Enhancing Resource Recovery

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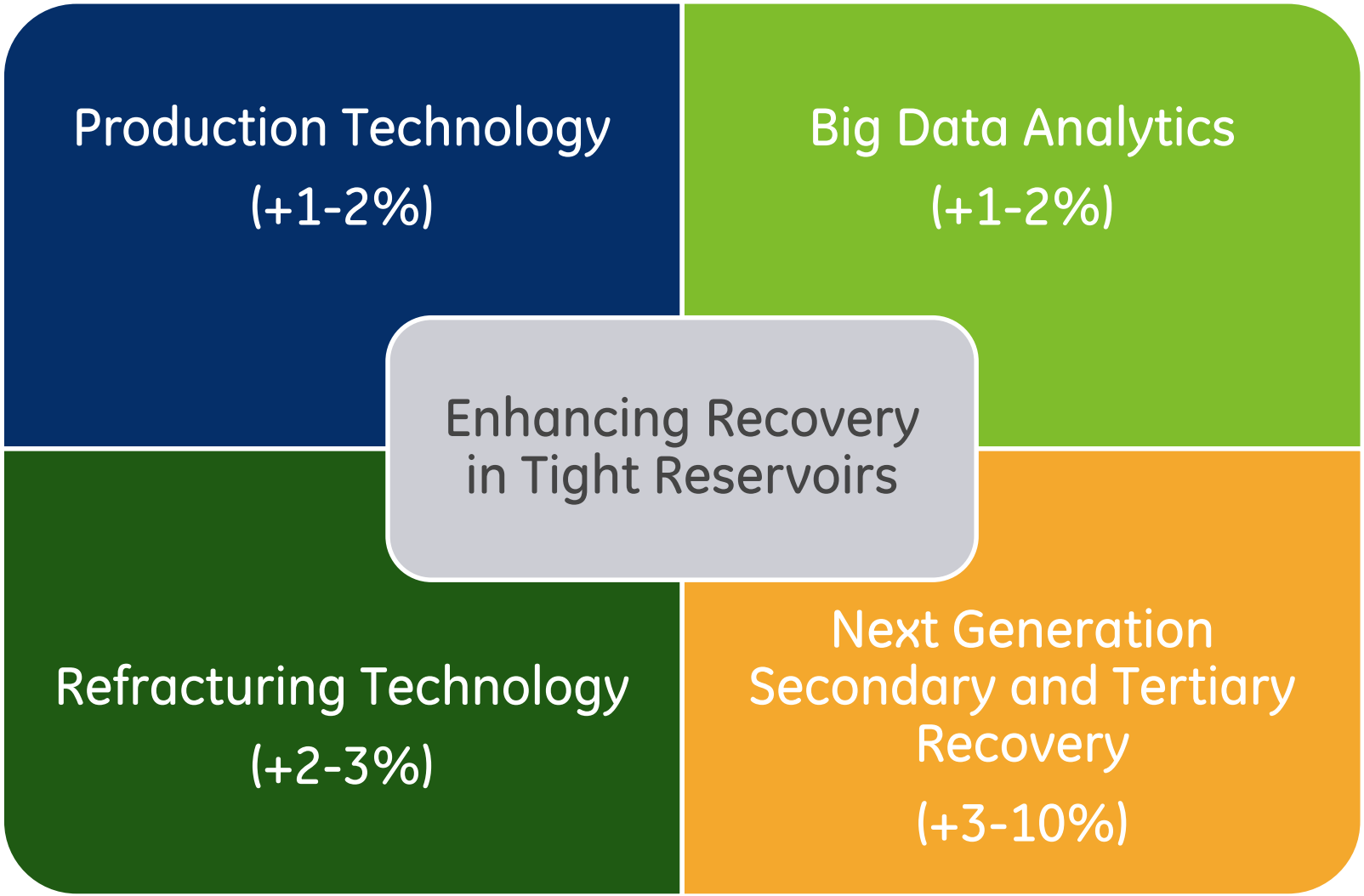
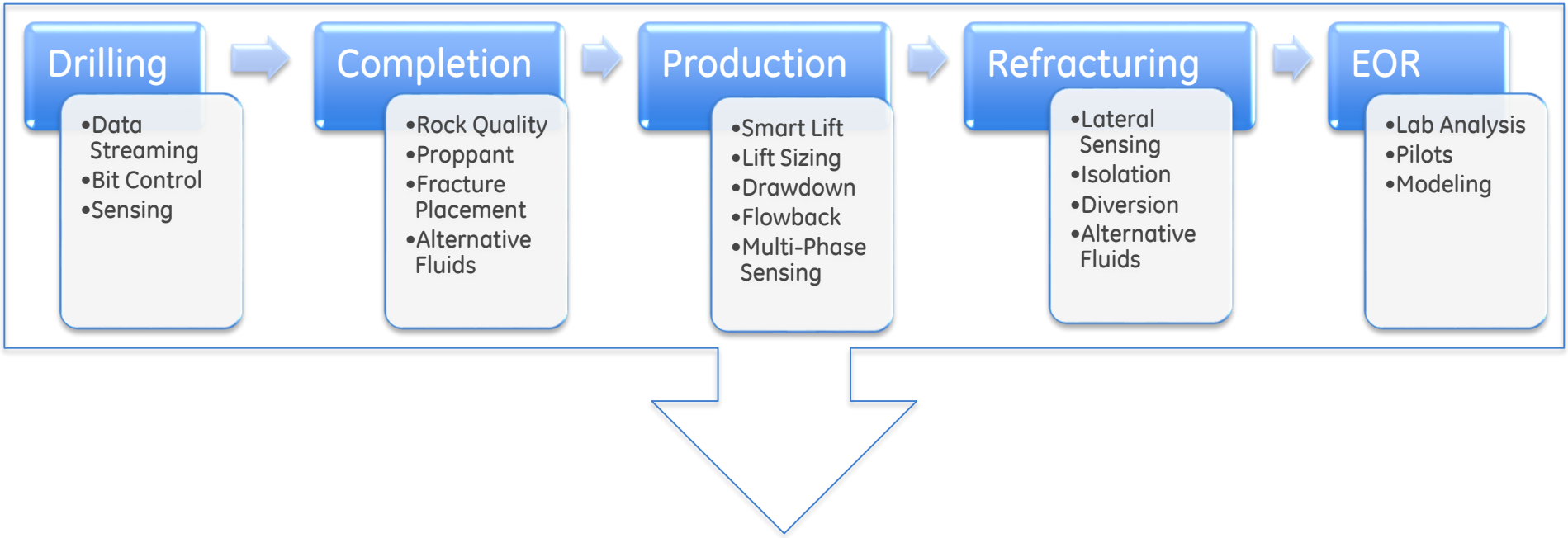
Imagination at work.


Production Technology
(+1-2%)
Big Data Analytics
(+1-2%)
Enhancing Recovery in Tight Reservoirs
Refracturing Technology
(+2-3%)
Next Generation Secondary and Tertiary Recovery
(+3-10%)

Well Lifecycle Optimization: Technological Advancements and Data Collection



Safety

Environmental Impact

Efficiency

Downtime

Well Lifecycle Optimization: Hardware Integration with Data and Models

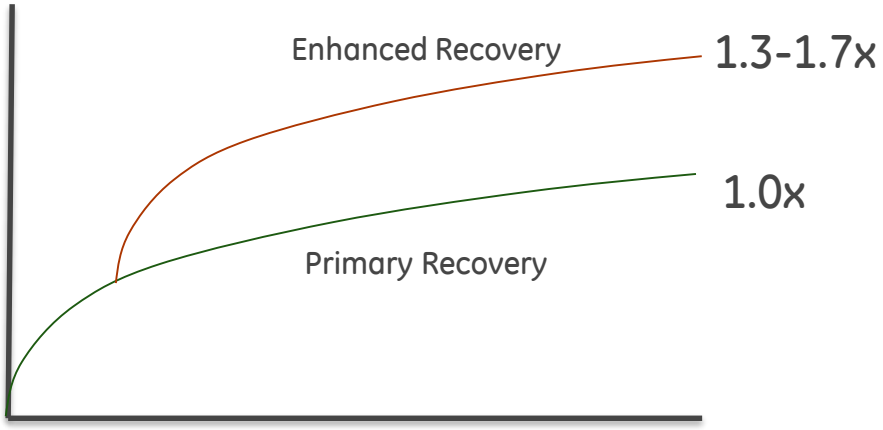
- Use Data and Models to Keep the Full Process in Mind
  - How should I space and fracture my wells knowing I might do EOR?
  - How do I flow back my well to mitigate fracture closure during production?
  - What wells should I refrac and where along the lateral?
  - When should I change my artificial lift and how does that impact my reservoir?
  - Can I optimize my surface facilities to reduce operating expenses?
  - When will downtime occur so I can allocate my resources appropriately?

Enhancing Recovery through Refracturing

- Identify low hanging fruit
  - Wells with suboptimal fracture designs
- Improve downhole sensing
  - Measure Production Along the Lateral
- Model Refracturing Process
  - Coupled geomechanical and production models
- Improve Fracture Technology
  - Alternative Fluids
  - Diverters
  - Offset Well Impact
- Understand Economic Success Prior to Refrac

Enhanced Oil Recovery

- Eagle Ford
  - 30-70% Recovery Increase
  - 1 data point (operator)
  - 3 year process
  - Scale from pilot to field
- Bakken
  - 7 pilots
  - Works on paper but unsuccessful
  - CO_2 looks promising but resource lacking
- Improve Understanding
  - Core Level
  - Modeling and Simulation
  - Pilot Deployment Level



Challenges Impeding Technology Advancement

- The Big Crew Change
  - Knowledge Transfer and “Reformatting” to Next Generations
- Who and how people collaborate
  - Data Science + Petroleum Engineering + Geology + Software Engineers
- Time
  - Won’t happen overnight. A lot of learning to do.
- Funding
  - Near term tech advancement focus (1-2 years) rather long term projects