Uinta Basin Oil and Gas Production Model

Summary and Long-Term Projections

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Simulated Price Forecast

• Current method
  – Based on EIA Annual Energy Outlook
Simulated Price Forecast

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  - $RE = \frac{FP - AP}{FP}$
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  - \( RE = \frac{FP - AP}{FP} \)
  - Find simulated price by randomly picking values of \( RE \)
Simulated Price Forecast

• 20-yr projection problem
  – Not enough data to use RE method
Simulated Price Forecast

• 20-yr projection problem
  – Not enough data to use \( RE \) method

• Options
  – EIA only method
    • Assume probability distribution
    • Fit to EIA low/reference/high forecasts
  – Meta-model with forecasts from more sources
  – Constant \( RE \) after 5 years
  – Random walk of \( \Delta RE \)
Drilling Forecast

• # of wells drilled f(energy prices)
  – EP and drilling correlated after 2000
Drilling Forecast

• # of wells drilled f(energy prices)
  – EP and drilling correlated after 2000
  – Tested 4 models:
    • [7]:  \( W_t = aOP_t + bGP_t + cW_{t-1} + d \)
    • [8]:  \( W_t = aOP_{t-1} + bGP_{t-1} + c \)
    • [9]:  \( W_t = aOP_{t-1} + b \)
    • [10]:  \( W_t = aGP_{t-1} + b \)
  – Eq. [9] has best performance
    • Can be used as-is for long-term projection
    • Error from simulated price forecast > drilling model
Well Type and Location

• Location
  – Model uses DOGM field numbers
  – Assuming new wells distributed to existing fields using same distribution as existing wells

• Well Type
  – Oil, gas, or dry
  – Probability of each is location specific

• Location and well type are assumed to be constant
Reworks

- Any well (new or existing) could potentially be reworked
- Currently estimating when reworks occur as f(time)
- Reworked wells are treated as new wells by model
- Reworks that occur before or after modeling period are effectively ignored
Production Forecast

• Two approaches
  – Existing wells
    • Hyperbolic decline curve
    • $q(t) = q_o(1 + bD_t t)^{-\frac{1}{b}}$
Production Forecast

• Two approaches
  – Existing wells
    • Hyperbolic decline curve
      \[ q(t) = q_o (1 + bD_t t)^{-\frac{1}{b}} \]
  – New wells
    • Cumulative production curve
      \[ Q(t) = C_p \sqrt{t} + c_1 \]
Existing Wells – 5 years

**Oil**

- Actual
- 50%
- 90%
- 30%
- 70%
- 10%

**Gas**

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Emissions Factors

- CO$_2$e (metric tons per well)

- Site preparation
- Transport of materials
- Drilling and fracturing
- Well completion
- Production
- Processing
- Transmission & distribution

Max
Q3
Q1
Min
Emissions Results

• Calculate emissions from production volumes, drilling schedule, and emission factors

• Can test possible impact of emission reductions by...
  – Emission factor category
  – Well type
  – Location / jurisdiction
  – Time
Conclusions

• Existing model can make long-term projections
  – Uncertainty increases as the projection horizon lengthens
    • Energy price forecast is most important source of error
    • Other important sources
      – Technology change in production rates from new / reworked wells
      – Well location and type
        » Assuming that future wells have same distribution as past wells
      – Extrapolation limits on decline curve analysis
  – Long term projections are still useful
    • Consistent, transparent, repeatable methodology
    • Editable input parameters allow testing and incorporation of new knowledge