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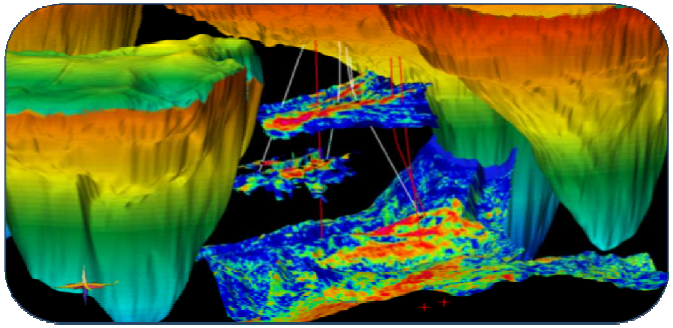

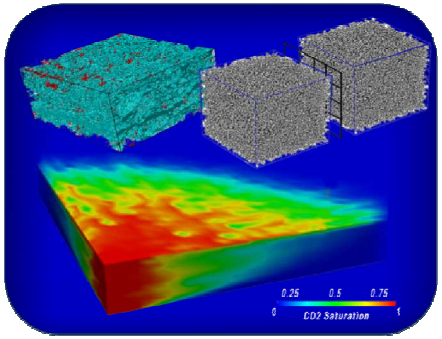

US Energy Security Assurance Through Domestic Shale Gas Production

Grand Challenge LDRD Presentation

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U.S. DEPARTMENT OF ENERGY

NNSA

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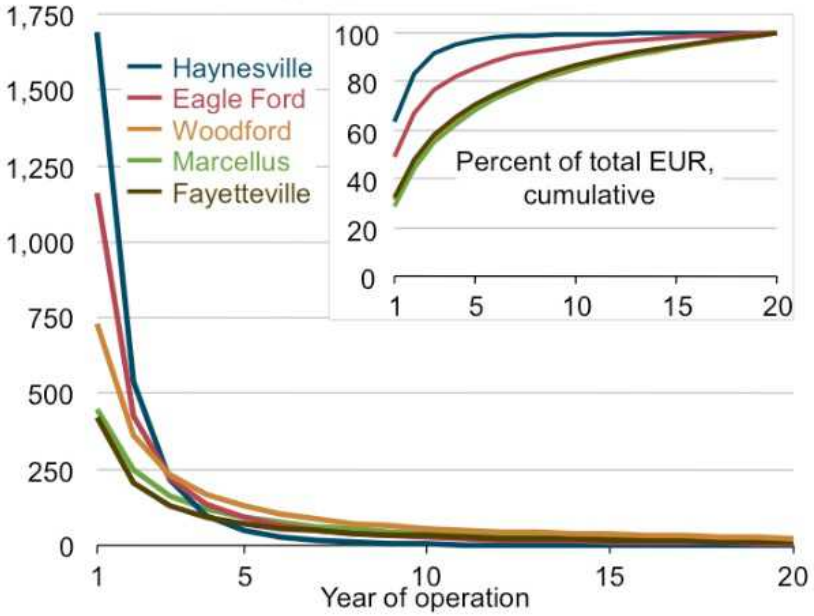
Sandia Can Address Knowledge Gaps

Figure 54. Average production profiles for shale gas wells in major U.S. shale plays by years of operation (million cubic feet per year)



From: US Energy Information Administration Annual Energy Outlook 2012

(EUR is estimated ultimate recovery)

- Ignorance about stimulated volume and proppant placement
- Disposition of the gas in the nano-porous rock during production
- Predict shale physics from well logs, seismic, core) i.e. data inversion
- Precise physics underlying the observed production declines and EURs*

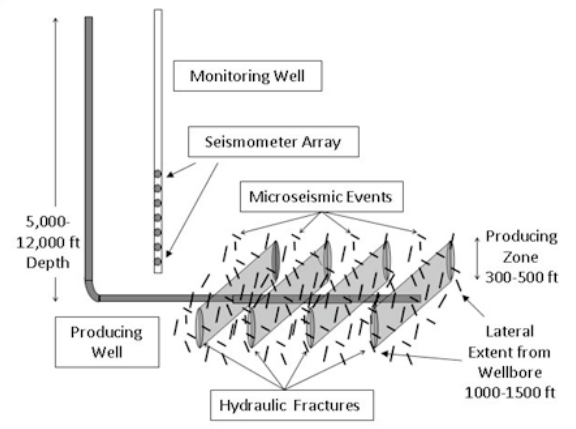
*For example Chesapeake Energy claims average EUR's for the Marcellus at 4.2 Bcf. Range Resources (RRC) has claimed average EUR's as high as 5.7 Bcf in investor presentations. According to USGS (2012) projections, however, the average EUR for the Marcellus is about 1.1 Bcf (billion cubic feet)

This Grand Challenge LDRD Proposal

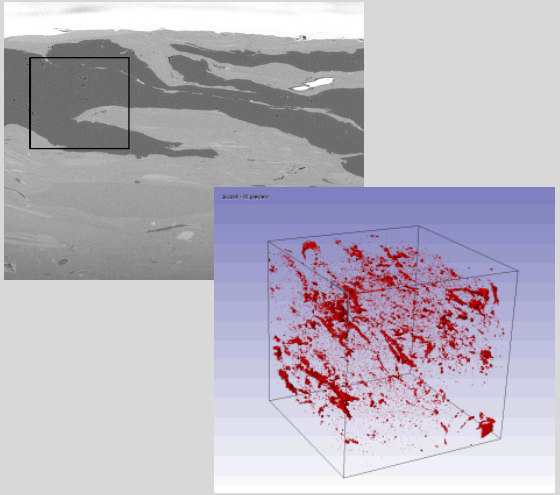
We will **assure domestic energy security** by reducing US dependence on foreign oil & gas through **science-based engineering solutions for sustainable shale gas production**.

Three coupled tasks to address knowledge gaps:

Task 1: Enhancement and preservation of stimulated volume



Task 2: Mechanistic understanding of methane disposition



Task 3: Data Fusion through inversion and simulation