



**PETRONAS**

# **PETRONAS**

# **Unconventional Journey**

September 2014



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# PROGRESS ENERGY CANADA LTD



## Progress Energy Canada Ltd.

Focused in three areas of the Western Canadian Sedimentary Basin

### North Montney Joint Venture (NMJV)

- ◆ Located in the province of British Columbia
- ◆ Progress is the largest Montney land holder
- ◆ Closest resource to the West Coast of Canada
- ◆ Include conventional and unconventional zones

### Progress Sasol Montney Partnership (PSMP)

- ◆ Resulted from Talisman asset's acquisition in 2014
- ◆ Increased Montney land position for future development

### Deep Basin

- ◆ Located in the province of Alberta
- ◆ Stacked zones with over 15 producing horizons
- ◆ Natural gas, NGL & oil drilling opportunities



# EVOLUTION OF THE NORTH MONTNEY

## 2005

- First multistage horizontals at Dawson

## Q3 - 2008

- First North Montney vertical test

## Q1 - 2009

- First horizontal test

## Q1 - 2010

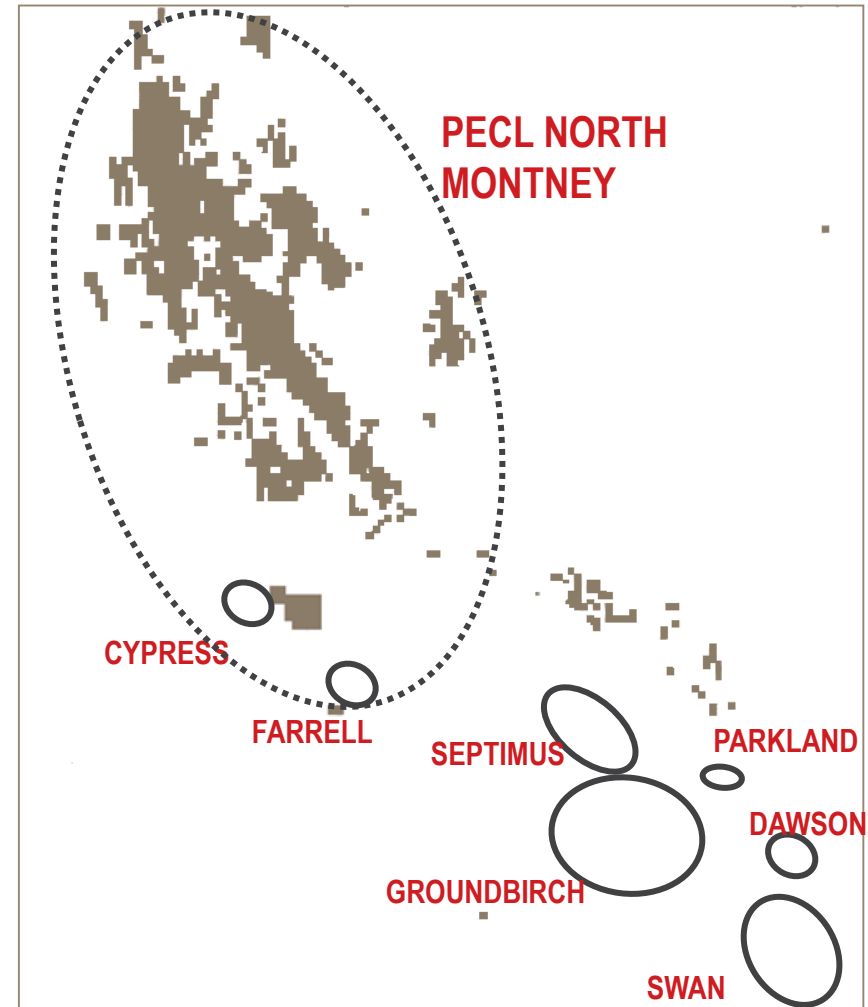
- First developments at Town and Farrell

## 2012

- 250 producing horizontal wells
- 9 commercial developments
- 2 international joint ventures
- PETRONAS/Progress acquisition

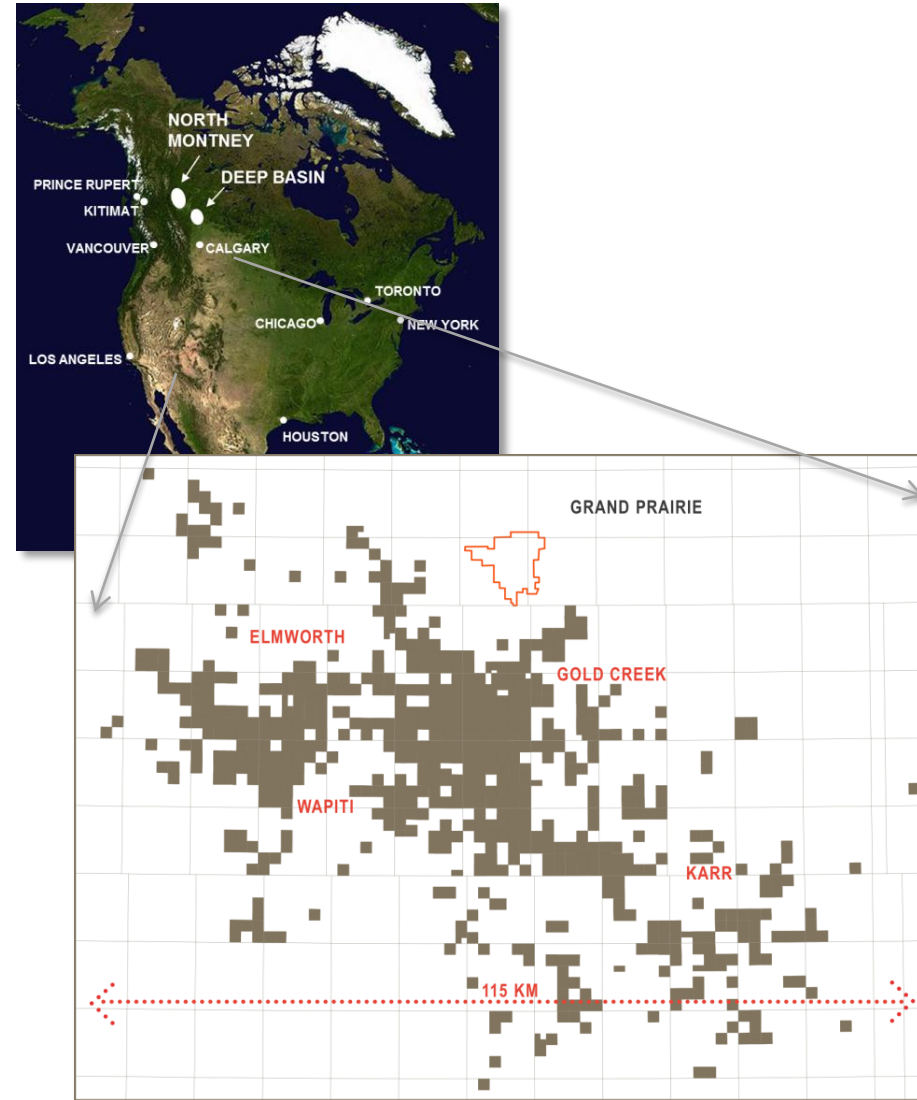
## 2014

- Progress drilled 315 horizontal wells to-date
- Over 400 mmscf/d production from NMJV



# DEEP BASIN

- ◆ Deep Basin forms part of WCSB, located in North West Alberta
- ◆ Progress has ~380,000 net acres of land (Elmworth, Gold Creek, Karr, Wapiti)
- ◆ Initially develop in 2004-2010 for tight gas—drilling results averaged 1.8 mmscf/d, with occasional wells at >5 mmscf/d
- ◆ PECL – first operator to drill horizontal wells for Dunvegan oil in 2011.
  - Original vertical rates 10-20 bbls/day
  - Initial 30 day light oil rates 210 – 290 bopd
  - Wells stimulated using innovative oil fluid system to reduce formation damage.
  - Frac oil recycling system developed to reduce capital costs.



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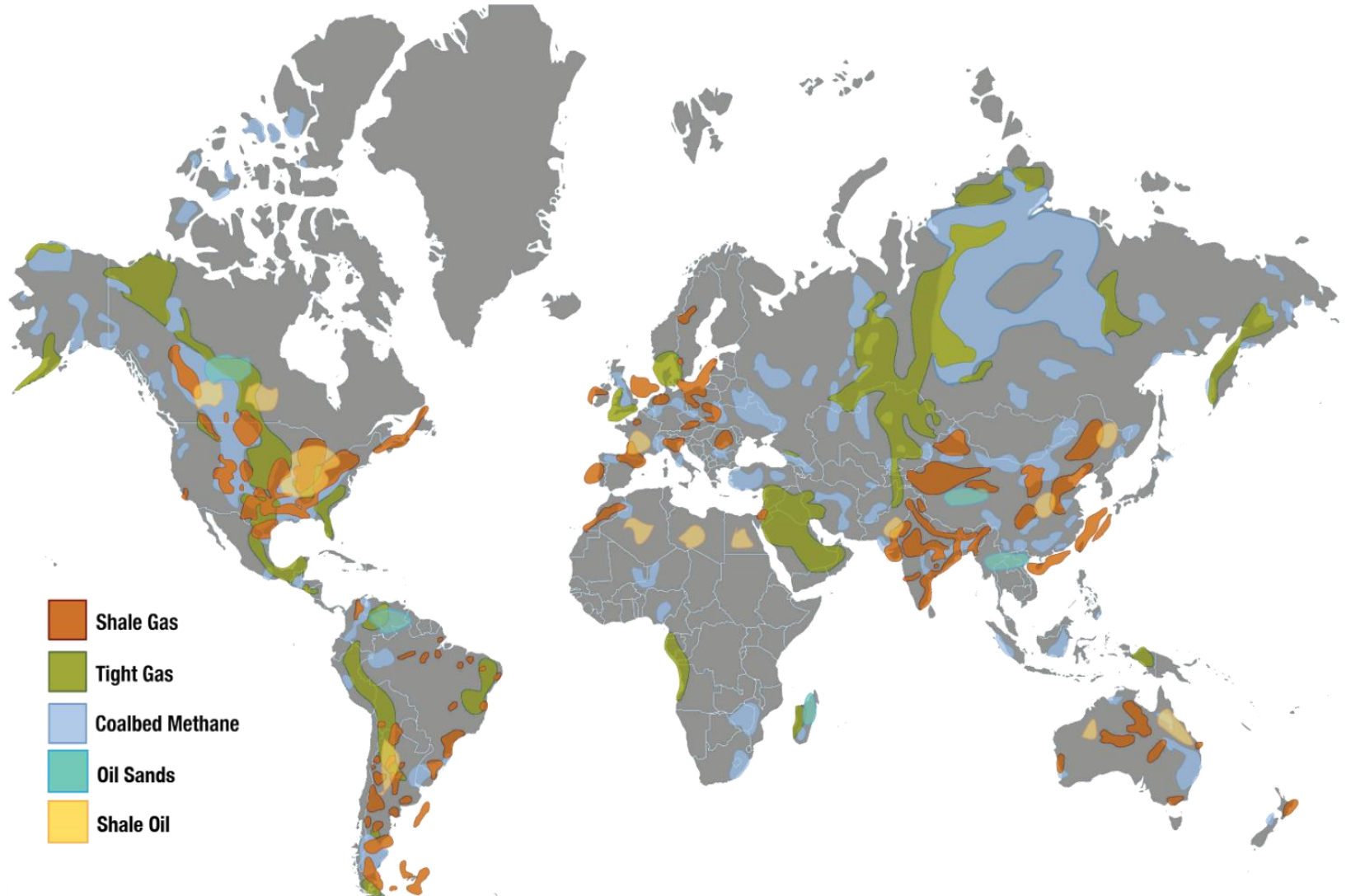
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# UNCONVENTIONAL : WHAT IS OUT THERE?

Nearly half of the increase in natural gas production to 2035 is from unconventional gas, with most of this coming from the United States, Australia and China.



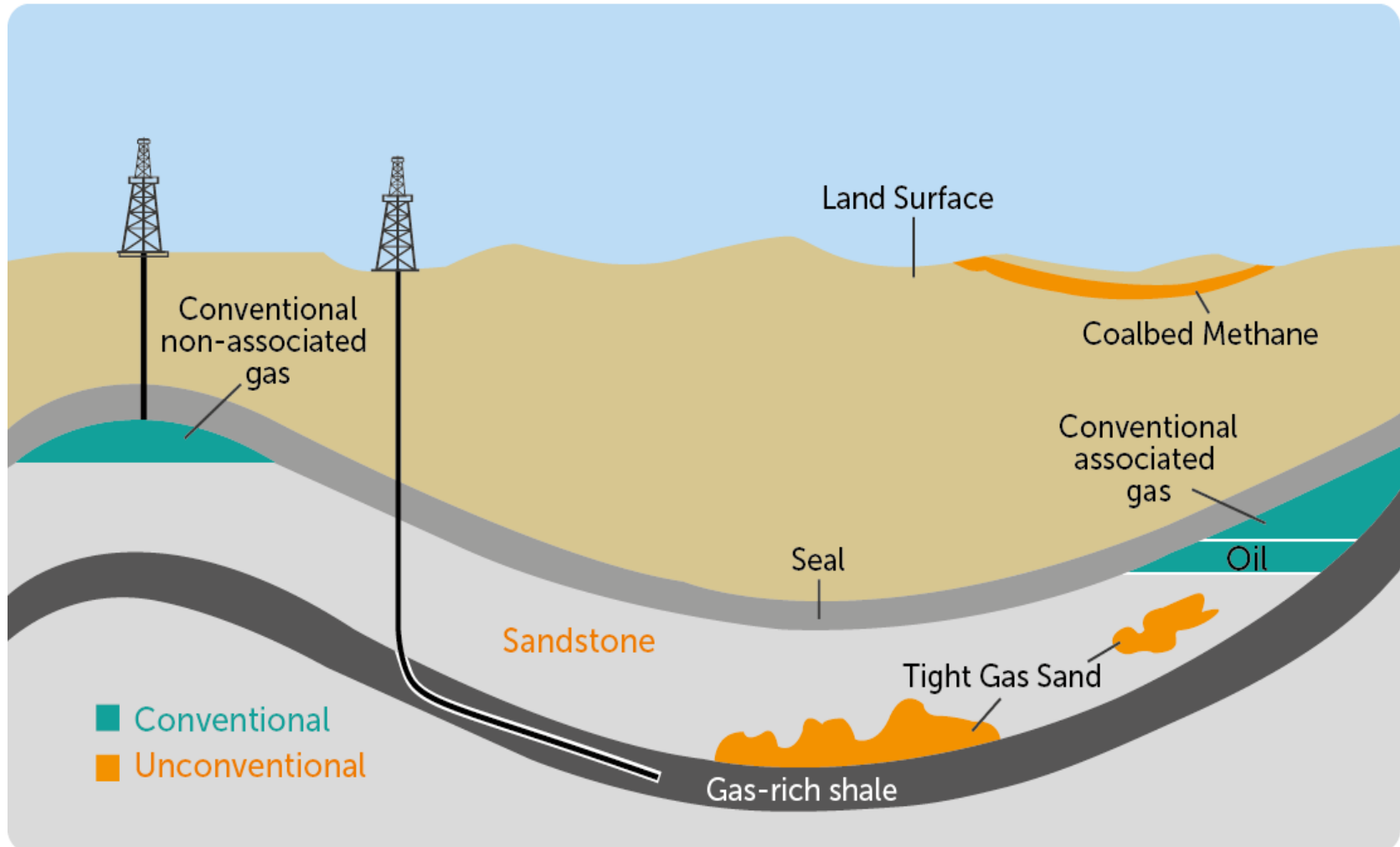
- Shale Gas
- Tight Gas
- Coalbed Methane
- Oil Sands
- Shale Oil

Sources: IEA, 2012, PacWest, WoodMac



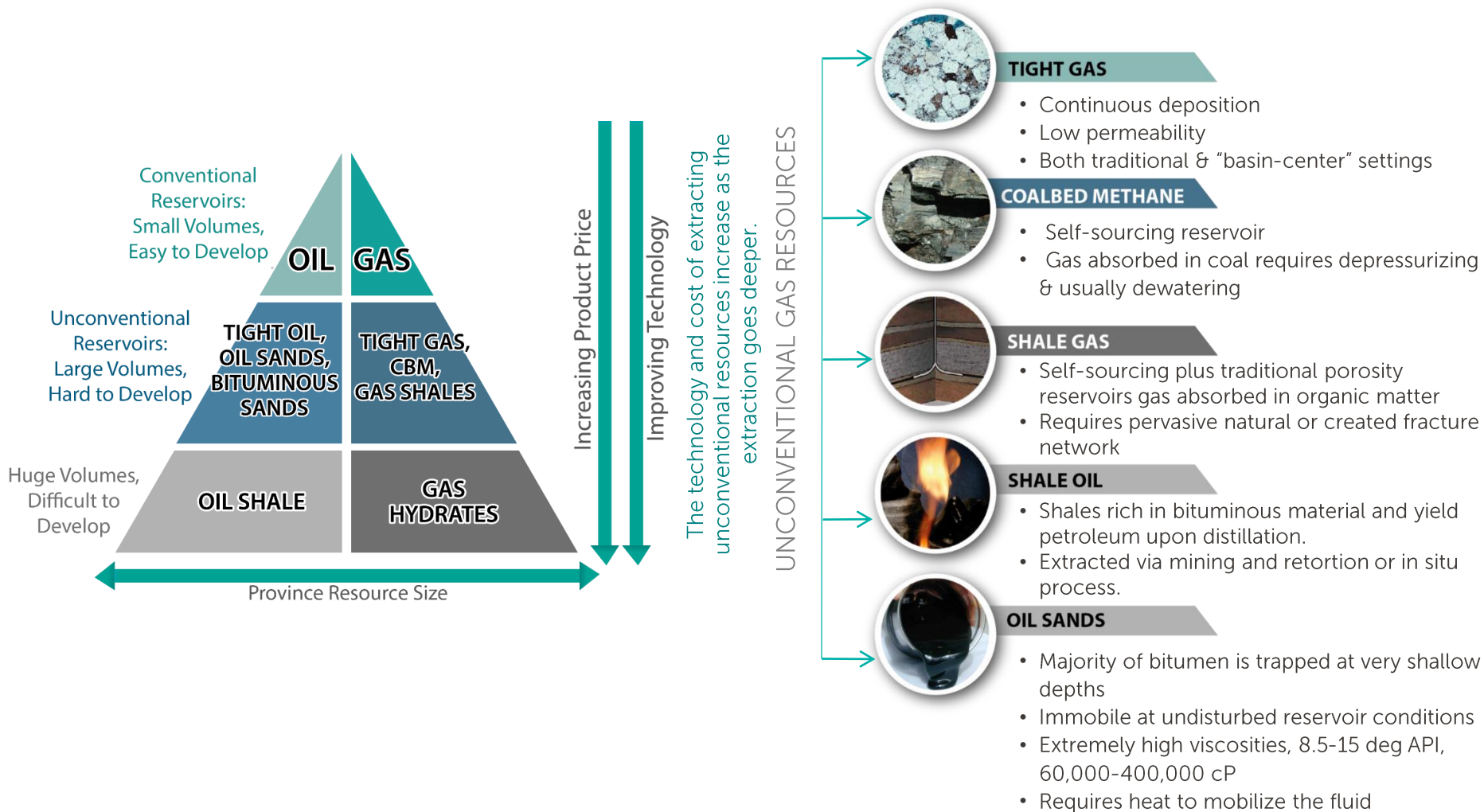
# UNCONVENTIONAL HYDROCARBONS: WHERE IS IT?

## Conventional vs Unconventional



# UNCONVENTIONAL HYDROCARBONS : WHAT IS IT?

The key difference between “conventional” and “unconventional” hydrocarbons is the **manner, ease and cost associated with extracting the resource.**



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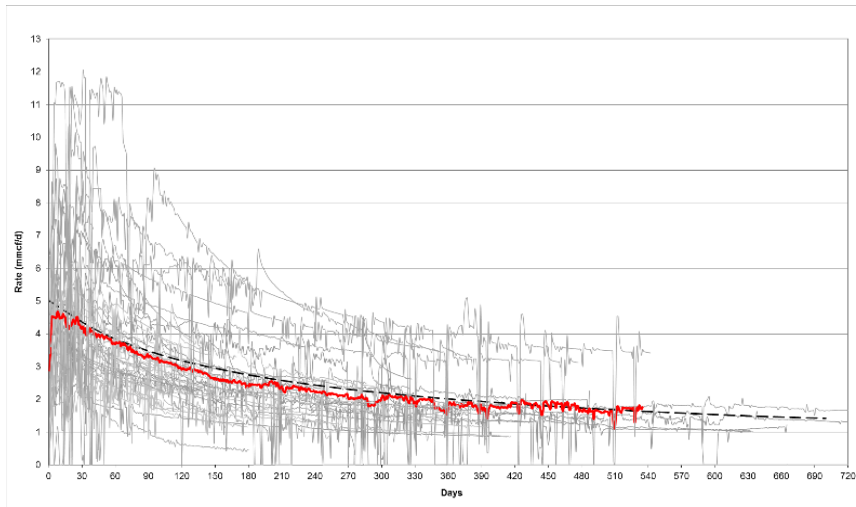
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# SUBSURFACE CHALLENGES



## Shale gas type curve

### Typical Montney Horizontal Well Schematic

#### Completions Design

- 8 stages
- 3 perf intervals per stage
- Flow-through bridge plugs

#### Frac Design

- 175T Total Sand
- 80T 40/70 sand
- 80T 30/50 sand
- 15T 20/40 resin coated sand
- 1200 m<sup>3</sup> slick water
- Rate of 10m<sup>3</sup>/minute

Surface Casing  
244.5mm, 53.6 kg/m  
J55, LT&C

Vertical Production Casing  
139.7mm, 29.7 kg/m  
L80, LT&C

Horizontal Production Casing  
114mm, 20.1kg/m  
P110, LT&C

Transition to smaller casing at 30 degrees

First Stage - 3 perf intervals

10m build

Horizontal Section - 1500m

## Horizontal Well Schematic

## Development Practice:

- Due to the reservoir decline behavior high number of wells are required to be drilled every year
- Uncertainty in well performance requires sufficient wells to be drilled before moving into full development
- Each wells will be drilled horizontally and fractured with several stages according to the frac design.
- The typical drilling and completion cost for shale gas wells range from \$ 6- 8 Million.
- Well placement is key to unlock the optimum resource from shale

# OPERATIONAL LOGISTIC CHALLENGES

Barnett operation



Canada operation



## Typical Frac Operation:

- ◆ Handling logistics of water, sand trucking pose challenges as the operation are extensive.
- ◆ Monitoring of the fracturing operation can now being done real-time.
- ◆ Less populated area are preferred for operation.
- ◆ Road / highway access is also crucial.



# WATER HANDLING CHALLENGES

## Each Area to Have:

- 20,000 – 30,000 m<sup>3</sup> double contained recycled water storage
- 50,000 – 200,000 m<sup>3</sup> fresh water storage
- Produced water recycle system
- 8" pipeline connection to each pad

## Typical Operation:

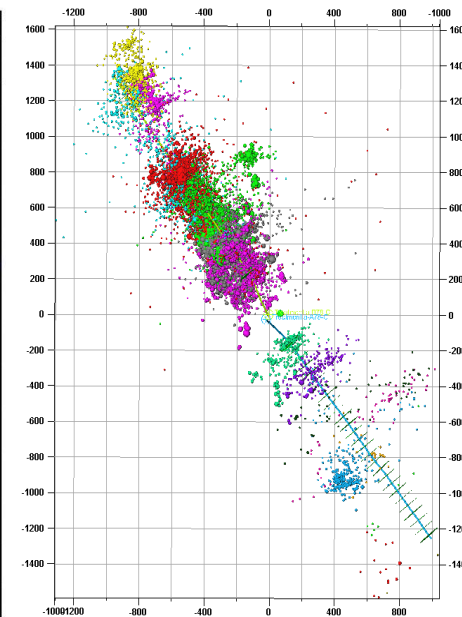
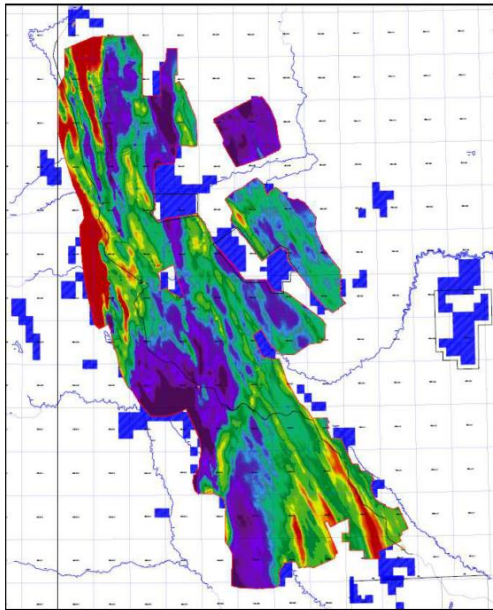
- Combination of fresh and produced water continuously pumped to C-rings at wellsite during fracturing
- Water heated during winter using specialized natural gas portable system
- Flowback water pumped back to central site for storage and re-use



# NORTH MONTNEY TECHNOLOGY APPLICATIONS

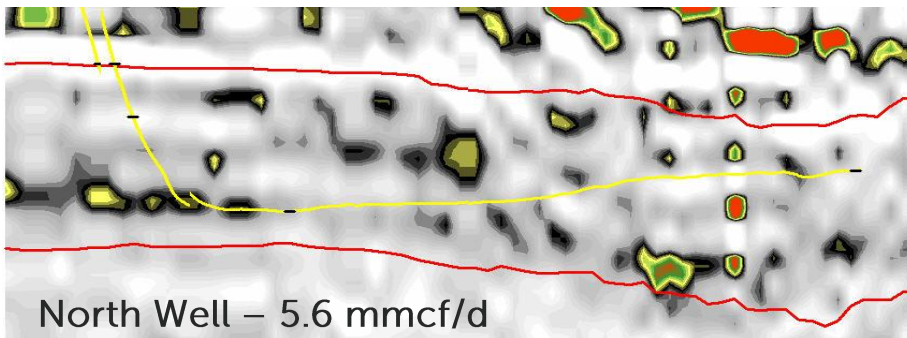
- ◆ Integrated subsurface - fracturing evaluation team
  - microseismic to define sweet spot and fracturing efficiency.
  - collaboration between operator and frac service providers are crucial.
  - real-time monitoring to ensure quick decisions.
- ◆ Modular design will reduce facilities cost and facilities installation timing.
- ◆ Drilling pads and Pod concept reduce footprint for operation.
- ◆ Recycling system for water and fracture fluid to reduce completion cost.

# Integrated Subsurface



## Subsurface Technology:

- ◆ Microseismic and reservoir modelling to optimize spacing and well placement
- ◆ Extensive 3D seismic used to improve well placement, fault mapping and inversion analysis.
- ◆ Geological mapping ensure understanding of hydrocarbon recovery trends for asset



North Well – 5.6 mmcf/d



# Facilities – Modular Design

*Consistent, repeatable design*

## Typical Compressor & Dehydration Facility

- ◆ Stage 1: 36-54 mmcf/d
  - Two inlet separators and two gas dehydrators
  - Two or Three 2,370 HP compressors
  - Liquids storage
  - Auxiliary Equipment
- ◆ Stage 2: Expand to 100-150 mmcf/d
  - Add additional compressors, separators,
  - Dehydrators and associated equipment



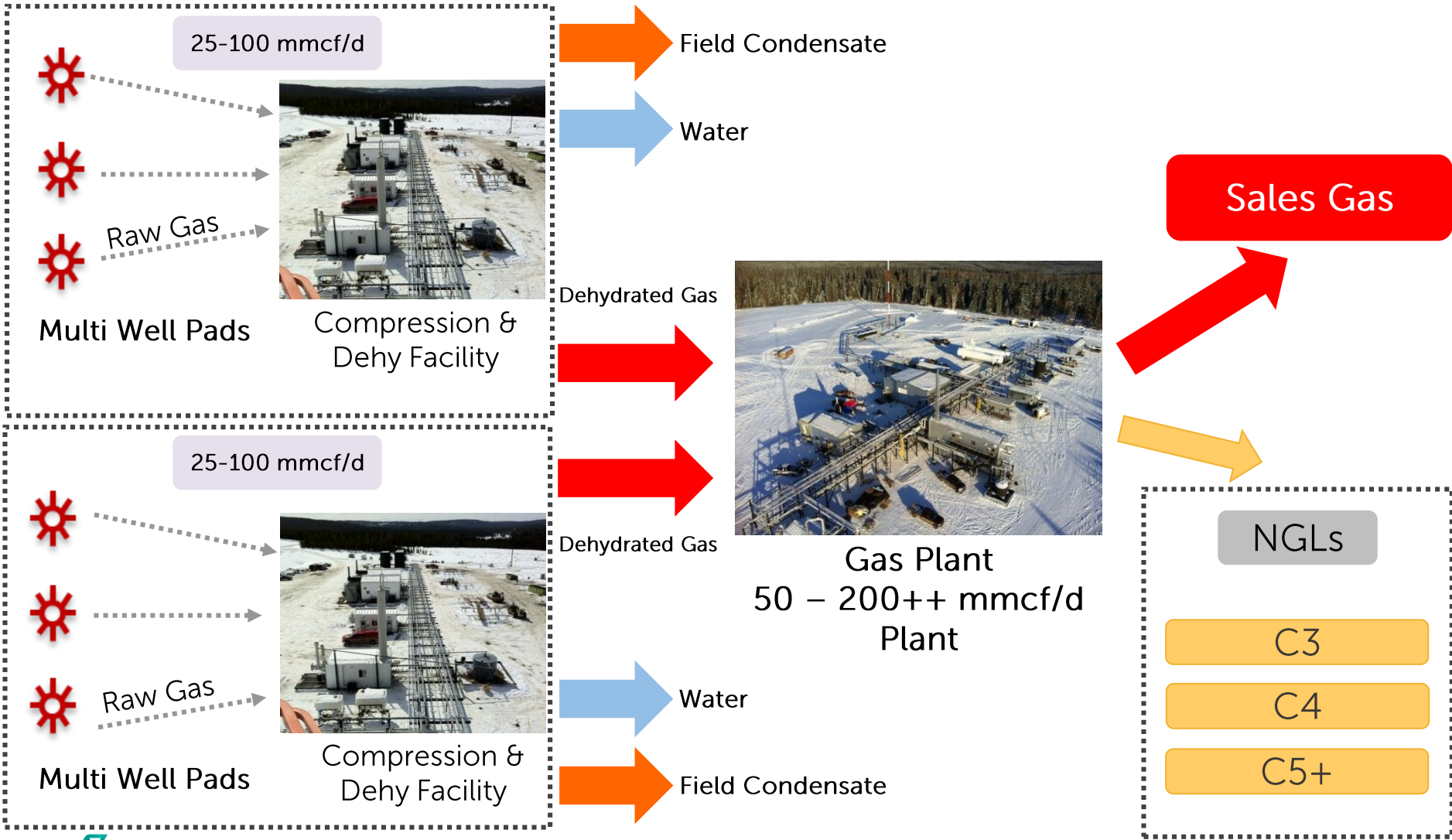
## Advantages

- ◆ Use economies of scale
- ◆ Keep equipment size workable
- ◆ Standardize across areas
- ◆ Design with sand erosion in mind
- ◆ Sand filters and wet meters at wellsites



# Standardized Process and Facilities

Repeatable and Lower Cost to Construct and Operate



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Best Practice & Fiscal Incentives

# NORTH MONTNEY ECONOMIC & FISCAL ADVANTAGES

- ◆ BC deep drilling credit – 3% royalty for 1 to 3 years
- ◆ 3<sup>rd</sup> party Pipeline access.
- ◆ Alaska highway provides all season access
- ◆ Few surface stakeholders
- ◆ Minimal above ground issues : i.e. Right of way & first nation
- ◆ Liquids-rich stream – significant revenue lift (8 to 30 bbls/mmcft)
- ◆ High heat content (1100-1260 mmbtu/scf)
- ◆ No hydrogen sulphide, minimal CO<sub>2</sub>
- ◆ Low Opex - \$0.28/mcf

# PROJECT EXECUTION CAPABILITY

- ◆ Proven track record over the past 12 years – Operating in the basin since 2002
  - Over 1,000 wells drilled in BC, including 315 Montney horizontals
  - Over 20 compressor stations constructed and online
  - Three gas plants online
- ◆ Top five driller in British Columbia for past five years
  - Recognized low cost producer
  - Top quartile finding and development costs
  - Operated over 25 rigs in Q4 2013
- ◆ Long term Drilling and Frac Contracts
- ◆ Canadian Association of Petroleum Producers (CAPP)
  - Highest level of Environmental, Health and Safety performance
- ◆ Capable, Stable and Professional Workforce
  - 229 employees and growing
  - Average industry experience of 15.6 years
  - Low attrition rate of 7.5% (well below industry average)
  - Significant in-house unconventional expertise

# CONCLUSIONS

- ◆ Unconventional hydrocarbon sources are revolutionizing the energy industry
- ◆ High capital costs require optimized performance and stable sociopolitical regime
- ◆ PETRONAS is positioning itself to be leading player in this sector
- ◆ The North Montney is a world class resource with a promising future
- ◆ Technological innovation will lead to cost and productivity breakthroughs



**THANK YOU**