Performing Forecasting Analysis with Symmetry* Process Software Platform

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A typical task in the management of a field and a processing facility is to perform a production forecasting analysis. Whether the field is under development, i.e. wells are added to the gathering network and production is expected to increase, or the field is entering a decline phase, and production is likely to decrease; it is important to run forecasting and what-if scenarios to detect potential bottlenecks in case of increased production or plant trips in case of not meeting the minimum turndown throughput in the opposite situation.

Typically, forecasts are produced using reservoir simulation, yet the simplest and most common form they are produced is in a time-dependent flow table per well. This forecast is provided to production and facility engineers to determine if the systems will be capable of collecting, treating, and delivering the fluids to their final consumers.

This article demonstrates how to set-up Symmetry to perform a forecasting analysis of an integrated model.

Modelling Scope

The model used corresponds to a small gathering network comprised of 4 natural gas wells. This gas is collected and routed to a TEG Dehydration facility to reduce water content to meet pipeline specifications. The gas is then pipelined in a 300-mile transmission line that includes a booster compressor station (see Figure 1).

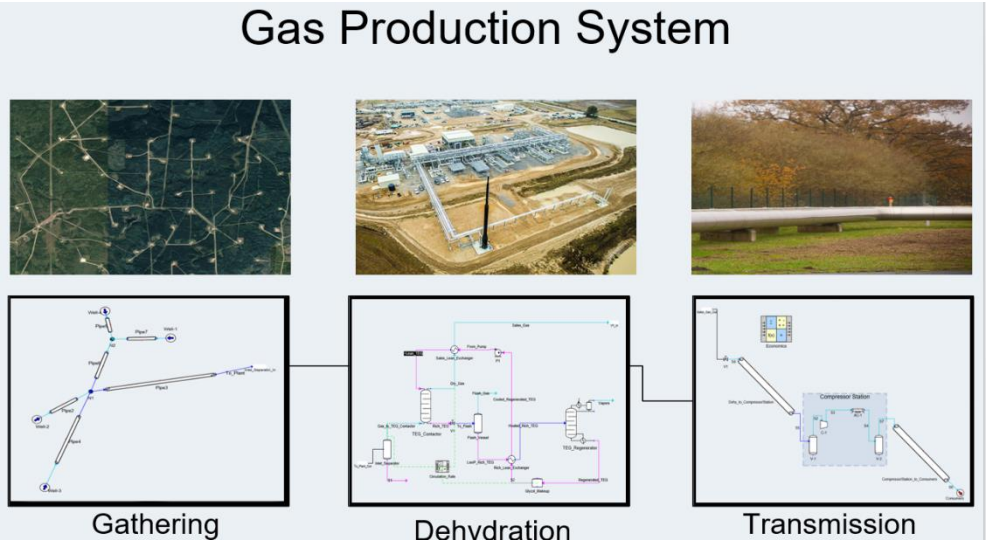


Figure 1: Gas Production System Model in Symmetry

In the Symmetry simulation case, the **Gathering** flowsheet is set as a Pipe type because it allows the use of the network solver, the most efficient way of solving pipe networks. The **Dehydration** and **Transmission** sections are using Process flowsheets because they are convenient for those applications.

The forecast used in this example consists of the expected flows per well on a per-year basis as shown in Table 1.

Year	Well 1	Well 2	Well 3	Well 4
2020	8.50	8.50	0.00	0.00
2021	8.50	8.50	4.25	0.00
2022	8.50	8.50	8.50	4.25
2023	8.50	8.50	8.50	8.50
2024	12.75	8.50	8.50	8.50
2025	12.75	12.75	8.50	8.50
2026	12.75	12.75	12.75	8.50
2027	12.75	12.75	12.75	12.75
2028	17.00	12.75	12.75	12.75
2029	17.00	17.00	12.75	12.75
2030	17.00	17.00	17.00	12.75

Table 1: Gas Field Forecast example

Setting up a Forecast Table

The first step to run a forecast is to add a Process Calculator. Even though the location of this unit operation won't affect the solution, it is recommended to place it within the gathering network (see Figure 2). The main function of this tool is to return the flowrate for each well when the user enters a year.

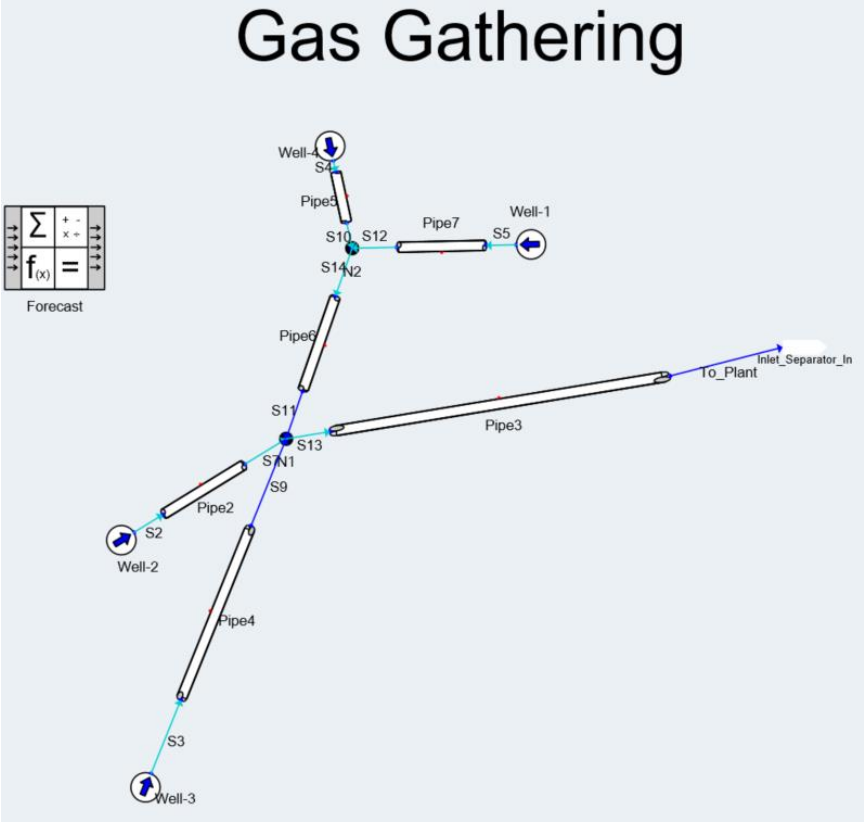
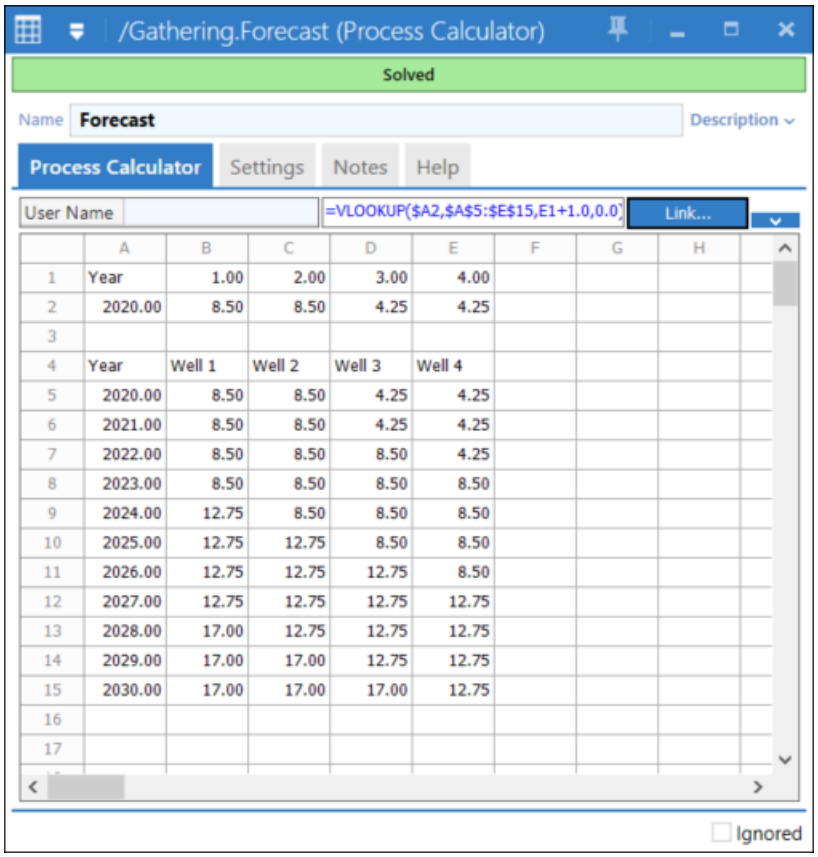


Figure 2: Gas Gathering Flowsheet with Process Calculator (Forecasting)

Then the user needs to copy the forecast table (from Table 1) and paste it in cell A4 in the Process Calculator (see Figure 3). In cell A2, the user will enter the desired year. By using the function VLOOKUP in the process calculator, the user can set cells B2 to E5 to return the corresponding flowrate given the year in cell A2 using this formula "=VLOOKUP($A2,$A$5:$E$15,B1+1.0,0.0)". That formula can be copied and pasted in the contiguous cells and might be extended in case of having more wells. For more information on the Process Calculator function check Symmetry's manual. This function is also 100% compatible with Microsoft ® Excel so users may be already familiar with it.



	A	B	C	D	E	F	G	H
1	Year	1.00	2.00	3.00	4.00			
2	2020.00	8.50	8.50	4.25	4.25			
3								
4	Year	Well 1	Well 2	Well 3	Well 4			
5	2020.00	8.50	8.50	4.25	4.25			
6	2021.00	8.50	8.50	4.25	4.25			
7	2022.00	8.50	8.50	8.50	4.25			
8	2023.00	8.50	8.50	8.50	8.50			
9	2024.00	12.75	8.50	8.50	8.50			
10	2025.00	12.75	12.75	8.50	8.50			
11	2026.00	12.75	12.75	12.75	8.50			
12	2027.00	12.75	12.75	12.75	12.75			
13	2028.00	17.00	12.75	12.75	12.75			
14	2029.00	17.00	17.00	12.75	12.75			
15	2030.00	17.00	17.00	17.00	12.75			
16								
17								

Figure 3: Process Calculator Containing Forecast Data

The next step is to link the calculated flowrates from the process calculator (cells B2 to E2) to the corresponding well in the flowsheet. The easiest way of doing this is by using Copy Connection (see Figure 4) and Paste Connection (see Figure 5) commands. These steps can be repeated as many times as wells are included in the forecast. The user may want to switch the solver to inactive to avoid resolving the network each time a well is linked. There are ways of automating this task and our technical support team can assist you in this process.

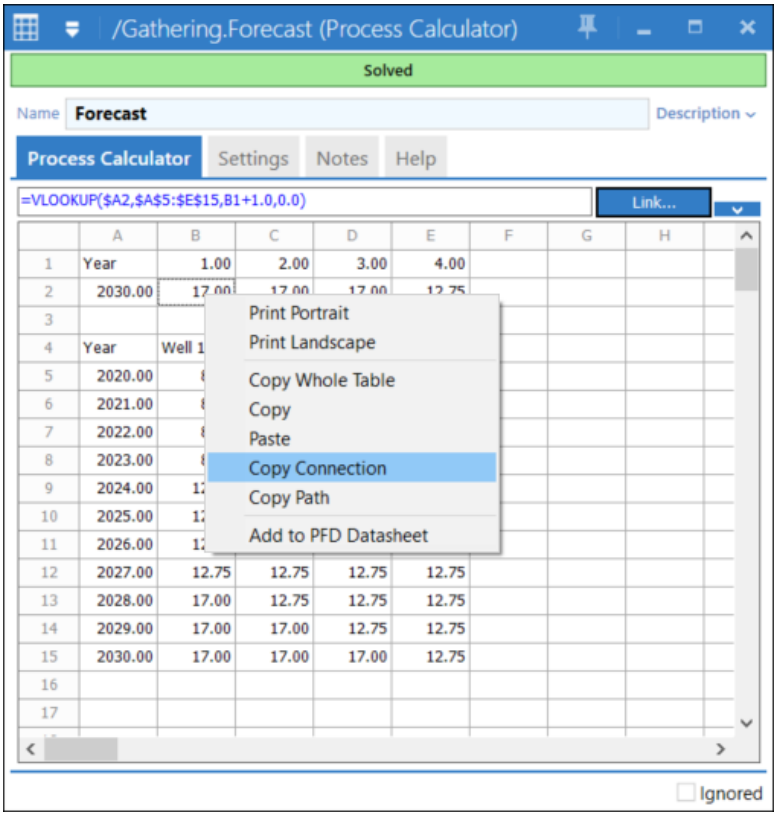


Figure 4: Copy Connection from Process Calculator (right-click over the cell)

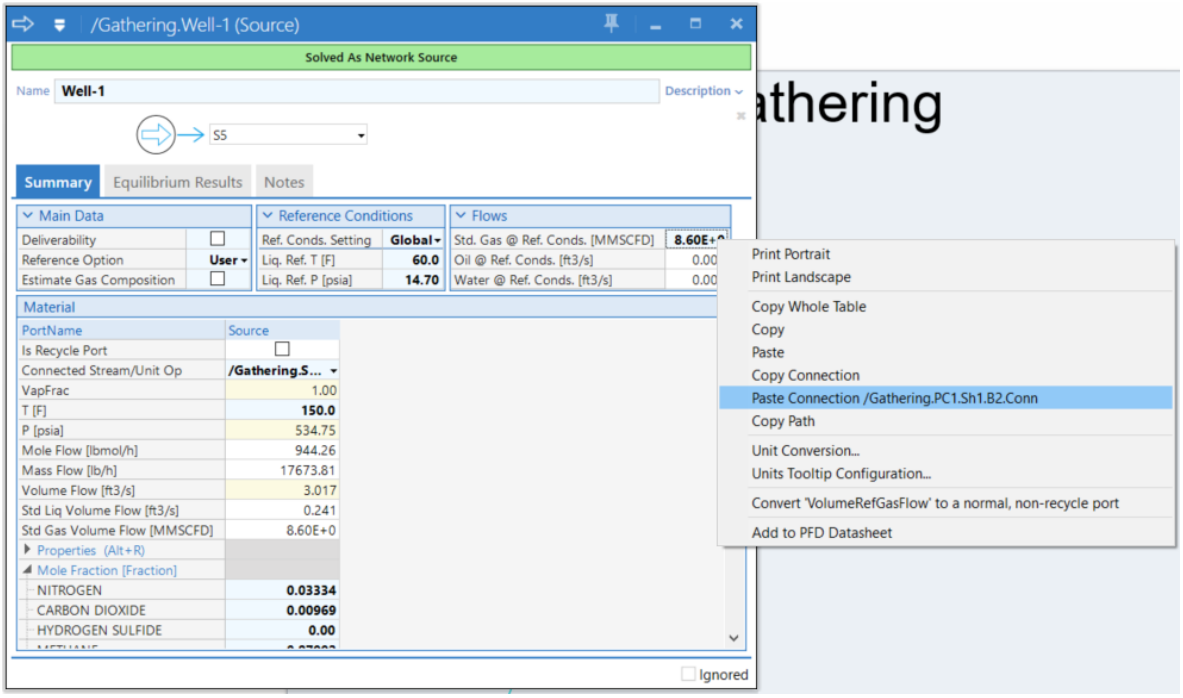


Figure 5: Paste Connection to Well Std. Gas @ Ref. Conds. (right-click over the input box)

At this point, if the year value in the process calculator is changed, the flow from the forecast table will be automatically updated into the flowsheet initiating a flowsheet solver pass (see Figure 6).

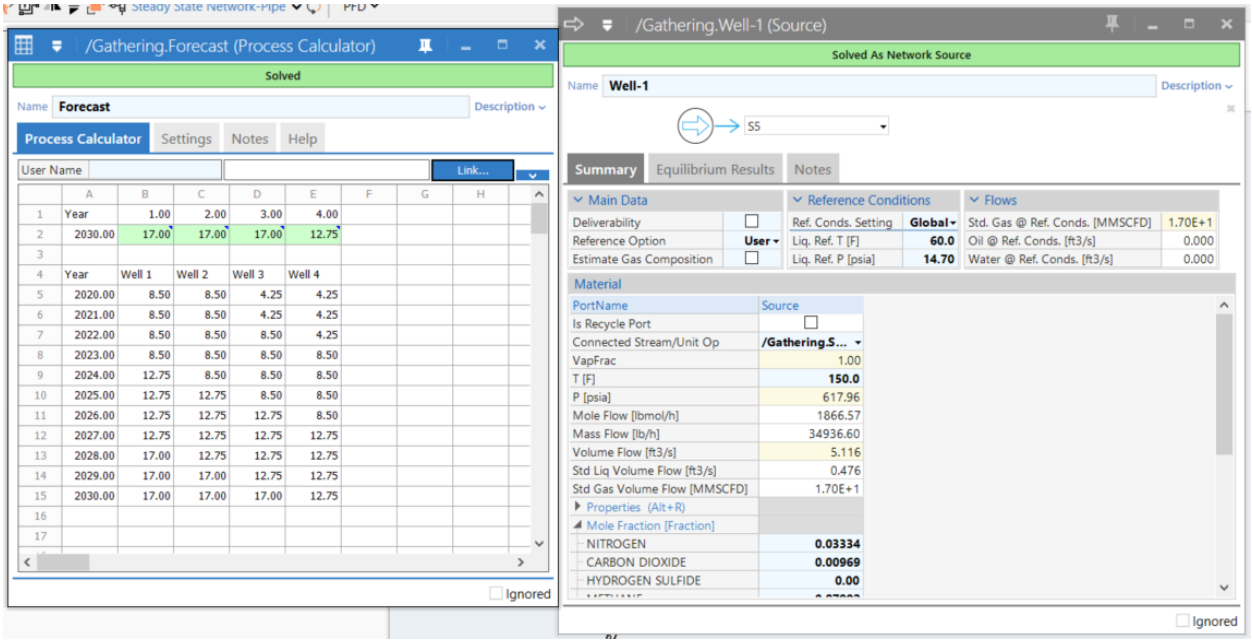


Figure 6: Process Calculator configuration

Running Multiple Forecasting Scenarios

Users may want to run all the forecasting scenarios sequentially or in batch, this can be accomplished by setting up a case study where the independent variable will be the forecast year (cell A2 in process calculator). Many variables can be chosen as dependent variables, i.e. results, for this example, the following were chosen:

- Wells back-pressure
- Total Gas Production
- TEG circulation rate in Dehydration Facility
- Power in Transmission compressor
- Duty in Transmission after cooler

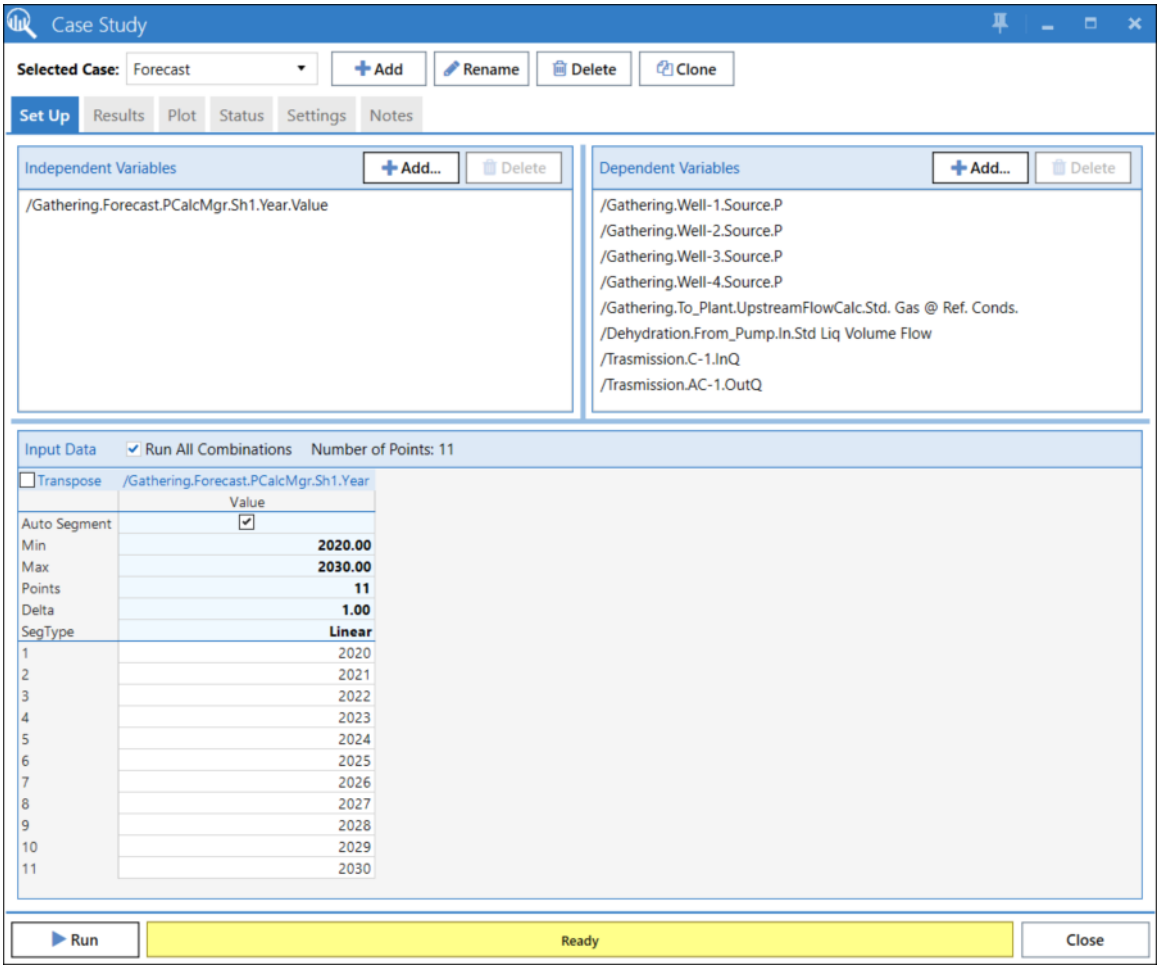


Figure 7: Forecast Case Study Set-up

The case study can be executed by clicking the **Run** button. This will run all the cases sequentially collecting the selected results. Once finished, results will be displayed in the **Results** tab. Also, the case study allows users to create plots by selecting the variables for the corresponding axes (see Figure 8).

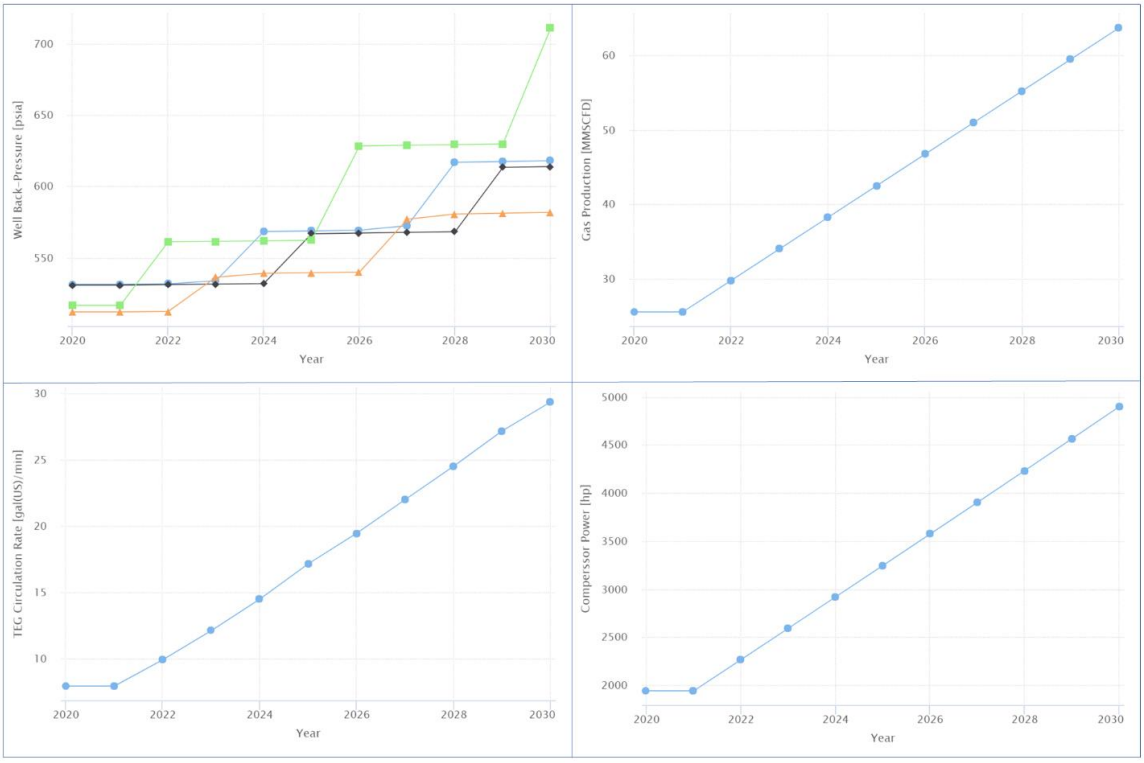


Figure 8: Forecast Results

Final Remarks

The Symmetry process software platform offers a unique opportunity to model your process workflows in one environment, integrating facilities, process units (Symmetry Process) with pipelines, networks (Symmetry Pipe) and flare, safety systems (Symmetry Flare) models, while ensuring consistent thermodynamics and fluid characterization across the full system.

To learn more about the Symmetry Process Software Platform please contact your local Schlumberger office.

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