Estimating Unconventional Oil Resources and Reserves*

Rick Marsh[1]

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[1]Energy Resources Conservation Board, Calgary, Alberta (rick.marsh@ercb.ca)

Abstract

Given its history, the Petroleum Reserves Management System (PRMS) is well suited to industry personnel trying to define a financial asset but somewhat less so to a resource manager trying to define potential, even more so when the potential is unconventional. To fully suit an unconventional world, PRMS likely needs some adjustments, and the value of non-proven reserve and resource estimates needs to be better appreciated by a wider audience. Current international mineral standards may better suit unconventional needs, and Canadian regulatory standards are showing the growing usage of Contingent Resources.

By its very nature, unconventional means looking at resources lower down in the resource pyramid, but just how much lower is an open ended question. Alberta has a long track record, especially with oil sands, of dealing with this issue, both from a government and industry perspective. Combining these perspectives yields common general categories of (constrained) total in-place, developable in-place, and recoverable resources (reserves).

Experience leads to the conclusion that for a resource assessment geologist, the production engineer is an important colleague. The geologist and the engineer are both charged with the same overall mission: find it and get it out of the ground at a profit. When dealing with unconventional resources, however, 'it' isn't necessarily obvious and neither is 'out of the ground'; that is why it's called unconventional, and properly estimated resources and reserves are the forecaster of success. The key middle ground for both disciplines is developable in-place (within the reservoir) and caprock integrity (external to the reservoir).

References

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Rick Marsh
Energy Resources Conservation Board
Calgary, Alberta

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Geological Aspects of Estimating Resources and Reserves

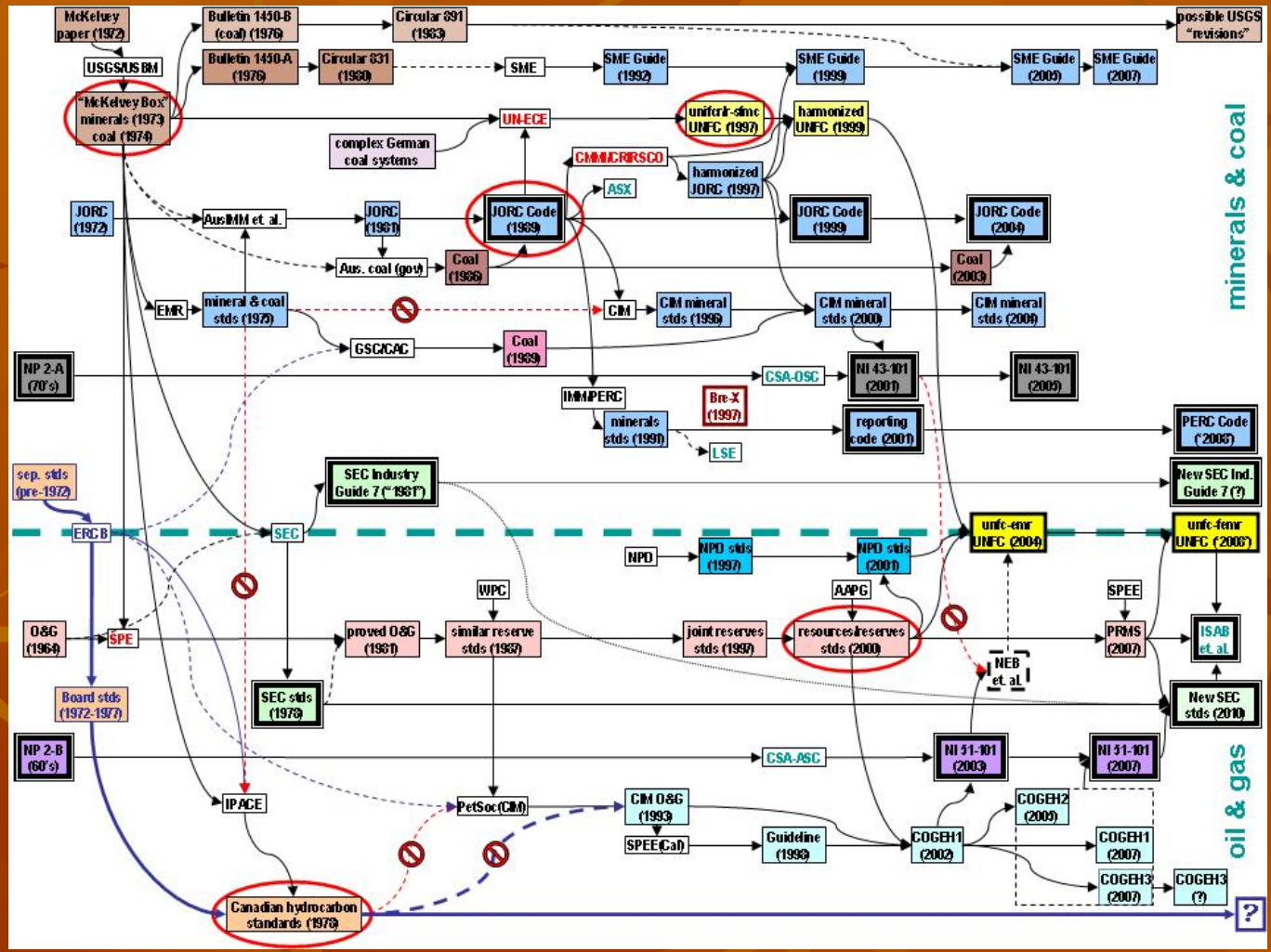
Houston – Sept 11, 2009

ERCB Energy Resources Conservation Board

Introduction

- Three items for discussion today
  - An unconventional view of PRMS
  - A resource manager's perspective of unconventional 'reserves'
  - Geologist and Engineer; an unconventional pair

Resource Classification Standards



There have been many standards leading to PRMS, 'SEC2', CRIRSCO (minerals), & UNFC (mineral & petroleum)

Unconventional View of PRMS

PRMS

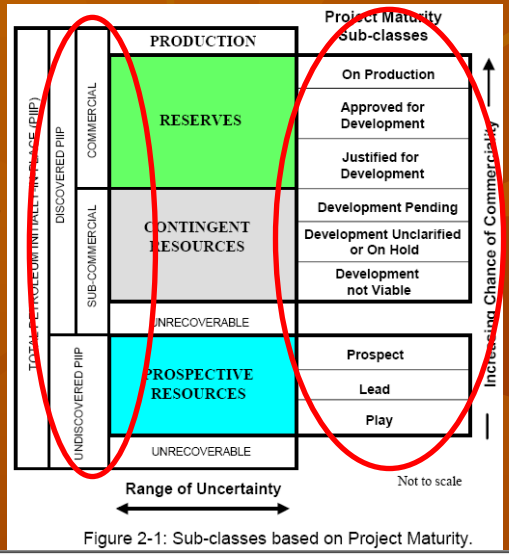
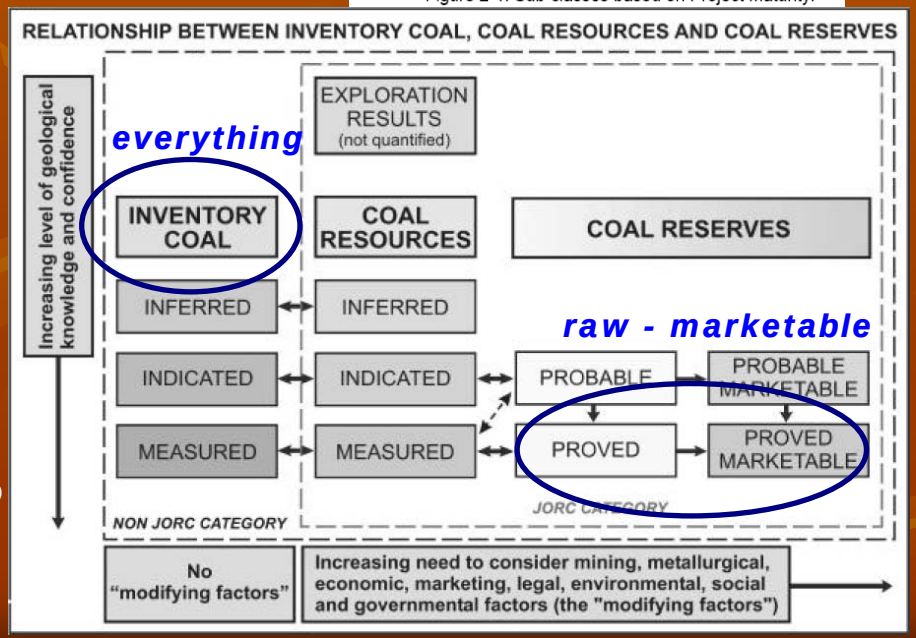


Figure 2-1: Sub-classes based on Project Maturity.

Worst *Best*

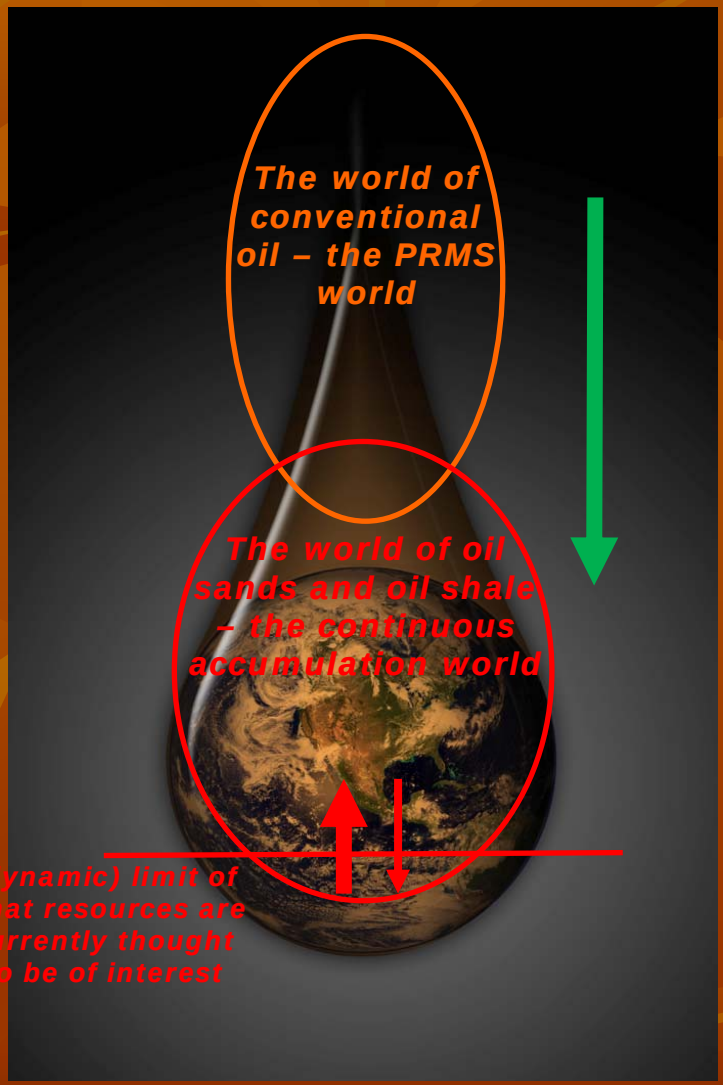
Australian Coal Standards



Source: Coalfields Geology Council of NSW & Queensland Mining Council - 2003

- PRMS – most applicable for categorizing industry assets but less so for resource managers dealing with unconventional resources
- Resource extraction moving from single pool to basin-wide deposit
- What is discovered?
- What about grade?
- Timeframe?
- Contingent resources; a useful category
- Mineral categories may be more applicable for unconventional development

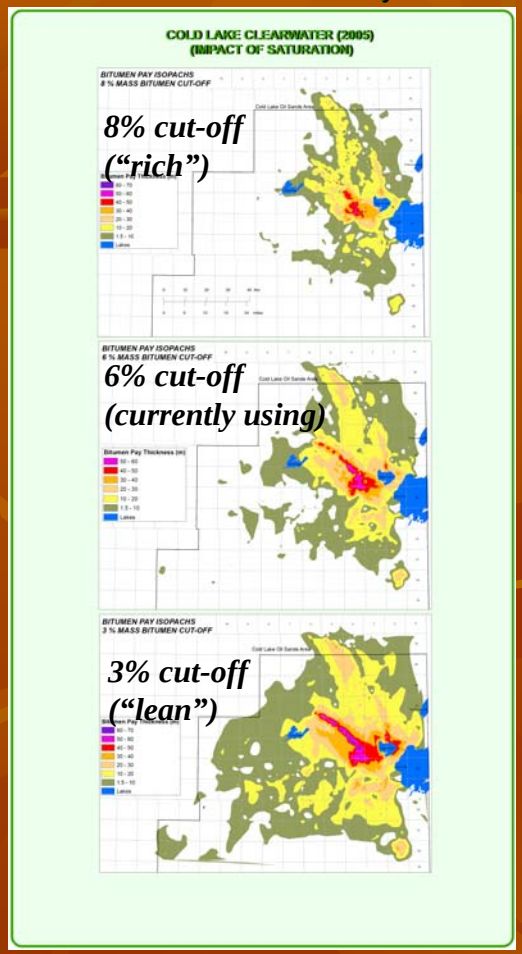
Resource 'Pyramid'



- Hydrocarbons similar to minerals development history – plums (conventional) then crumbs (unconventional)
- When categorizing; keep the net wide – we don't know what we don't know; initial commerciality ideas likely wrong
- In Alberta;
  - ERCB initially used 3% mass bitumen cutoff; now using 6% (to exclude marginal grade material)
  - CSS development moving into thinner (more marginal) zones; SAGD still restricted to plums

"Pay Grade" – where to start?

Oil Sands Pay



Source: Marsh – Understanding Alberta's Bitumen Resources

Oil Shale Grade

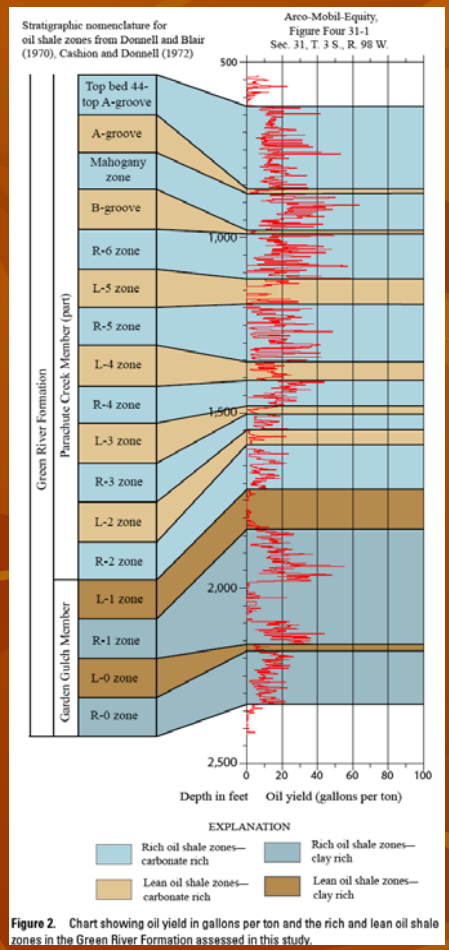
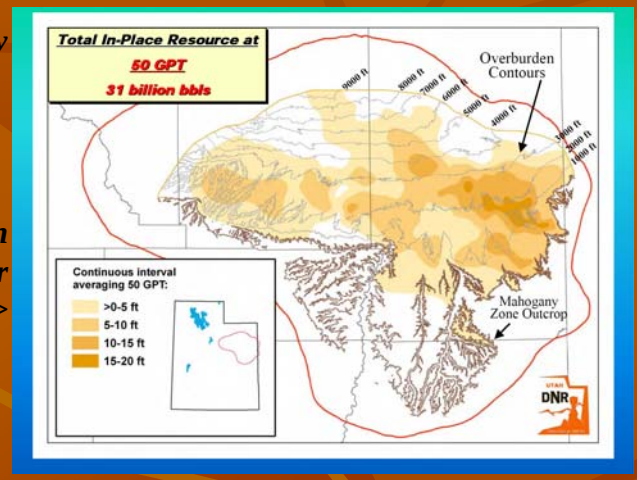


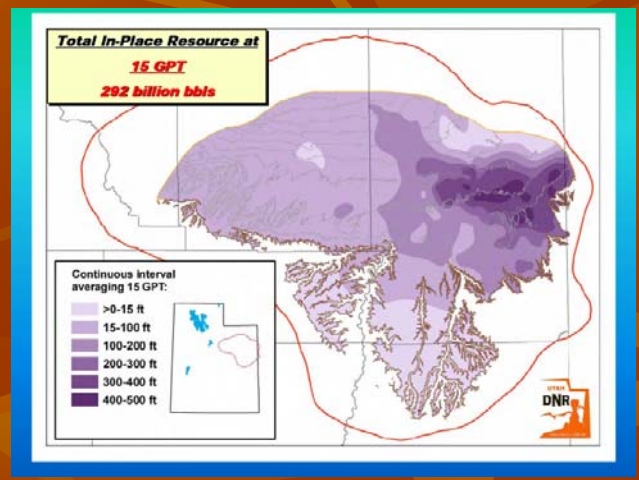
Figure 2. Chart showing oil yield in gallons per ton and the rich and lean oil shale zones in the Green River Formation assessed in this study.

Source: USGC Fact Sheet 2009-3012

< initially just rich/lean

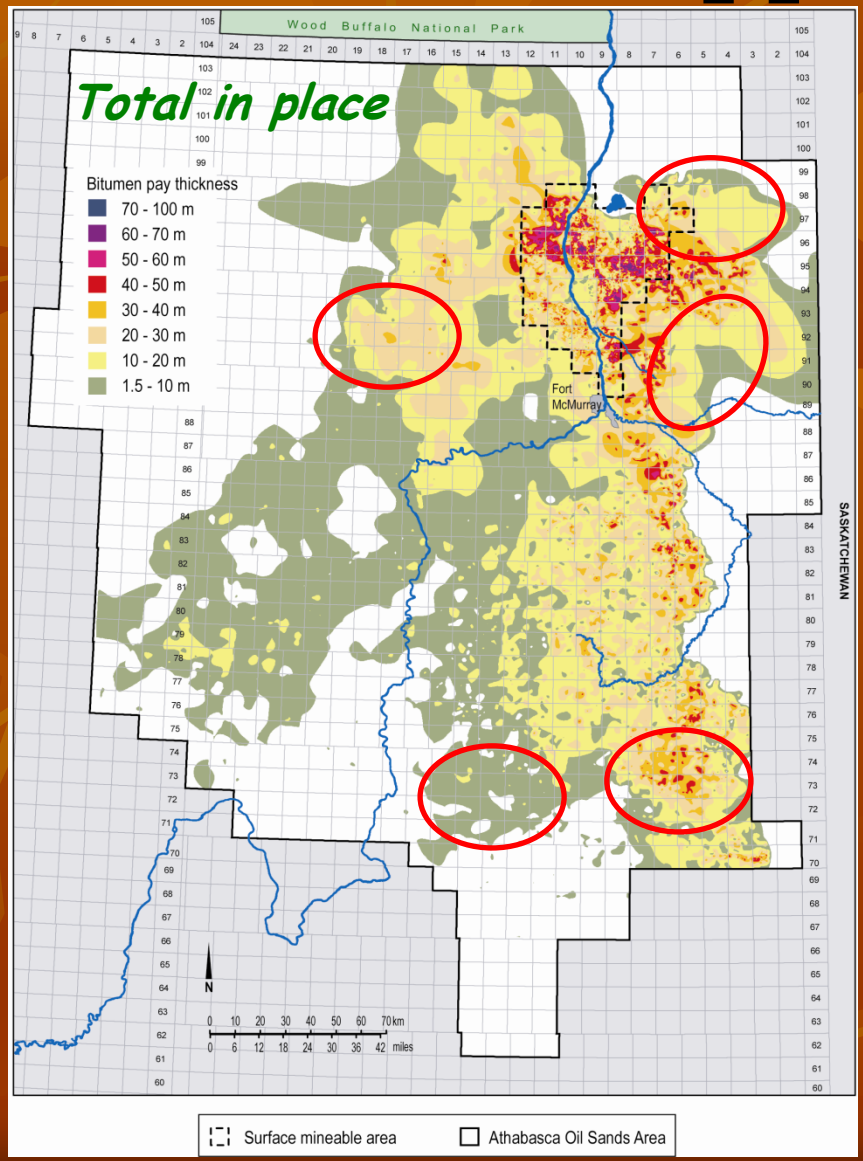
then in greater detail>



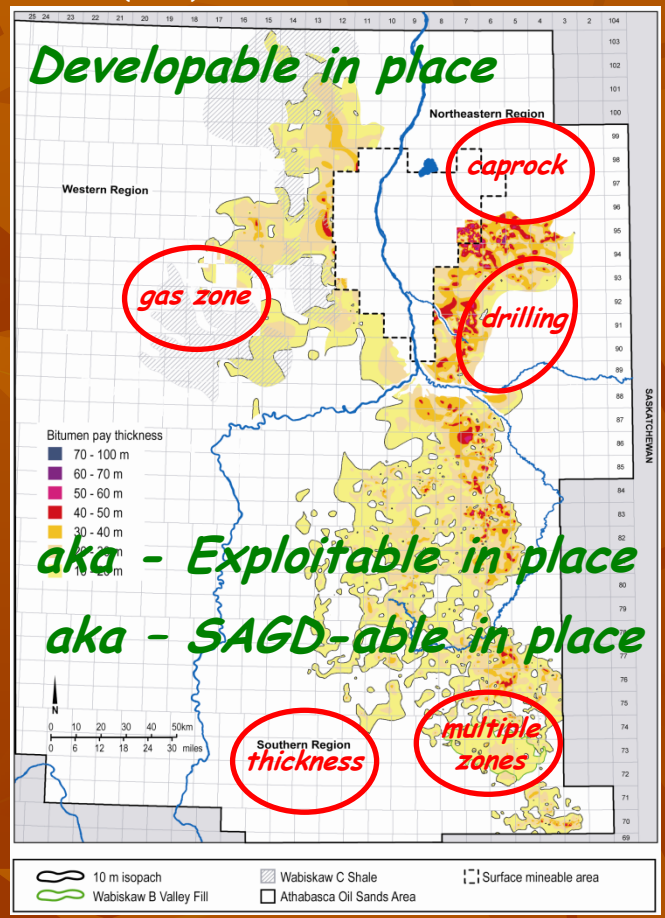


Source: Vanden Berg (2008) – Utah Geological Survey

Constraint Mapping – Oil Sands

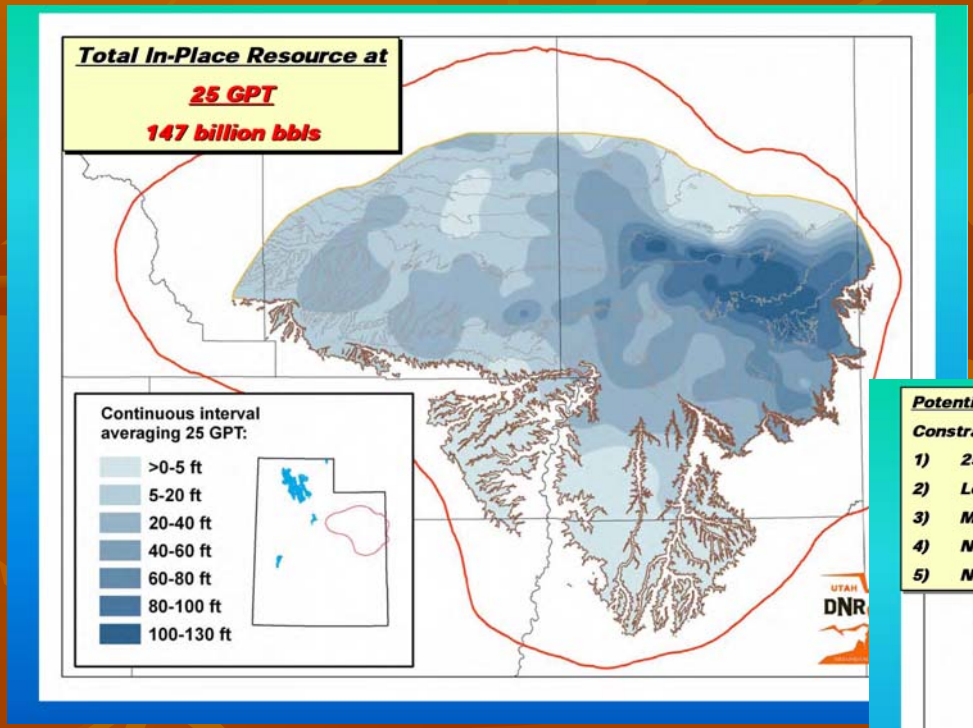


Source: EUB (ERCB) ST98-2005

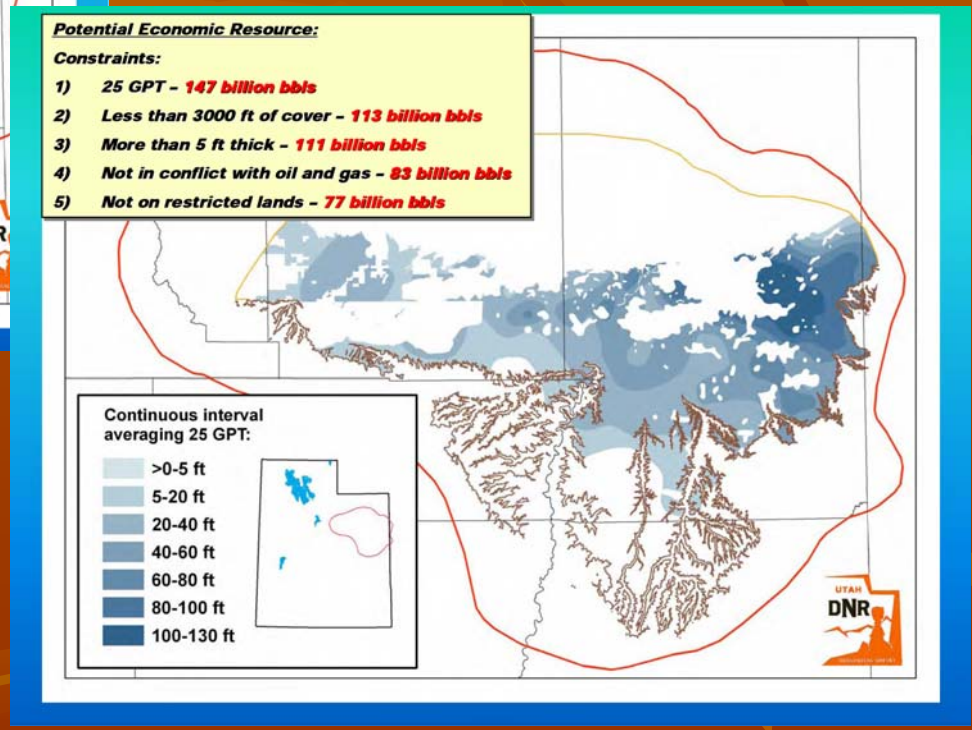


- *Regional perspective of developable (Alberta's Wabiskaw-McMurray deposit)*
- *Industry perspective is similar but on a much smaller scale*

Constraint Mapping – Oil Shale



reduced by 48%!



Potential Additional Constraints;

- Data Density?
- Minimum Volume?
- Caprock?
- Socio-Environmental constraint areas?
- Other operational (commerciality) constraints?

Source: Vanden Berg (2008) – Utah Geological Survey

Recoverable

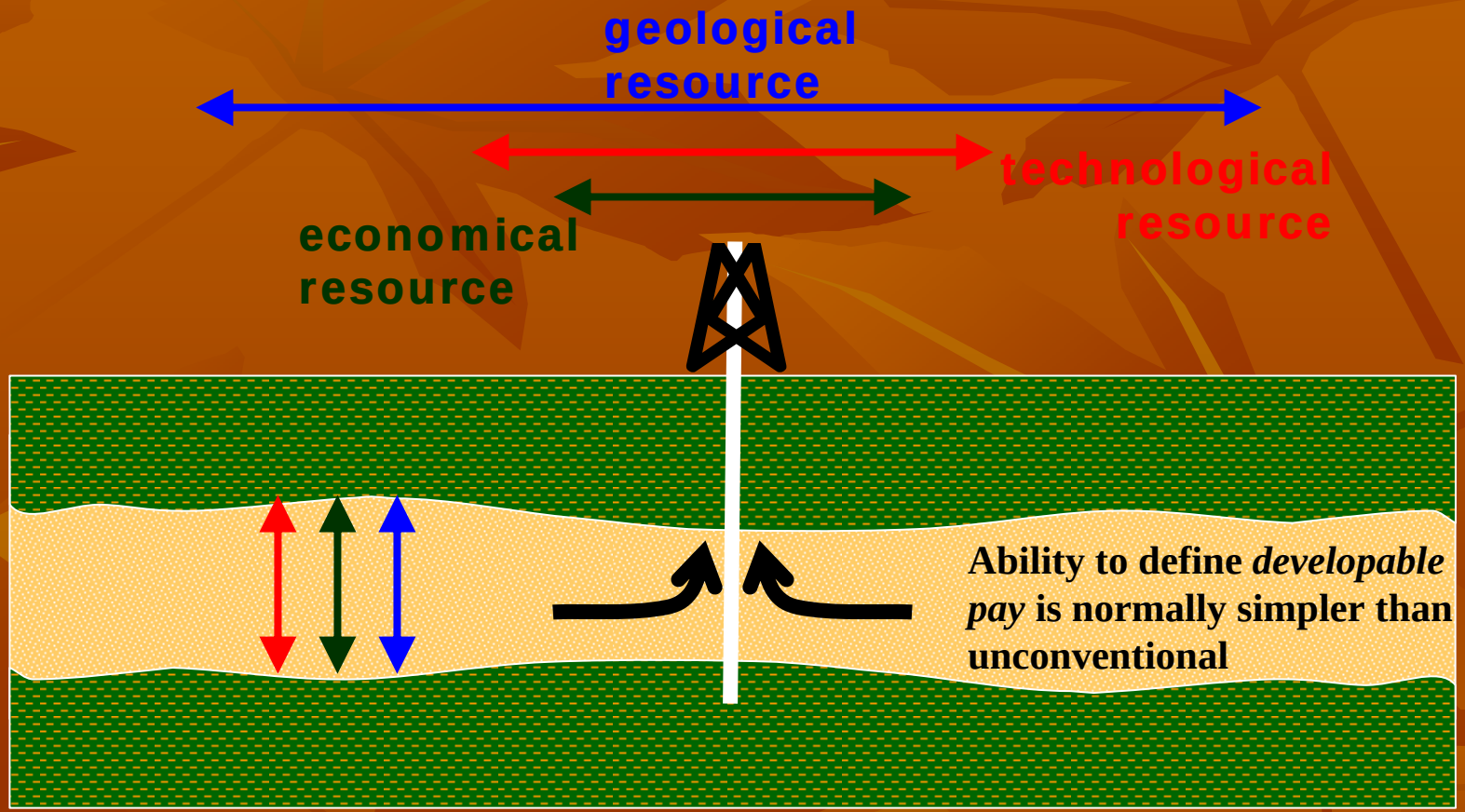
- Developable in place **x** recovery (or utilization) factor **=** recoverable resource (reserve)

- *A provincial perspective of recoverable (used for unconventional oil and gas in Alberta) – start with in place only, then book initial reserves = production, then book project reserves, then finally book* ***regional reserves*** *(inter-project reserves)*

Geologist & Engineer

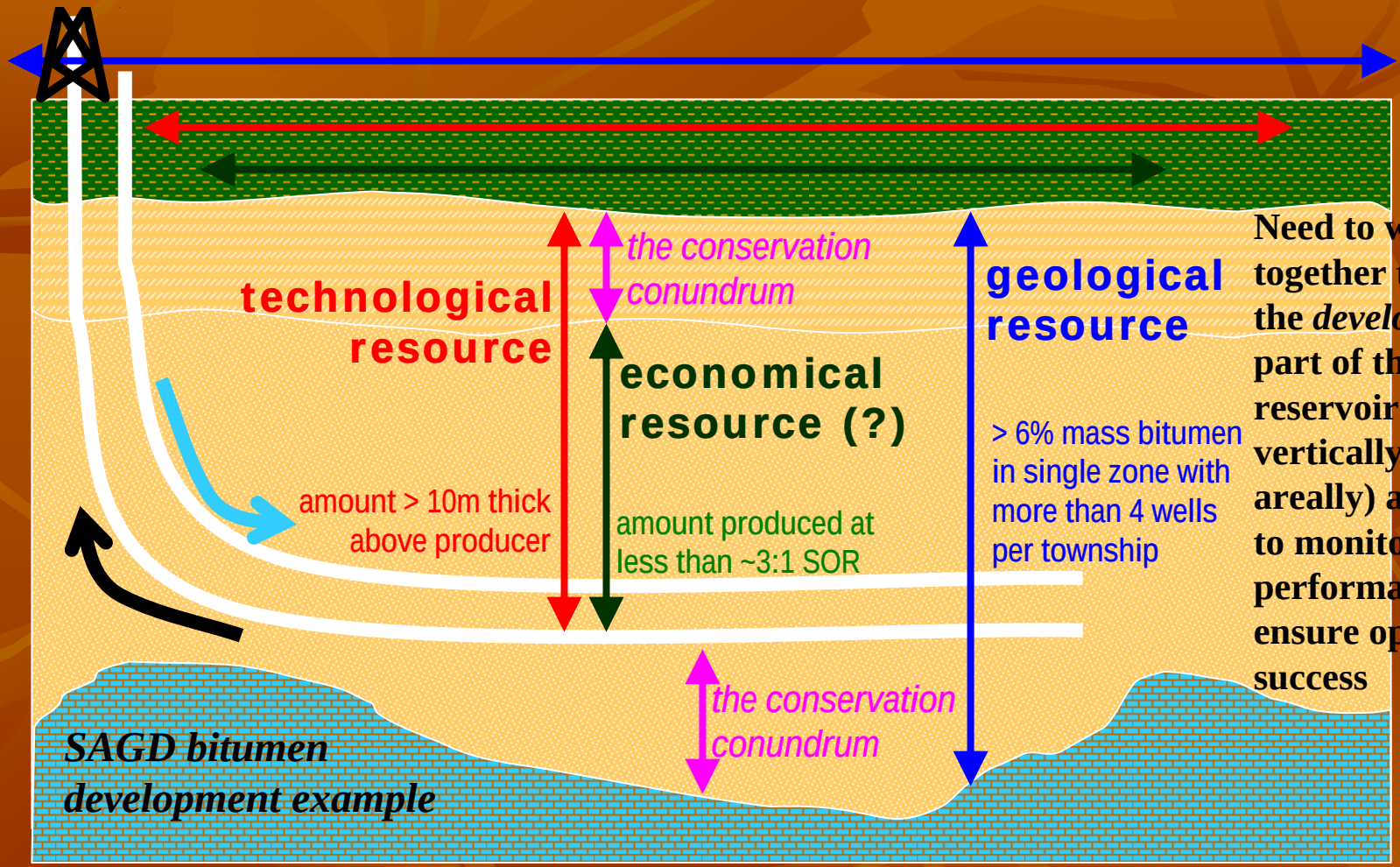
- Geologists & engineers – *brothers in arms*, but…
  - Geologists see in color; engineers in black & white
  - Geologists love maps; engineers love charts (geologists are visual; engineers are numerical)
  - Geologists are wildcatters (failure is part of learning); engineers are risk adverse (a bridge cannot fail)
- Need to marry the skills and tendencies of both
- Working together on issues like defining *developable pay*, creating *reservoir models*, and ensuring *caprock integrity* are important

Developable Pay - conventional



Schematic of simplified resource classes – conventional

Developable Pay – unconventional

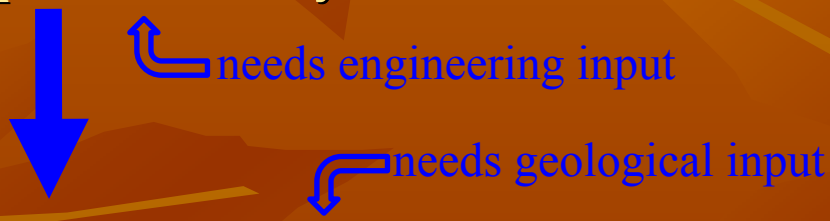


Need to work together to define the *developable* part of the reservoir (both vertically & areally) and then to monitor performance to ensure operational success

Schematic of simplified resource classes – unconventional

Modelling

- Geological Model
  - 'Begin with the end in mind' – model for flow simulation or detailed geological/reservoir model
  - Don't hide unknowns or limits of knowledge
  - **For flow simulation, need to preserve heterogeneity more than attain spatial accuracy**



- Reservoir Flow Simulation
  - **Output is limited by input**
  - History matching is good only so far as there is sufficient history and you understand the process
  - It is the future prediction that is important; what about monitoring

Caprock Integrity

- Ever increasing importance; need to think long-term
- Caprock Definition
  - Seal vs. Caprock
  - Mechanical; Chemical; Thermal?
- Timescale
  - Three months or three decades?
- Need to work together to understand the geology and the recovery mechanism to ensure recovery is confined to the strata intended

Thank you for your time

Questions?

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