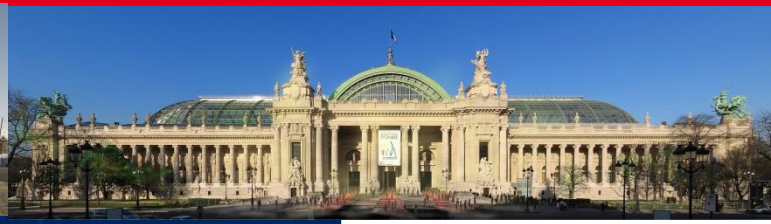
26th World Gas Conference

1 – 5 June 2015, Paris, France



TS WOC 1.1

THE IMPORTANCE OF PREDICTIVE MODELING TO GEOLOGIC AND ENGINEERING GRADING, AND INFORMATION SHARING FOR OPTIMIZING RESULTS IN UNCONVENTIONAL HYDROCARBON DEVELOPMENTS

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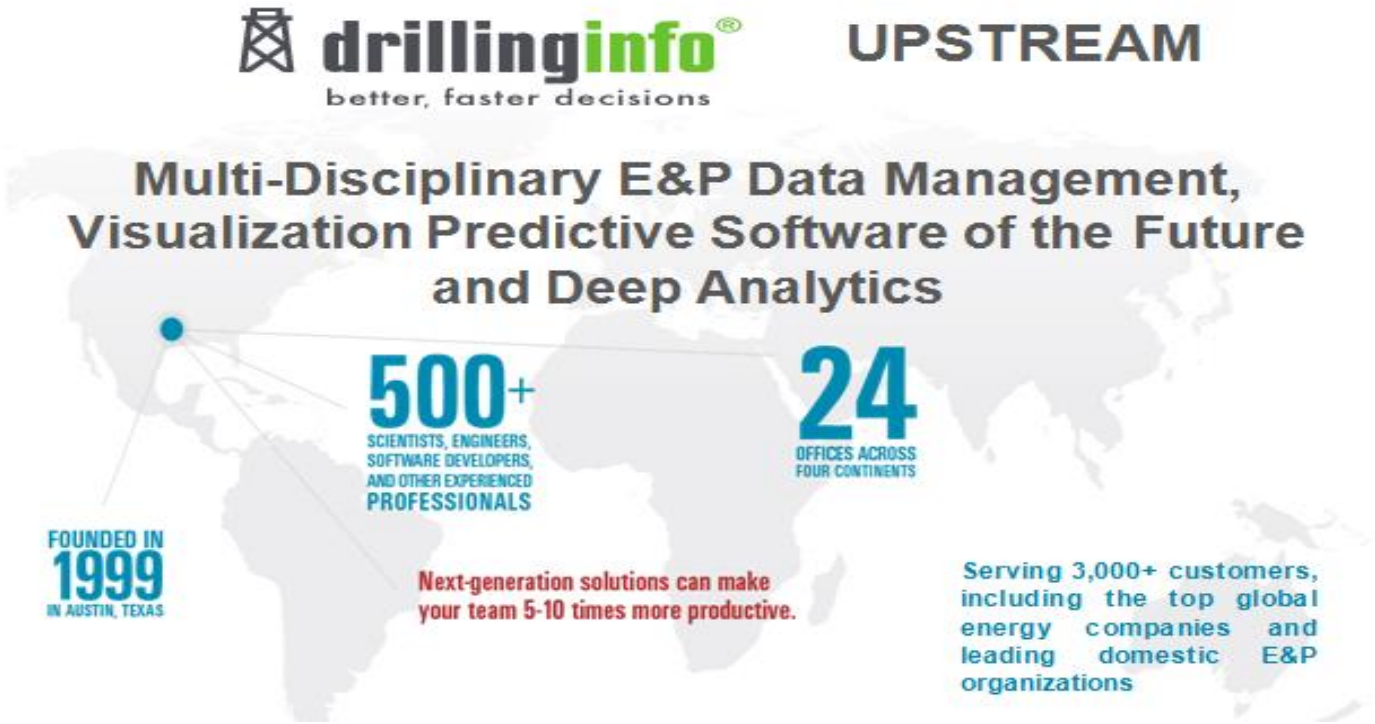
About DrillingInfo



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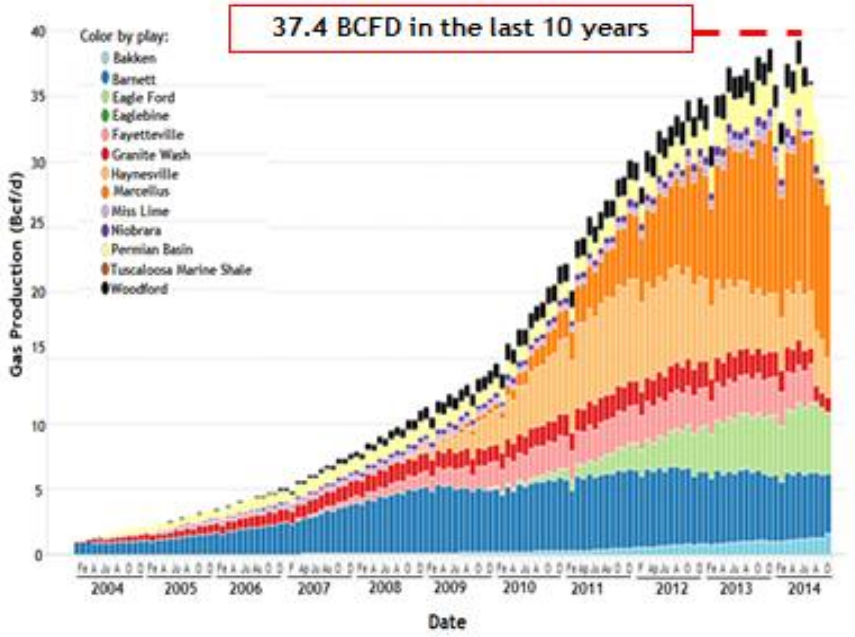
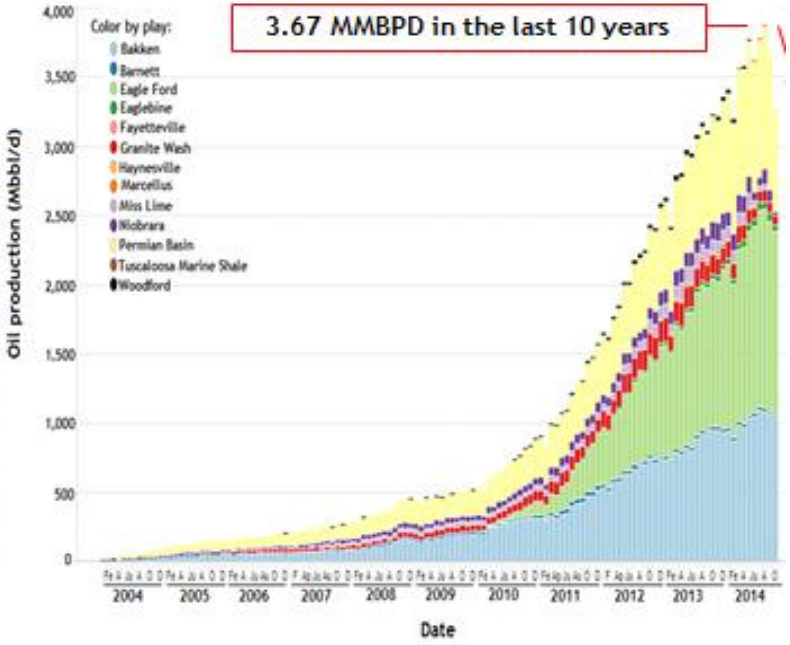
Concepts and Objective

- Present basic concepts regarding predictive modeling and grading an acreage to optimize results in unconventional hydrocarbon developments.
- Analyze the benefits of information sharing for unconventional developments.
- Analyze how these practices are still being applied in other plays in the U.S. and how they could be applied globally and result in extensive benefits.
- Argentina - Vaca Muerta shale formation as an example.

U.S. Shale Gas and Shale Oil Boom





Gas: **8 to 9 USD/MMBtu**

Oil: **80 to 90 USD/Bbl**

Average Savings 2004 to 2014: 90 to 100 Billion USD/Year

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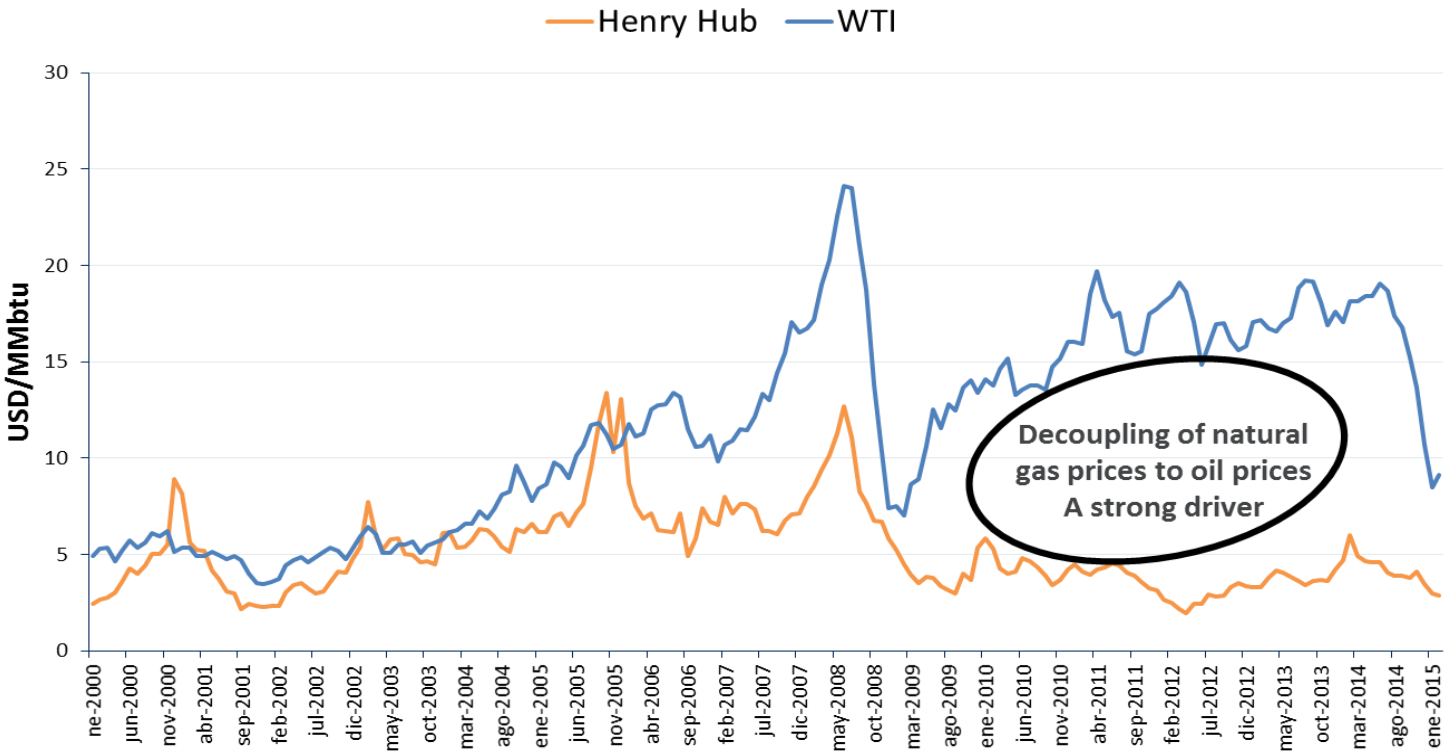
U.S. Shale Gas and Shale Oil Boom



Source: EIA,

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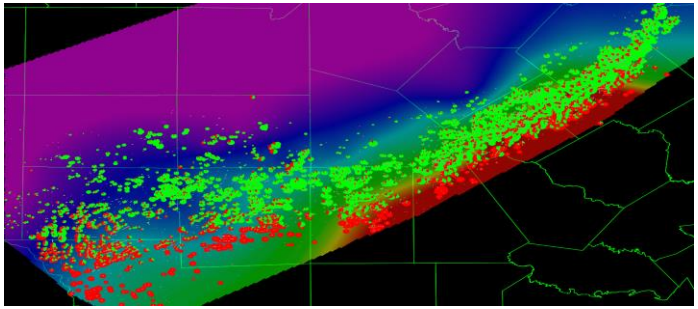
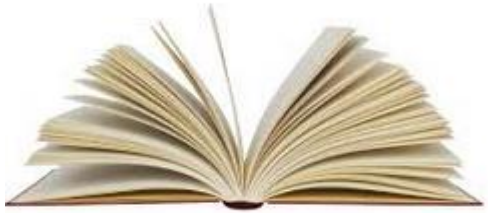
What is Predictive Modeling?





- For the shale gas/oil industry, predictive modeling techniques such as regression analysis are used to grade the acreage (new play or area within a play)
- Acreage grading uses predictive models to find the relationship between geology and engineering data and known production.
- It is important to use as much **relevant** data as available.

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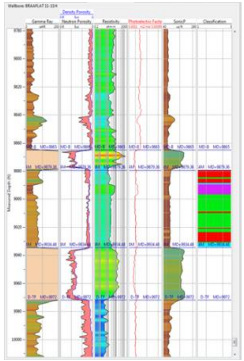
How Predictive Modeling Works?

Geology Data +

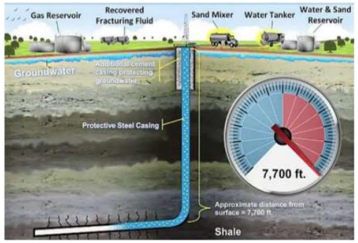
- Ex.:
- well log attributes: gamma ray, resistivity, porosity and many others.



Engineering Data +

Ex.:

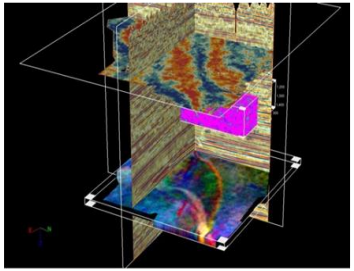
amount of proppant, lateral length, amount of fracture fluid and literally dozens of other parameters



Subsurface Data

Ex.:

2D, 3D, microseismic and more lately 3-C and 9-C seismic can be used.



→

Known Production Data

Data is input into the predictive model and the correlation between it and known production is established.

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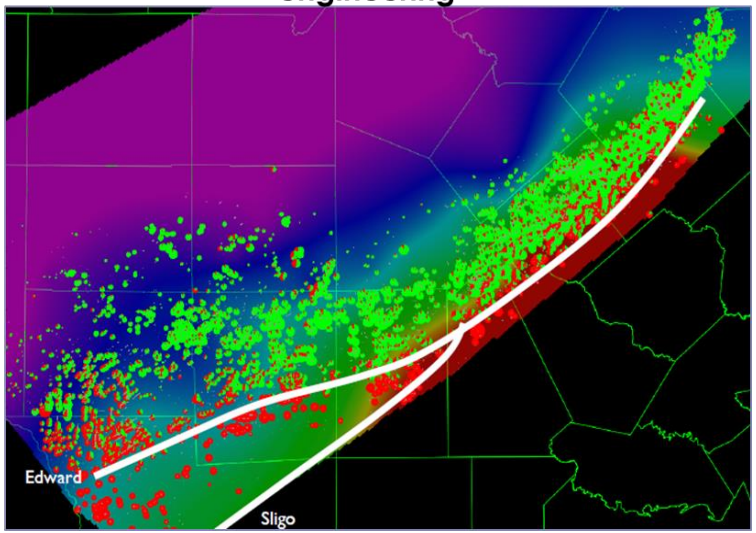
Results

- Correlation is then used to **predict production anywhere where the geology data exists**, regardless if there is production or not.
  - Predictive modeling to grade the acreage (play) allows to characterize regional or local sweetspots and predict production
  - Enormous value:
    - Much better than guessing
    - Establish from the beginning
      - ✓ Monetization techniques
      - ✓ Recovery factors
      - ✓ Drill pilot tests
      - ✓ Start factory drilling

Eagle Ford sweetspot map with normalized engineering



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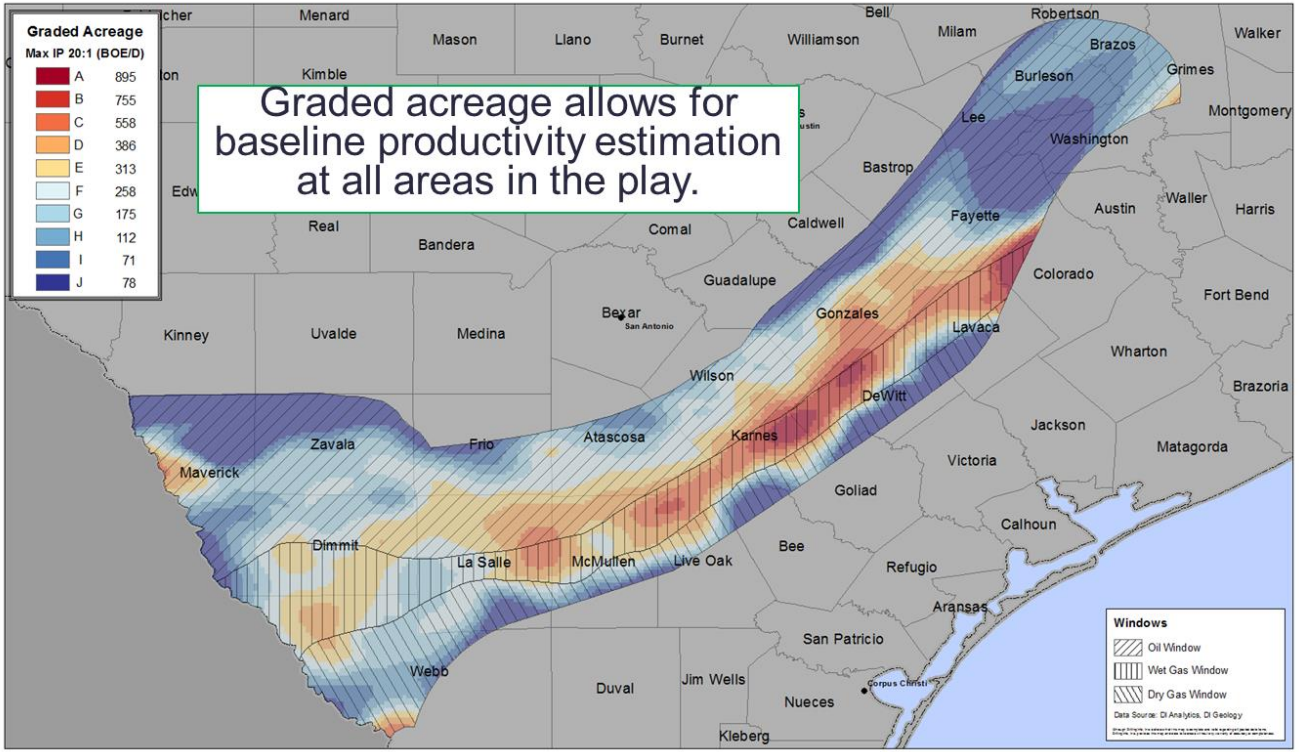
Eagle Ford Acreage Grading



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Eagle Ford

The economic deliverability grading result of the Eagle Ford play in south-central Texas

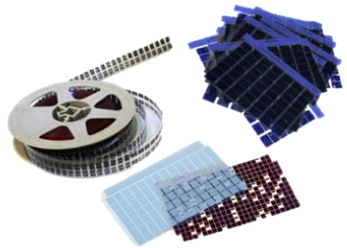
Eagle Ford
Acreage Grading

DI Information Process

External sources

Proprietary data

Public repositories



Proprietary Process for Collecting, Digitalization and Cleaning Upstream Data

Public Data
FRRC

- Development of the unconventional industry in U.S. has been driven by sharing of information or the exchange of data and information

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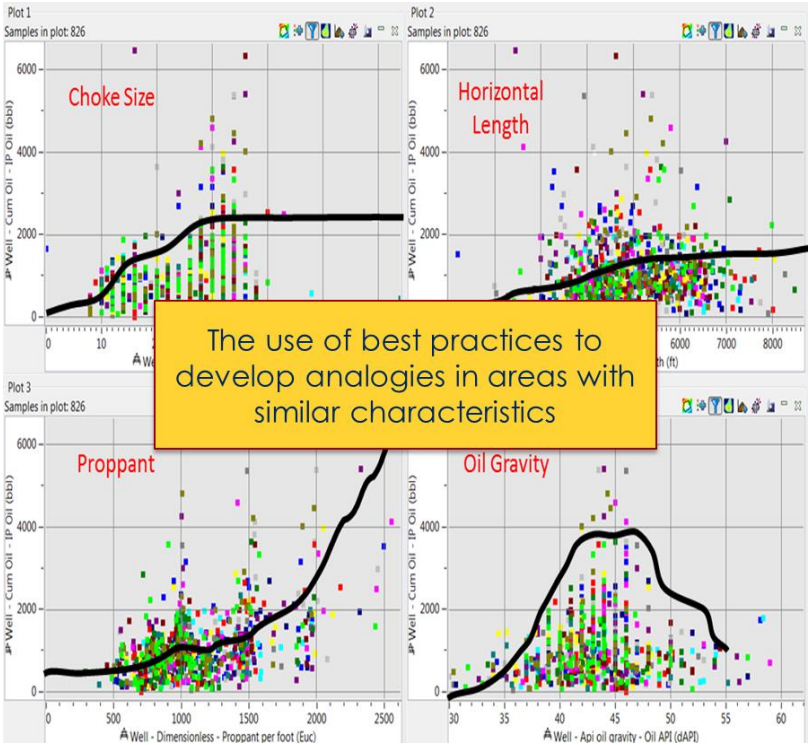
Optimize Production Through Best Practices



- Without sharing information valuable analysis could be lost.
- Operators could not perform geological comparative studies and tendencies to improve their performance across zones in a determined play.
- Benefits for the overall industry by increasing production and returns of investments.

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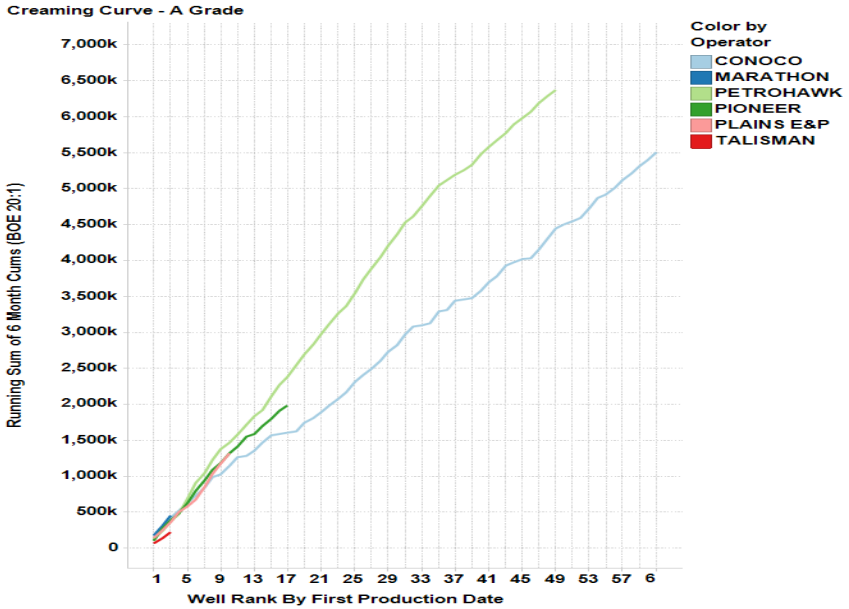
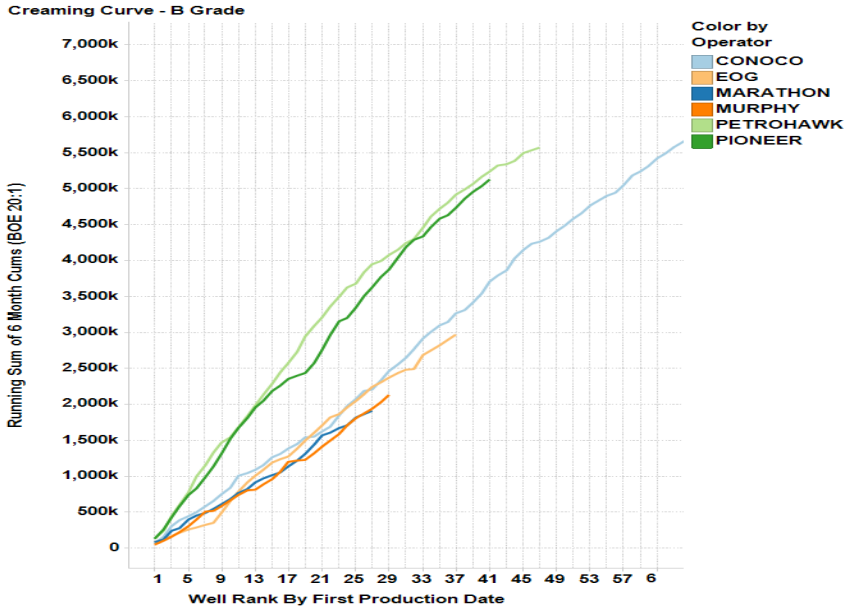
Best Practices – Sharing of Information





Sharing information is valid not only for determining sweetspots and predict production, but to make adjustments during factory drilling

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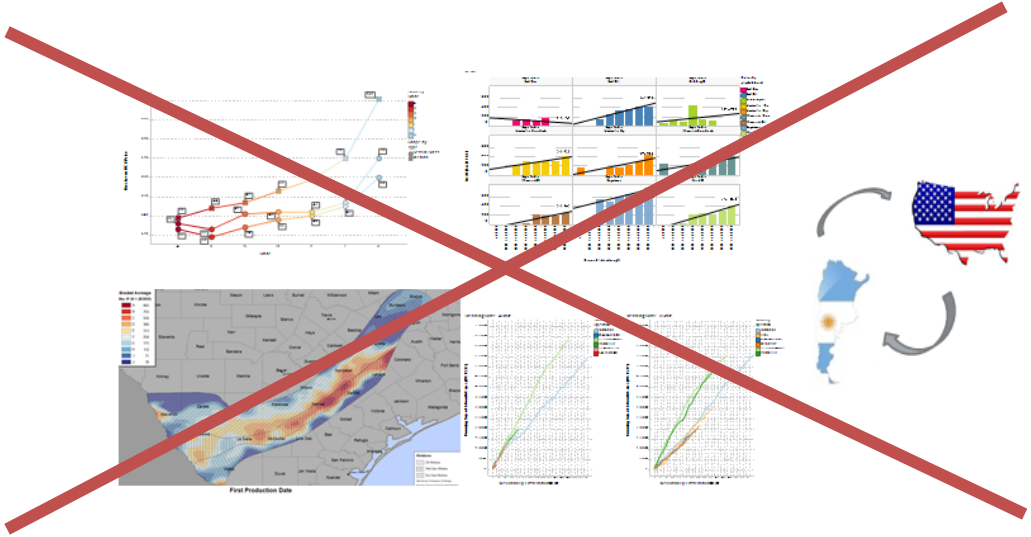
Importance of Sharing of Information

Without sharing data, it would be very difficult to perform more accurate predictive modeling and acreage grading, which in turn will not allow more clearly determining or predicting sweetspots within a play, neither compare best practices across a play or plays around the world.



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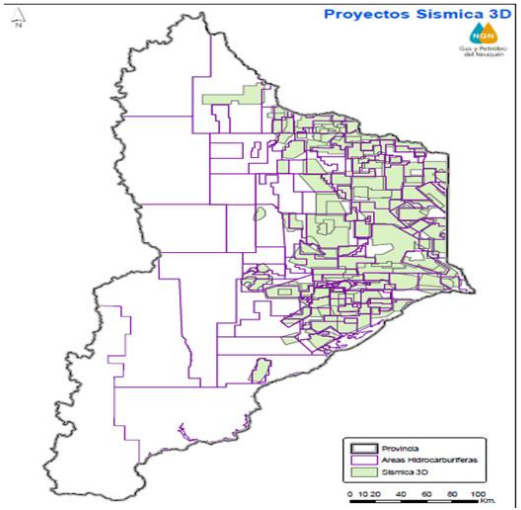
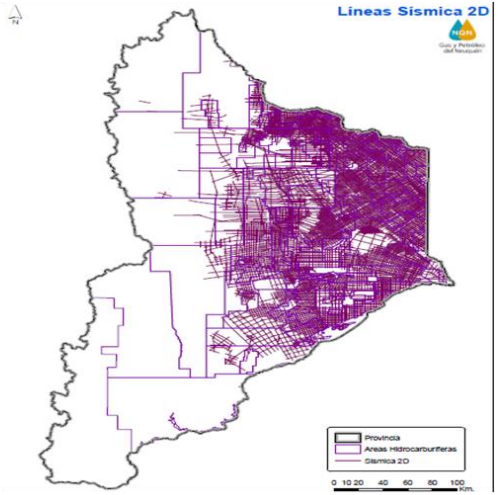
Extensive Information for Vaca Muerta Shale in Argentina

- **Seismic Data – 2D Lines, 3D Blocks**





Vaca Muerta play in Argentina, has data for over 12,000 penetrations (well logs) and also extensive 2D and 3D data

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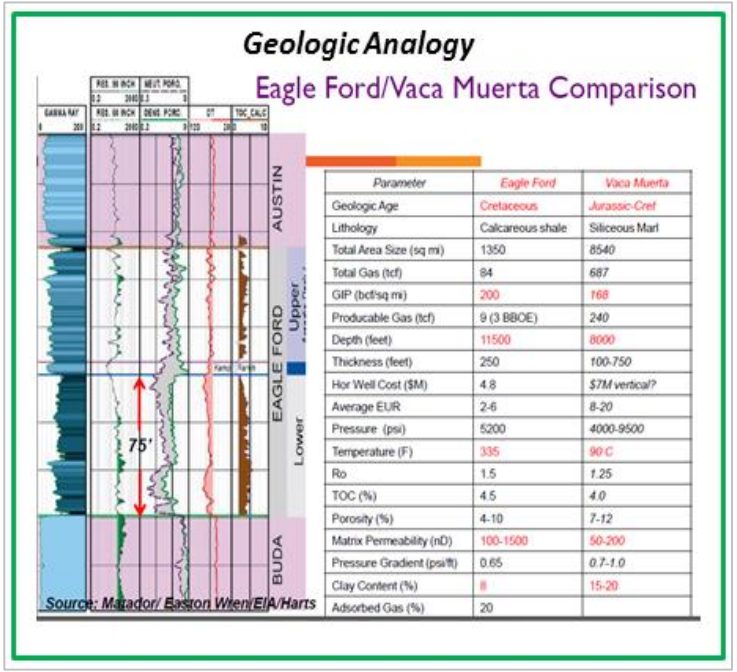
Source: GyP

Proposed Process for the Development of Vaca Muerta



Parameter	Eagle Ford	Vaca Muerta
Geologic Age	Cretaceous	Jurassic-Cret
Lithology	Calcareous shale	Siliceous Marl
Total Area Size (sq mi)	1350	8540
Total Gas (tcf)	84	687
GIP (bcf/sq mi)	200	168
Producable Gas (tcf)	9 (3 BBOE)	240
Depth (feet)	11500	8000
Thickness (feet)	250	100-750
Hor Well Cost ($M)	4.8	$7M vertical?
Average EUR	2-6	8-20
Pressure (psi)	5200	4000-9500
Temperature (F)	335	90 C
Ro	1.5	1.25
TOC (%)	4.5	4.0
Porosity (%)	4-10	7-12
Matrix Permeability (nD)	100-1500	50-200
Pressure Gradient (psi/ft)	0.65	0.7-1.0
Clay Content (%)	8	15-20
Adsorbed Gas (%)	20	

Pre-established Behavior / Predictive Simulation Models

Gradin - Identify Sweetspots (Vaca Muerta)

Grading - Predict Production (Vaca Muerta)

Drill Pilot Wells

Factory Drilling & Adjust With Best Practices

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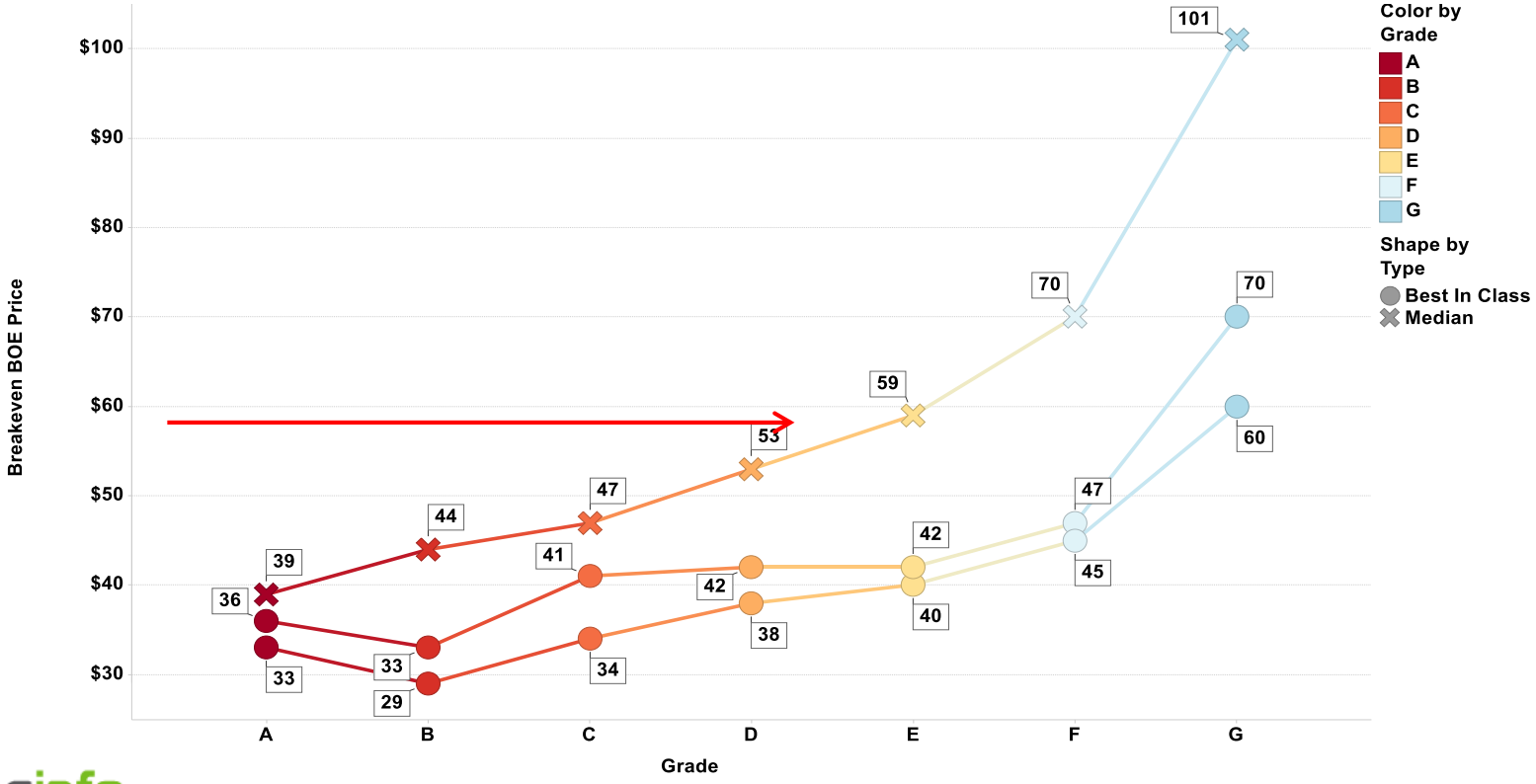
Break Even Prices



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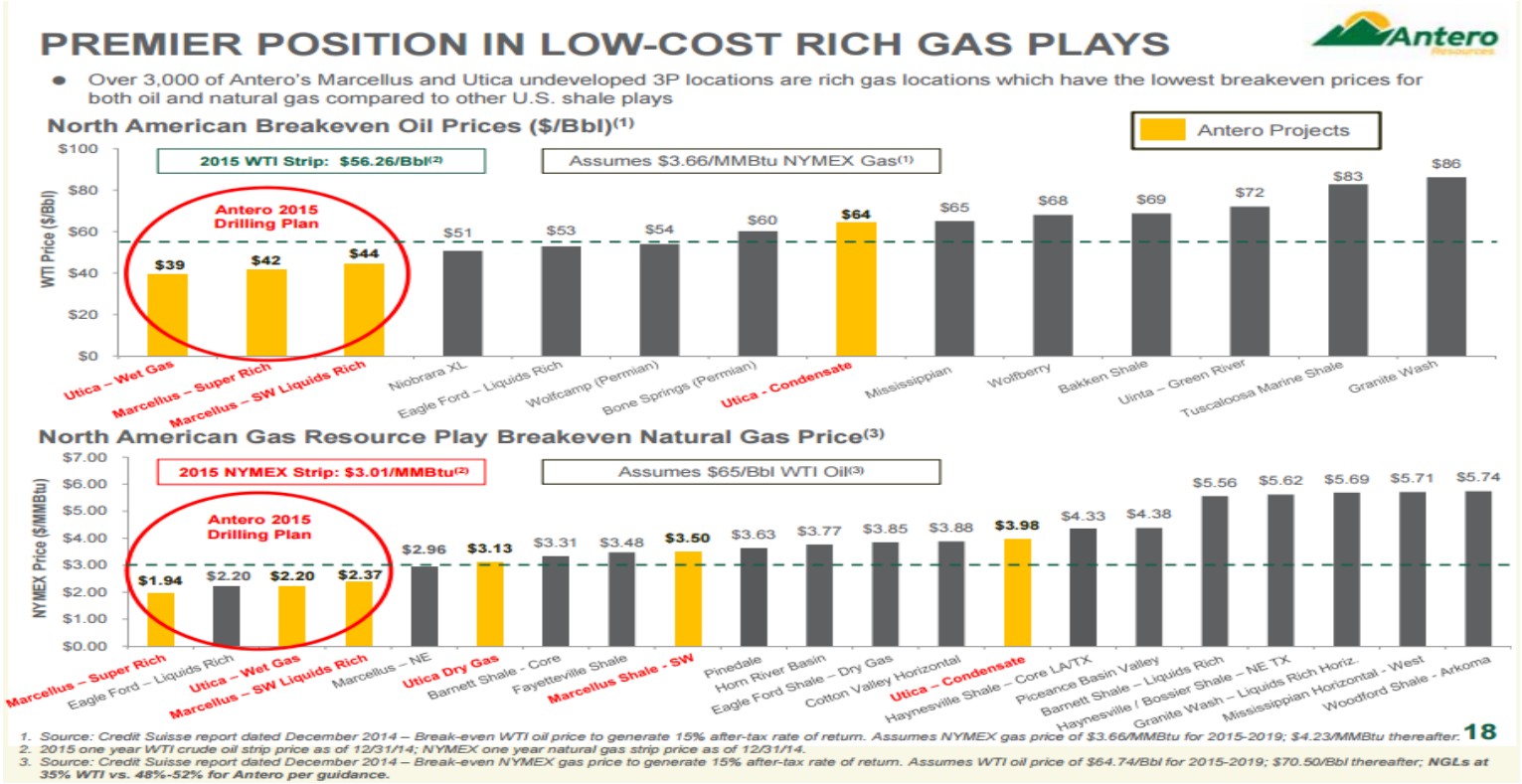
Break Even Prices



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Conclusions

- ✓ Sharing information improved efficiency and rock productivity and brings benefits to companies and countries.
- ✓ Predictive modeling is a useful tool that allows grading an existing or new acreage to determine sweet-spots, predict production and apply best practices to most effectively brake the rock.
- ✓ It is a valid scientific approach to achieve better and improved results in unconventional developments around the world.
- ✓ It is important to use as much data as possible but it has to be relevant data

THANK YOU!

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