Production Prediction and Decline Curve Statistical Analysis of Oil and Gas Production in Utah

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Abstract
The Uinta basin suffers from high ozone air quality problems in the winter months. Industrial activities of the oil and gas industry in the basin appear to be a significant source of hydrocarbon emissions that are linked to ozone production in winter months. The objective of this proposal is to transition an oil and gas production model to evaluate policy concepts and policy implementation dates so that the oil and gas industry can continue to grow and the air quality in the Uinta basin can be maintain within regulatory limits. The model was developed at the University of Utah using the software R that has proven accurate for the Uinta basin into a tool for the Utah Department of Air Quality (DAQ)

Introduction
Work at the University of Utah has developed a production model for the oil and gas industry in the Uinta basin in Utah. This model has been developed using historical data from January 1999 to December 2005. The production model has undergone uncertainty quantification predicting production for the period from January 2006 to December 2012. The model uses a Monte Carlo prediction model to generate a new well in a given field. The Monte Carlo model draws upon The R^2 for oil well production data was 0.88 on an annual production basis and the R^2 for the gas well production data was 0.76 on an annual production basis. This model provides a month-by-month production estimate for oil and gas wells drilled within the basin.

The objective of this work is to customize this Monte Carlo based oil and gas production model for DAQ's needs that would consist of the following:

1) accommodate the subset of wells that do not conform to a steady decline curve;
2) increase the spatial resolution of the model to account for individual well fields in the Basin;
3) incorporate a methodology similar that used in the DAQ white paper to track production on a yearly basis so that varying VOC emission factors can be applied based on a regulatory schedule that is phased in over different time periods;
4) attempt to account for a fraction of wells that are reworked (or fracked) to stimulate production from wells existing before an air quality regulation is imposed; and
5) Provide some initial consultation for set up and use of the software system as currently configured in the "R" programming language.

The work will also take a look at predicting the change in VOC emission factors as they vary from field to field and as they change as the oil/gas ratio produced by the well changes. These VOC emission factors will need to be developed in conjunction with DAQ as this work progresses. In addition the work will take a look at any metric that may presently be in the DOGM data base or may be requested to be added to the DOGM database to allow an estimate if during the very early stage of well production it would in fact be producing enough product to be subject to DAQ's existing permitting guidelines.

Work Plan

Work on this contract will utilize the skills of Mr. Jon Wilkey who is presently a PhD student in the Department of Chemical Engineering at the University of Utah. He has developed the R based Monte Carlo simulation of the oil and gas production in the Uinta Basin. Jon is expected to finish his thesis in the Spring Semester of 2015. Work on this project will engage Jon as a Post Doc Associate for the period of the contract. The work is to be broken down into the follow tasks associated with modifications to the present model.

1) Increase the spatial resolution of the model to account for individual well fields in the Basin.
2) Incorporate a methodology similar that used in the DAQ white paper to track production on a yearly basis so that varying VOC emission factors can be applied based on a regulatory schedule that is phased in over different time periods.
3) Account for a fraction of wells that are reworked (or fracked) to stimulate production from wells existing before an air quality regulation is imposed.
4) Provide some initial consultation for set up and use of the software system by DAQ personnel.
5) Attempt to develop VOC emission factors as they might vary from field to field and over the production cycle of the well.
6) Attempt to develop an early warning metric that can be used reliably to predict the 1st year production from a new well.
7) Write up the final report.

Gantt Chart for the Tasks in this project

Task	Mo. 1	Mo.2	Mo.3	Mo.4	Mo.5	Mo.6	Mo.7	Mo.8
1	X	x						
2		x	x	x	x			
3		x	x	x	x			
4					X	x	x	x
5			x	x	x	x	x	x
6	x	x	x	x	x	x	x	
7								x

Budget

The budget considers a start date for the project of January 1, 2015. The project will have a budget that will essentially pay for Jon Wilkey's time and his supervision. Jon will continue to be a Chemical Engineering graduate student during the spring semester in 2015 – from 1/1 to 4/31. A part of his thesis work will be the projection of oil and gas production into the future which is also required for this project. During the first quarter of 2015, Jon will be working on this project approximately 75% of the time and 25% of his time writing his thesis. When his thesis is finished by the end of April 2015, he will convert to a Post Doc Associate and receive a higher salary for the next 4 months and will work solely on the DAQ project. As a result the salary for Jon is broken into that for a graduate student for the first 4 months of the project and that of a Post Doc Associate for the remaining 4 months of the project. The balance covers faculty supervisor salary at $4,000, benefits at $8,700.00 and F&A at 10% of Direct Costs equal to $43,700.00 for a total of $48,070.00.

Budget for 2015

Faculty Salary	$ 4,000.00
Post-doc Fellow	$ 22,000.00
Graduate Student	$ 9,000.00
Benefits	$ 8,700.00
Direct Costs	$ 43,700.00
F&A (10%)	$ 4,370.00
TOTAL	**$ 48,070.00**