# *forecasting New Well supply for Oil and natural gas*

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#### **Overview**

The Oil and Gas Supply Module (OGSM) of the National Energy Modeling System (NEMS) (U.S. EIA. 2014) is a forecasting tool that utilizes type curves to estimate the supply of oil and natural gas, disaggregated at the conventional and unconventional levels, by geographic region. The objective of this study is to expand on the OGSM’s type curve parameters’ estimation model to disaggregate supply of oil from horizontal and vertical new wells by formation. In addition, the production of new wells is disaggregated by the year of completion, which allows mapping production trends over time. This study focuses on New Mexico’s Permian and San Juan basins as the case study but the estimation framework can be expanded to all onshore plays. Monthly production data for wells drilled between 2001 and 2015 in Permian and San Juan basins are used for this study. On average, natural gas production data from 1,055 wells per year and oil production from 785 wells per year are analyzed. The analysis include refining and disaggregating production data, and finding optimal type curve parameters using a nonlinear least squares method. In addition to providing a more detailed forecast system, this supply model informs a statewide system dynamics energy water nexus model in New Mexico.

#### **Methods**

Nonlinear least square estimation method is used to estimate the decline curve parameters of disaggregated wells in New Mexico. A combinatorial optimization technique is utilized to improve the estimation precision.

#### **Results**

The results of this study are the type curve parameters associated with horizontal new wells recovering from 17 formations and vertical new wells recovering from 20 formations during the 2000-2015 period. For instance, the estimated average initial natural gas production rate -- $\frac{Q\_{0}}{N}$, where $Q\_{0}$is the aggregated initial production rate and $N$ is the number of contributing wells-- for horizontal and vertical wells producing from Mesaverde formation is shown in figure 1.

Figure 1: Estimated average initial natural gas production from horizontal and vertical wells in Mesaverde formation

#### It is noteworthy that the average annual number of horizontal and vertical wells producing from the Mesaverde formation during this period was 47 and 147, respectively. Another comparison is made between average initial natural gas production from Mesaverde and Delaware formations in figure 2.

Figure 2: Comparison between estimated average initial natural gas production from Mesaverde and Delaware formations

#### Similarly, initial oil production is compared between horizontal and vertical wells producing from Bone Spring formation, Permian basin, in figure 3.

Figure 3: Estimated average initial oil production by horizontal and vertical wells producing from Bone Spring formation

#### **Conclusions**

#### This study expands on the Oil and Gas Supply Module of the National Energy Modeling System (U.S. EIA. 2014), and disaggregates production at two additional levels: well trajectory and year of completion. These additional disaggregation could improve estimations of the oil and natural gas supply. Nonlinear Least Squares method is used for the estimation of the type curve parameters. As a case study, supply of the oil and natural gas is estimated for 22 formations in New Mexican Permian and San Juan basins, and the results are compared with the actual supply data. Future work includes adding drilling and completion costs and measuring the drilling profitability for vertical and horizontal wells over time and basins.

#### **References**

#### U.S. EIA. 2014. Oil and Gas Supply Module of the National Energy Modeling System: Model Documentation 2014. http://www.eia.gov/forecasts/aeo/nems/documentation/ogsm/pdf/m063(2014).pdf [accessed 15 March 2018].