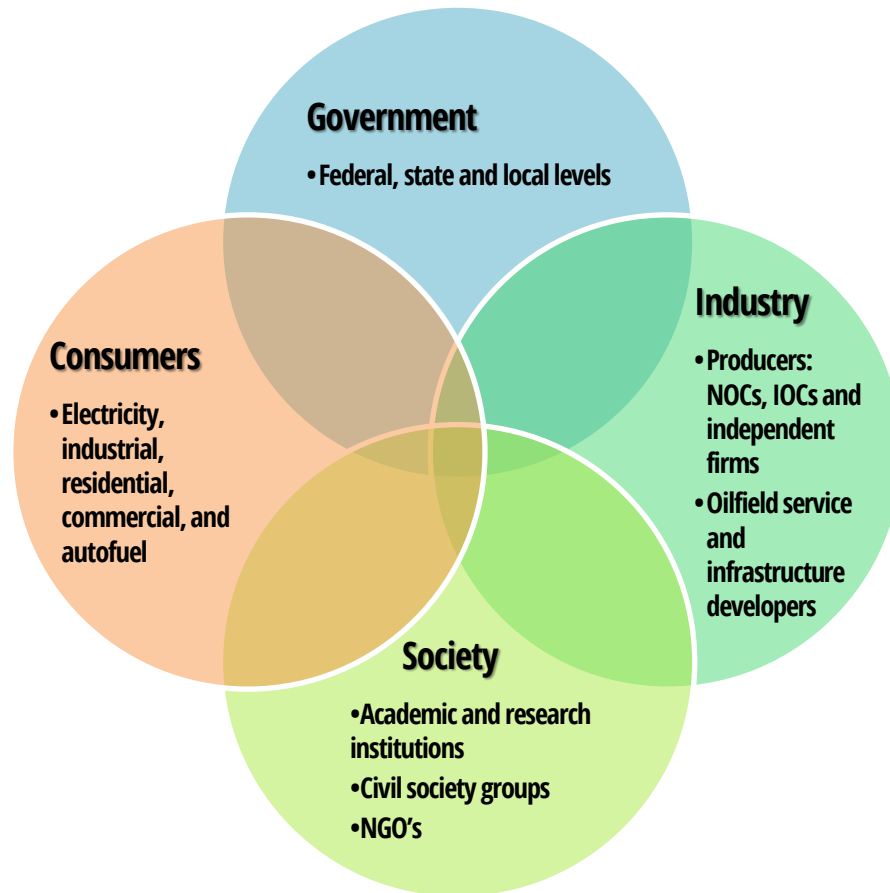
# Shale gas development: Multiple actors and interests involved

## Consumers:

- Cheaper prices
- Uninterrupted supply
- Flexible and competitive supply options

## Society:

- Environmental sustainability, especially in regards to protection of water resources
- Safety to public health and life quality
- Local development, jobs and increased demand for complementary products and services, spillovers on education



## Government:

- Energy security
- Royalties/fiscal revenue
- Knowledge and technology spillovers
- Effective policies and efficient regulation coordinated at different levels

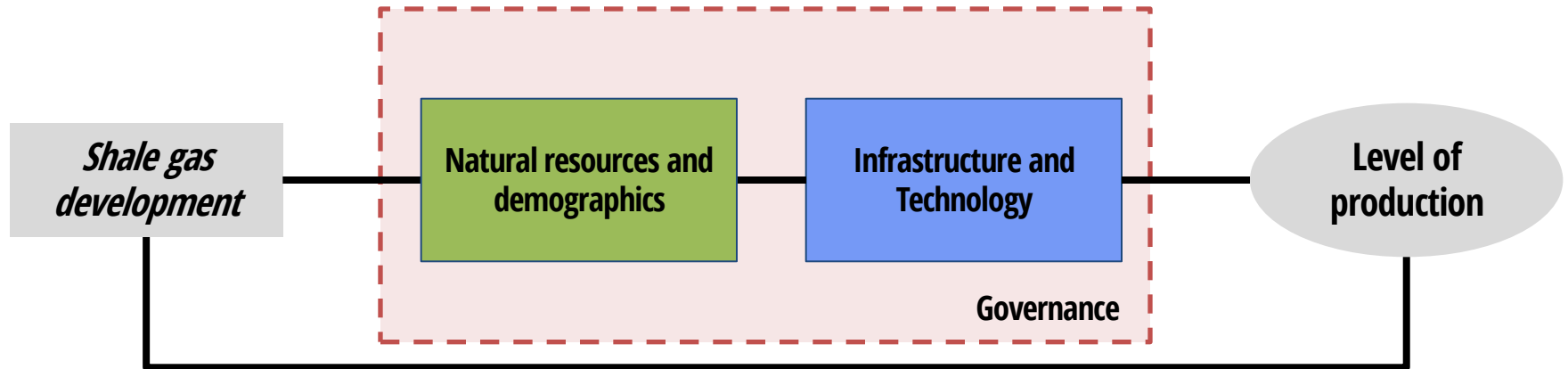
## Industry:

- Certainty on their investments and operations
- Incentives for the increased risks and capital involved in comparison to conventional gas projects
- Adequate infrastructure to deploy cost-effective supply chains and production methods
- Social license

Source: APERC (2014)

# Shale gas development:

## A dynamic approach from a broader perspective



Source: APERC (2014)

### Natural resources and demographics

- The predisposed endowment of natural resources (water and shale gas and liquids) that cannot be changed at all and without which shale gas production cannot take off, as well as the population characteristics that drive infrastructure and market development that would take many decades to be modified significantly.

### Infrastructure and technology

- The tangible and intangible assets necessary for economic development and particularly to produce and market shale gas resources. The factors in this category are mainly made and could be developed in timeframes from years to decades. Multimodal transportation and water infrastructure are also included.

### Governance

- The formal rules that define the political, economic and social interactions among the diverse stakeholders involved in the development of shale gas resources, expressed through different institutional frameworks.

# Concepts to focus on

Label	Category	Factor
N1	Natural resources and demographics	<b>Favorable geology</b>
N2	Natural resources and demographics	<b>Water availability</b>
N3	Natural resources and demographics	<b>Relatively low population density in prospective shale plays</b>
I1	Infrastructure and technology	<b>Access to financial markets</b>
I2	Infrastructure and technology	<b>Availability of multimodal transportation and water infrastructure</b>
I3	Infrastructure and technology	<b>Extensive pipelines and distribution networks</b>
I4	Infrastructure and technology	<b>Geological data with unrestricted public access to results</b>
I5	Infrastructure and technology	<b>Natural gas industry's expertise</b>
I6	Infrastructure and technology	<b>Oil and gas field services</b>
G1	Governance	<b>Political support to shale gas development and lack of blanket restrictions</b>
G2	Governance	<b>Alignment of interests between developers and landowners/Fiscal regime for natural gas E&amp;P</b>
G3	Governance	<b>Competitive market structure with no entry barriers and barring monopolies</b>
G4	Governance	<b>Unregulated natural gas prices</b>
G5	Governance	<b>Open access to pipelines</b>
G6	Governance	<b>Decentralized regulation</b>
O1	Others	<b>Other issues applicable to the particular context of each economy</b>

# APERC's key message:

## Where should shale gas policies focus on?

- **These categories suggest the type of resources, capabilities and time frames involved in the development of shale gas.**
- While natural resources and demographics cannot be readily changed and infrastructure and technology can be built-up in reasonable time horizons, **it is governance that brings about a favorable context for commercial shale gas production.**
- **Governance issues are politically sensitive** and not all economies **will even aspire to address them or recognize their importance. Nonetheless,** they seem to have been **critical to the United States experience,** as they provided a context favorable for everything else to occur.



V.



Preliminary barriers and opportunities by economy

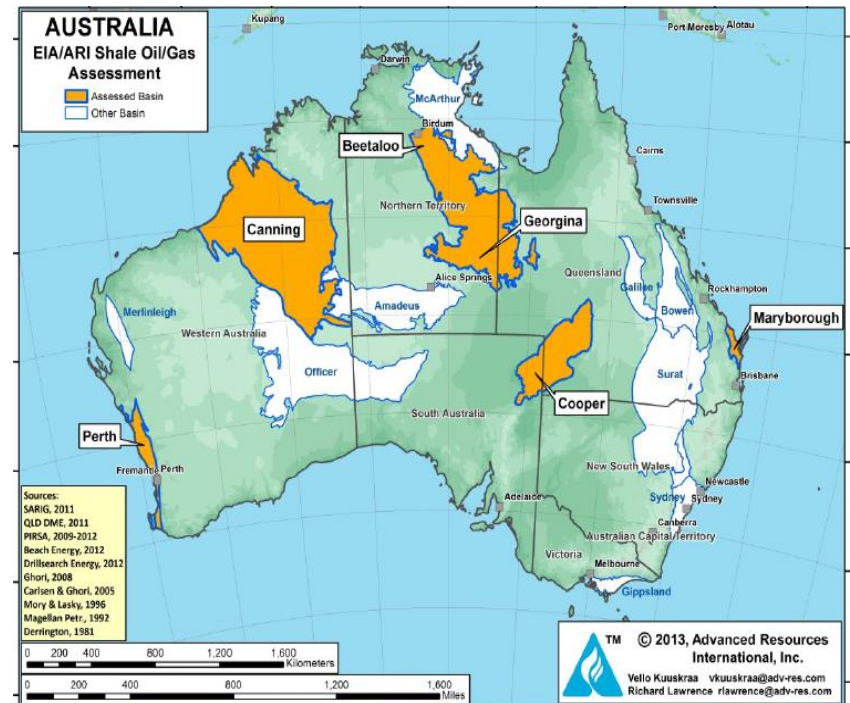


# Australia:

## Significant shale gas resources in place

### Natural resources and demographics

- Australia has abundant fossil resources. Its shale resources are estimated among the top 10 economies in the world distributed across its territory in six basins.
- Given its population and territory, Australia stands among the top five least densely populated economies in the world.
- Water resources are deemed good overall, (Aquastat, 2014) although the arid and semiarid regions in the center may face scarcity.



Source: EIA (2013)



# Australia:

## At the early stage of commercial development

### **Infrastructure and technology**

- Remote areas may lack sufficient infrastructure to develop larger outputs, including pipelines, processing plants and roads.
- Number of drilling rigs and capacity of oilfield services might be also compromised under a larger scale of production.

### **Governance**

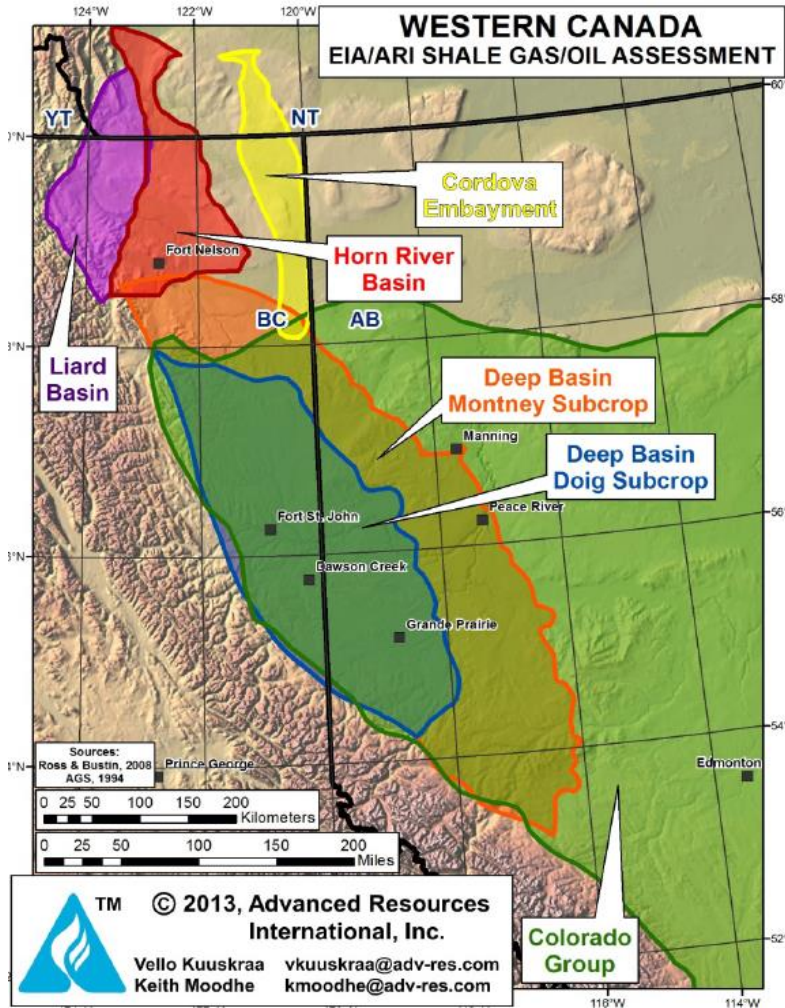
- Open access to shared infrastructure like pipelines is not fully in place.
- In order to move forward with their operations, producing companies must succeed in negotiating land access agreements with landowners, which strengthens their social license.

### **Others**

- How does shale gas stands against Australia's plentiful supply of conventional and unconventional resources?

# Canada:

## Plenty of shale gas resources to be developed



Source: EIA (2013)

## Natural resources and demographics

- Fifth largest resource base assessed (EIA, 2013), with some shale basins overlapping with the United States.
- With less than 4 people per square kilometer, Canada has a very low population density.
- Canada is one of the economies with the best water availability in the world (Aquastat, 2014).
  - Its total water renewable resources of over 83,000 cubic meters in 2010 were approximately 8 times larger than those in the United States.





# Canada: Just a matter of time?

## **Infrastructure and technology**

- Well-developed infrastructure and expertise. Integration with the United States gas market. Pipeline lines may represent a hurdle in the short term.

## **Governance**

- Regulation at different levels works effectively and the market is highly competitive with market-based pricing. Some provinces have set fiscal incentives to recent shale gas production.

## **Others**

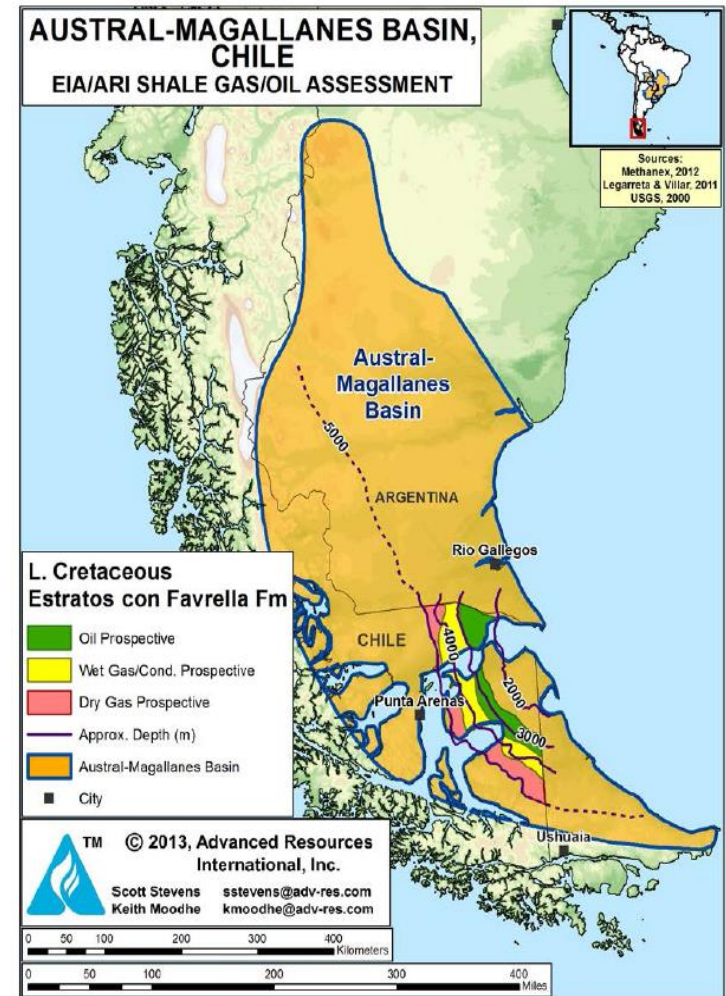
- West Canada's LNG exports to Asia may fuel faster its shale gas development.
- How does shale gas and liquids stand against other unconventional oil and gas resources?

# Chile:

## Natural resources but big infrastructure challenges

### Natural resources and demographics

- Very little conventional oil and gas resources.
- The shale gas resource base estimated (EIA, 2013), is approximately 13 fold its proved natural gas reserves.
- Chile has plenty of water resources, with nearly 53,000 cubic meters (Aquastat, 2014).
- Three-quarters of the Chilean population live in the center of its territory. Less than 1% lives where shale resources have been inferred (Magallanes).



Source: EIA (2013)



# Chile: A door to reduce gas dependency?

## **Infrastructure and technology**

- Chile's particular topography and geography present huge challenges to infrastructure development, in particularly pipelines, which are fragmented and much more developed in the north and center. Infrastructure in the Magallanes region is good but lacks of connection with the largest markets.
- Chile's scarce fossil resources have resulted in a modest oil and gas industry.

## **Governance**

- Most of the oil and gas sector has been liberalized, but prices are regulated exclusively in the Magallanes region. As of late 2012 and 2013 the government through its state-owned oil and gas company undertook tight gas exploration in Magallanes, which was successful.

## **Others**

- Chile is highly dependent on gas imports, which could haste the pursuit of shale gas production.

# China:

## Holding the largest shale gas resources worldwide

### Natural resources and demographics

- China has the largest shale gas resource base in the world spread across its territory in seven basins (EIA, 2013).
- Water availability is a concern with roughly 2,000 cubic meters of total renewable water resources (Aquastat, 2014).
- China is one of the most densely populated economies in the world, exceeding 250 people per square kilometer in prospective shale gas areas.



Source: EIA (2013)



# China:

## Shale gas development is proving very challenging

### **Infrastructure and technology**

- Infrastructure, especially in terms of pipelines is still insufficient. Geological data are still limited and oil and gas services and expertise is concentrated in the state-owned companies.
- Unconventional gas production of CBM has been ongoing for some decades.

### **Governance**

- China lacks of a competitive market, which is dominated by a few players. Prices are regulated in a cost-plus mechanism and open access is still not granted,. There is a lack of comprehensive legal framework and some regulations may be enforced loosely.
- On the other hand, shale gas enjoys ample governmental support, fiscal incentives, special status as an independent mineral resource in order to allow foreign investment and was set quinquennial production targets that suggest its massive production in some years.

### **Others**

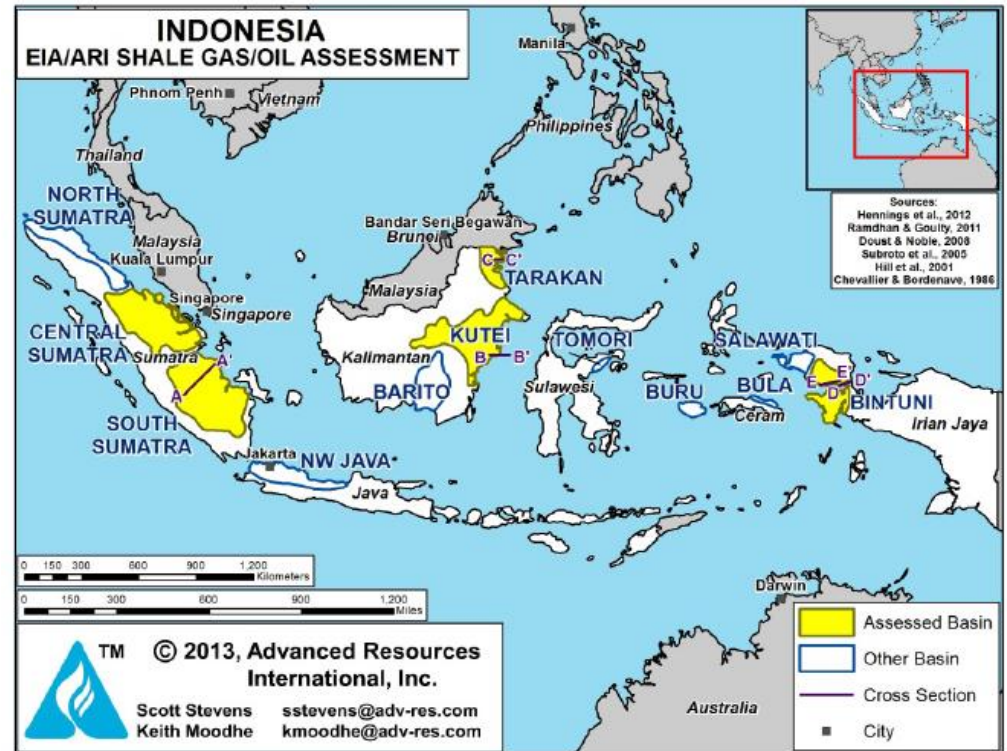
- In spite of the high governmental support, China needs to introduce more market-based mechanisms to promote more intensive drilling and technology assimilation.


# Indonesia:

## At the early stages of shale gas development

### Natural resources and demographics

- Preliminary assessments (EIA, 2013) indicate moderate shale gas resources (1,303 bcm) smaller than its natural gas proved reserves.
- Water availability is relatively good (over 8,000 cubic meters of total renewable water resources – Aquastat, 2014).
- As one of the most populated economies in the world, high concentrations of people might be a concern for a more intensive shale gas development.





# Indonesia:

## Moving on in spite of the challenges ahead

### **Infrastructure and technology**

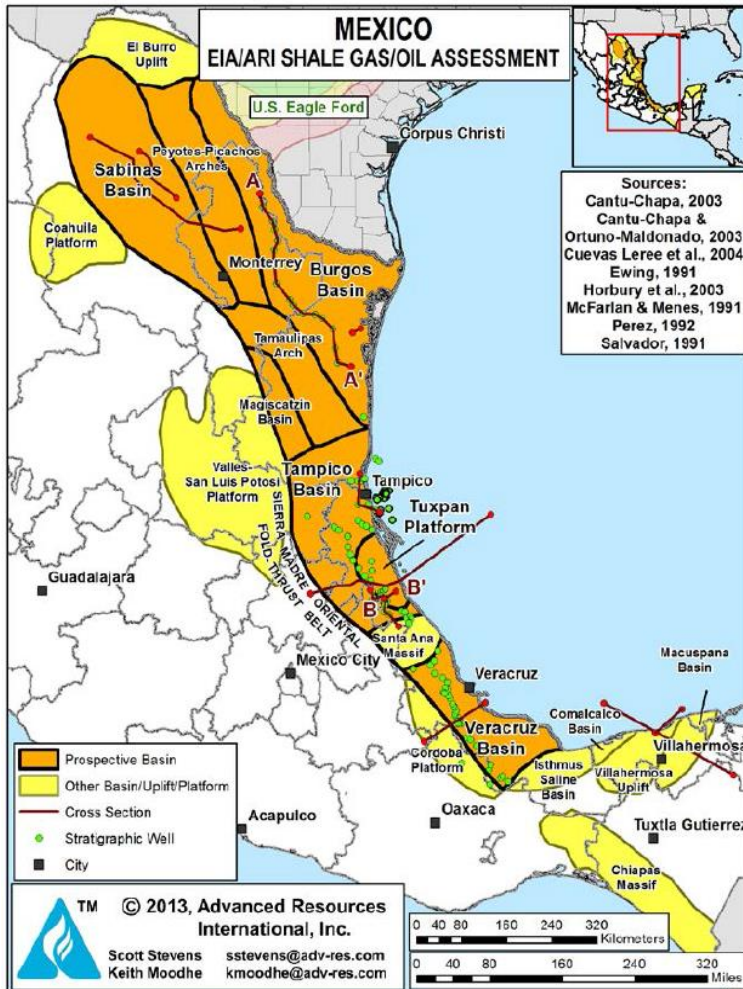
- Due to its insular conditions, Indonesia's infrastructure is not well integrated and its development is challenging. Existing pipelines might not be well-developed in some islands and the natural gas market is fragmented. Shale gas potential needs further assessment and access to geological data requires official permission.

### **Governance**

- Layers of bureaucracy slow down significantly permitting, rivalry between government at different levels might hinder some projects. Third party access to existing conventional and CBM infrastructure is still under discussion.
- So far, only one shale gas production sharing contract has been signed with Pertamina, expecting results in at least seven years from now.

# Mexico:

Promising resources contiguous to the Eagle Ford Shale



## Natural resources and demographics

- One of the largest resource base worldwide spread in four basins (EIA, 2013) in its northeast and southeast regions.
- Eagle Ford shale extending well into Mexico, with oil and gas windows.
- Water scarcity an issue in the Eagle Ford extension.





# Mexico:

## Will it join its neighbor's shale gas revolution?

### **Infrastructure and technology**

- Infrastructure has lagged behind in terms of capacity and reach. Serious pipeline bottlenecks blocking larger gas imports from the United States. Most geological data and infrastructure still in hands of the state-owned oil and gas monopoly.

### **Governance**

- The most difficult changes may have been already accomplished. In December 2013 Mexico passed an ambitious energy reform that crushed its state-owned oil and gas monopoly of more than 75 years and opened the door to foreign investment and more competition in order to reverse declining oil and gas domestic production.
- Regulation is mainly exerted at a federal level, and prices are still regulated in a mechanism attached to the Henry Hub that does not reflect at all the conditions of the Mexican natural gas market. Governance changes remain to be seen in the practice, as secondary legislation is still in process. Shale gas enjoys ample political support, largely based on the United States.

### **Others**

- Organized crime operations, which include oil products theft, are underway in the area where the Eagle Ford extends.

VI.



# Shale gas development: Time, resources and planning involved

- **There is no single rapid solution to shale gas development.** Owing to the interdependence of multiple elements that involve diverse stakeholders and vary across time and space, it is a complex and uncertain task.
- **Shale gas development in the United States did not emerge overnight.** While remarkable results have been observed in recent years, they are the result of a process that is at least three and a half decades old considering the earliest efforts started in the late 1970s.
- In addition to natural resources, appropriate financial, technological capabilities, adequate infrastructure and especially, favorable governance are paramount **to accomplish a balance between diverse stakeholders.**
- **The key message is that the more economies deny the importance of governance, the longer it might take for them to develop the foundations on which commercial shale gas production can take off more effectively.**

# *Thank you*

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