

Process Yield Optimizer – Description

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Program Purpose:

Common concern in research environment is the ability to develop process or service that generates the most possible revenue with least cost. A Ph.D. student deciding on how best to spend grant money for research experiments has similar constraints to that of a team of engineers developing a product or service in an industry environment (though at a much smaller scale). My goal was to develop a simple tool on spare time that address this concern and demonstrates my capability to design user friendly software applications using proper design patterns. Process Yield Optimizer is a WPF application written in C# .NET using MVVM design pattern.

Program Description:

Goal of program is to analyze complex production and service scenarios by dividing them up by performance indicators. Whether you are involved in a startup or are part of a fully operating production environment, you have divided your production or service in some format of cost model which highlights the most expensive or time consuming steps. The goal is to be able to view each of these 'costs' or performance indicators that affect your production or service and see at what condition are you in the most optimal stage with overall cost being the lowest.

Process Yield Optimizer – User Guide

Anytime feel free to open solution in Visual Studio 2013 or individually inspect source files to learn more [Source files are in the 'Source Folder' in this repository].

Step 0:

Setup

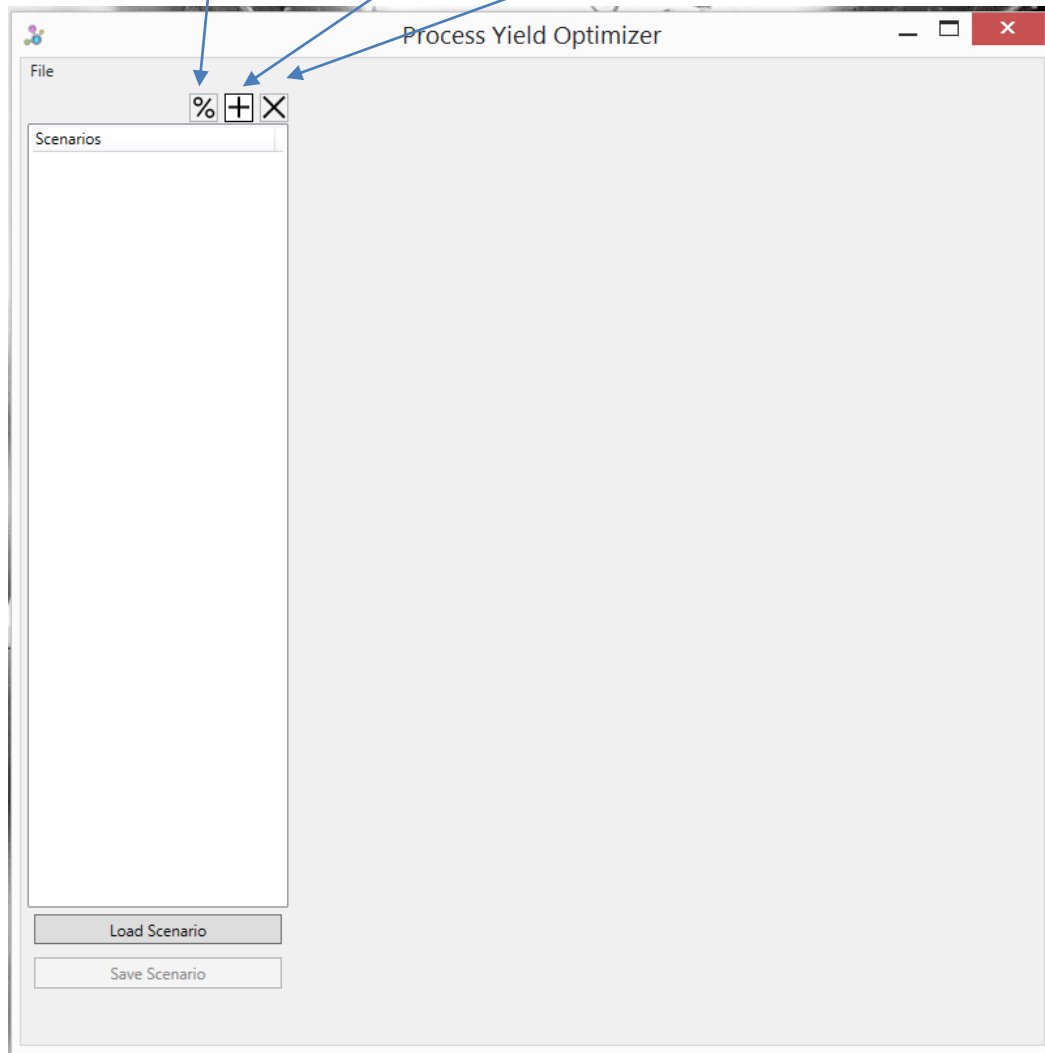
PC > Documents > GitHub > Program			
Name	Date modified	Type	Size
Scenarios	7/9/2014 10:02 PM	File folder	
Sessions	7/9/2014 10:03 PM	File folder	
Microsoft.Practices.Prism.Composition.dll	7/4/2014 9:09 AM	Application extens...	138 KB
Microsoft.Practices.Prism.Interactivity.dll	7/4/2014 9:09 AM	Application extens...	28 KB
Microsoft.Practices.Prism.Mvvm.Desktop...	7/4/2014 9:09 AM	Application extens...	15 KB
Microsoft.Practices.Prism.Mvvm.dll	7/4/2014 9:09 AM	Application extens...	31 KB
Microsoft.Practices.Prism.PubSubEvents....	7/4/2014 9:09 AM	Application extens...	23 KB
Microsoft.Practices.Prism.SharedInterfac...	7/4/2014 9:09 AM	Application extens...	13 KB
Microsoft.Practices.Prism.ServiceLocation.dll	7/4/2014 9:09 AM	Application extens...	18 KB
ProcessYieldOptimizer.exe	7/9/2014 4:30 PM	Application	621 KB
System.Windows.Interactivity.dll	2/18/2013 2:30 PM	Application extens...	55 KB

Download or checkout the folder 'Program' from GitHub onto your system. Your system will need have .NET installed (tested on versions 4.0 and higher). All demo files used in this guide are included in this folder.

Step 1:

Launch 'ProcessYieldOptimizer.exe' – Take a look around

Example: Buttons to modify a selected scenario add a new scenario or remove a selected scenario.

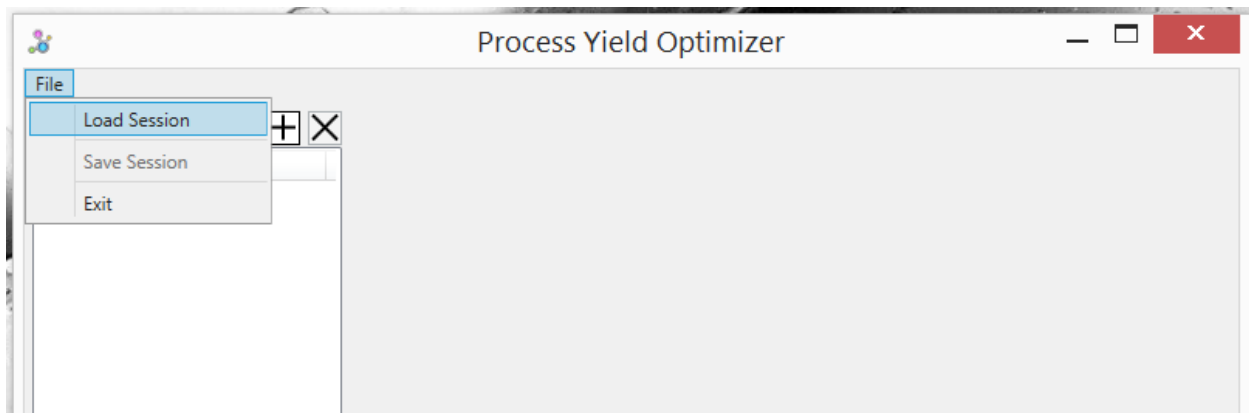


Don't click on anything yet. See step two.

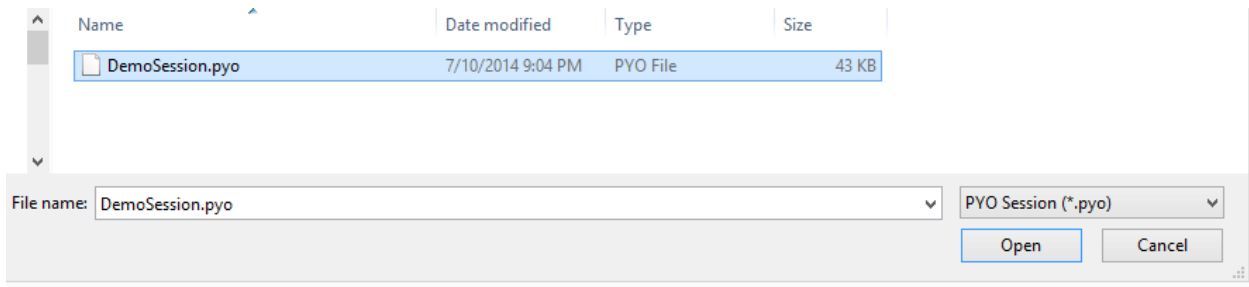
Step 2:

Load a Session

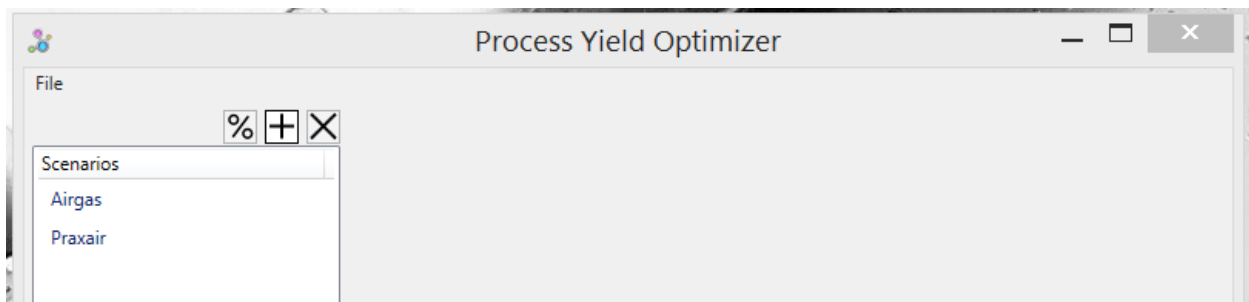
Hit the 'File' from menu and click on 'Load Session'.



Go to the 'Sessions' folder and load 'DemoSession'.



This will add 'Scenarios' in the .pyo file to the program. Since we had no scenarios in Step 1, our program should reflect only the scenarios loaded from the session file.



Click on 'Airgas' scenario.

Step 3:

See Tabs and their functionality

The session file that we loaded in 'Step 2' contains the following information. There are two scenarios one is 'Airgas' and other is 'Praxair' both are real companies that sell liquid nitrogen which is commonly used to freeze cells. *Note: the values presented in this demo are exaggerated and do not represent the actual cost.* When trying to decide how much liquid nitrogen one will need, you can create CSV, use Excel spreadsheet or Google sheets etc. and plan out for how much liquid nitrogen will be needed for your cells and how much the

company will charge for the amount of liquid nitrogen and its delivery. The previous user already planned that out using Process Yield Optimizer and saved it as a session. Lucky us.

In each scenario you will notice there are three tabs:

‘Cells [ml]’, ‘Liquid Nitrogen [\$]’, ‘Delivery Fee [\$]’

Process Yield Optimizer

File

Scenarios

- Airgas
- Praxair

Load Scenario

Save Scenario

Calculate Efficiency

Add Row

Delete Row

	A	B	D	E	F	G	H	I	J	K
1	500	503	506	509	512	515	518	521	524	527
2	533	536	539	542	545	548	551	554	557	560
3	566	569	572	575	578	581	584	587	590	593
4	599	603	607	611	615	619	623	627	631	635
5	641	645	649	653	657	661	665	669	673	677
6	683	687	691	695	699	703	707	711	715	719
7	725	729	733	737	741	745	749	753	757	761
8	770	774	778	782	786	790	794	798	802	806
9	812	816	820	824	828	832	836	840	844	848
10	854	858	862	866	870	874	878	882	886	890
11	896	900	904	908	912	916	920	924	928	932
12	938	942	946	950	954	958	962	966	970	974
13	980	984	988	992	996	1000	1004	1008	1012	1016
14	1022	1029	1036	1043	1050	1057	1064	1071	1078	1085
15	1087	1088	1089	1090	1091	1092	1093	1094	1095	1096
16	1098	1099	1100	1101	1102	1103	1104	1105	1106	1107
17	1108	1109	1110	1111	1112	1113	1114	1115	1116	1117
18	1119	1120	1121	1122	1123	1124	1125	1126	1127	1128
19	1130	1131	1132	1133	1134	1135	1136	1137	1138	1139
20	1141	1142	1143	1144	1145	1146	1147	1148	1149	1150
21	1152	1153	1154	1155	1156	1157	1158	1159	1160	1161
22	1163	1164	1165	1166	1167	1168	1169	1170	1171	1172
23	1174	1175	1176	1177	1178	1179	1180	1181	1182	1183
24	1185	1186	1187	1188	1189	1190	1191	1192	1193	1194
25	1196	1197	1198	1199	1200	1201	1202	1203	1204	1205

Paste All

Copy All

Paste Row

Copy Row

Cells [ml]

Liquid Nitrogen [\$]

Delivery Fee [\$]

Each tab has ‘Add Row’ and ‘Delete Row’ button to add new rows or delete selected row from the data grid in the user interface. The cells are editable and are laid out in a spreadsheet type format.

You can use the ‘Copy All’ button to copy all the cells and paste it onto any supported spreadsheet format (even tables in .doc) and vice-versa using ‘Paste All’. You can use ‘Copy Row’ and ‘Paste Row’ to just modify

few rows. Don't worry if you try to paste more rows than that are in the selection it will just omit the extra rows contained in the clipboard similar to how Microsoft Excel works.

Step 4:

Calculate Efficiency or Simple Yield

Select 'Airgas' in the Scenario list on the left and hit the button 'Calculate Efficiency'.

Process Yield Optimizer

File

Scenarios

Airgas

Praxair

Load Scenario

Save Scenario

Calculate Efficiency

Add Row

Delete Row

	A	B	D	E	F	G	H	I	J	K
1	500	503	506	509	512	515	518	521	524	527
2	533	536	539	542	545	548	551	554	557	560
3	566	569	572	575	578	581	584	587	590	593
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7	725	729	733	737	741	745	749	753	757	761
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10	854	858	862	866	870	874	878	882	886	890
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18	1119	1120	1121	1122	1123	1124	1125	1126	1127	1128
19	1130	1131	1132	1133	1134	1135	1136	1137	1138	1139
20	1141	1142	1143	1144	1145	1146	1147	1148	1149	1150
21	1152	1153	1154	1155	1156	1157	1158	1159	1160	1161
22	1163	1164	1165	1166	1167	1168	1169	1170	1171	1172
23	1174	1175	1176	1177	1178	1179	1180	1181	1182	1183
24	1185	1186	1187	1188	1189	1190	1191	1192	1193	1194
25	1196	1197	1198	1199	1200	1201	1202	1203	1204	1205

Paste All

Copy All

Paste Row

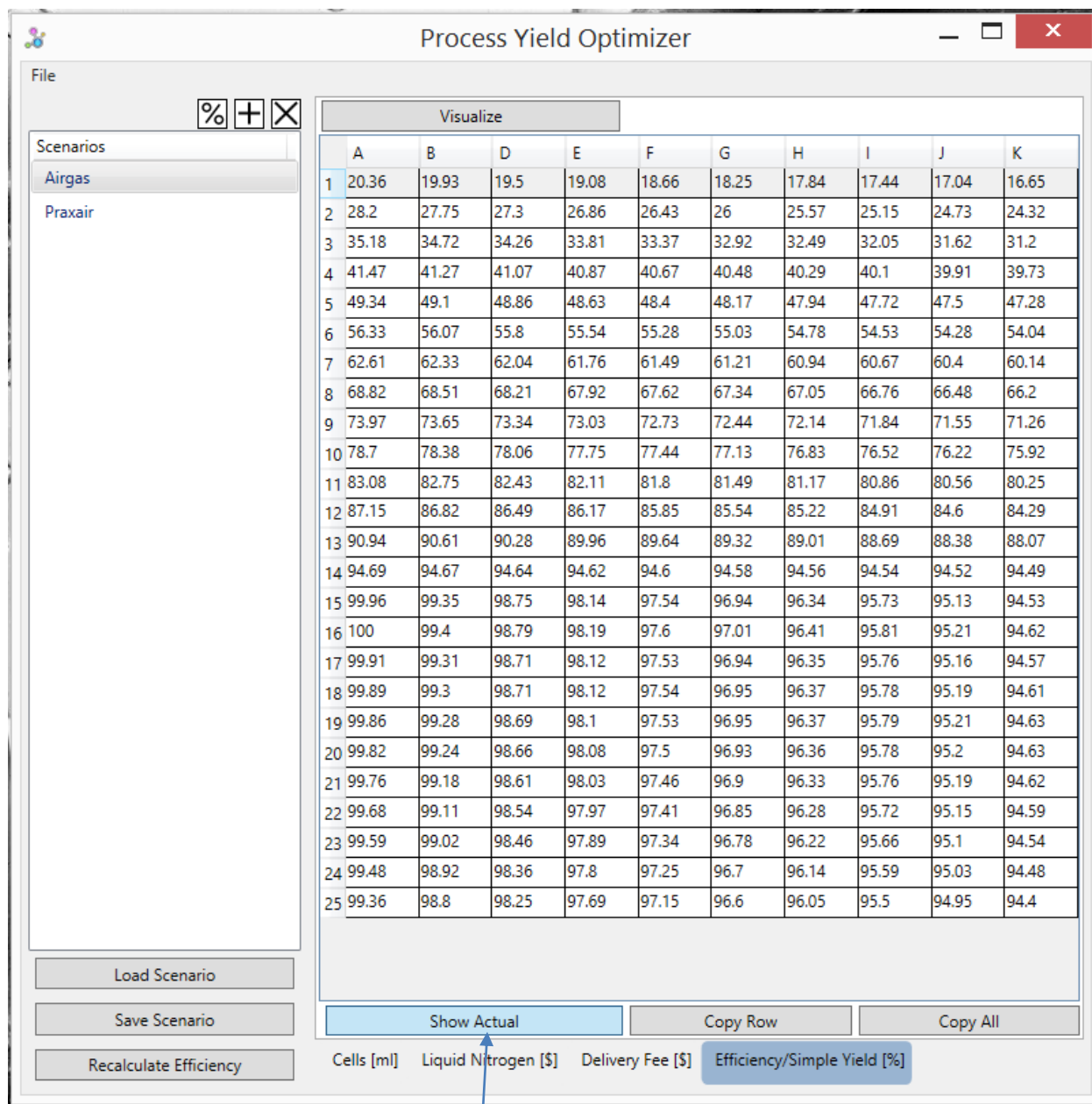
Copy Row

Cells [ml]

Liquid Nitrogen [\$]

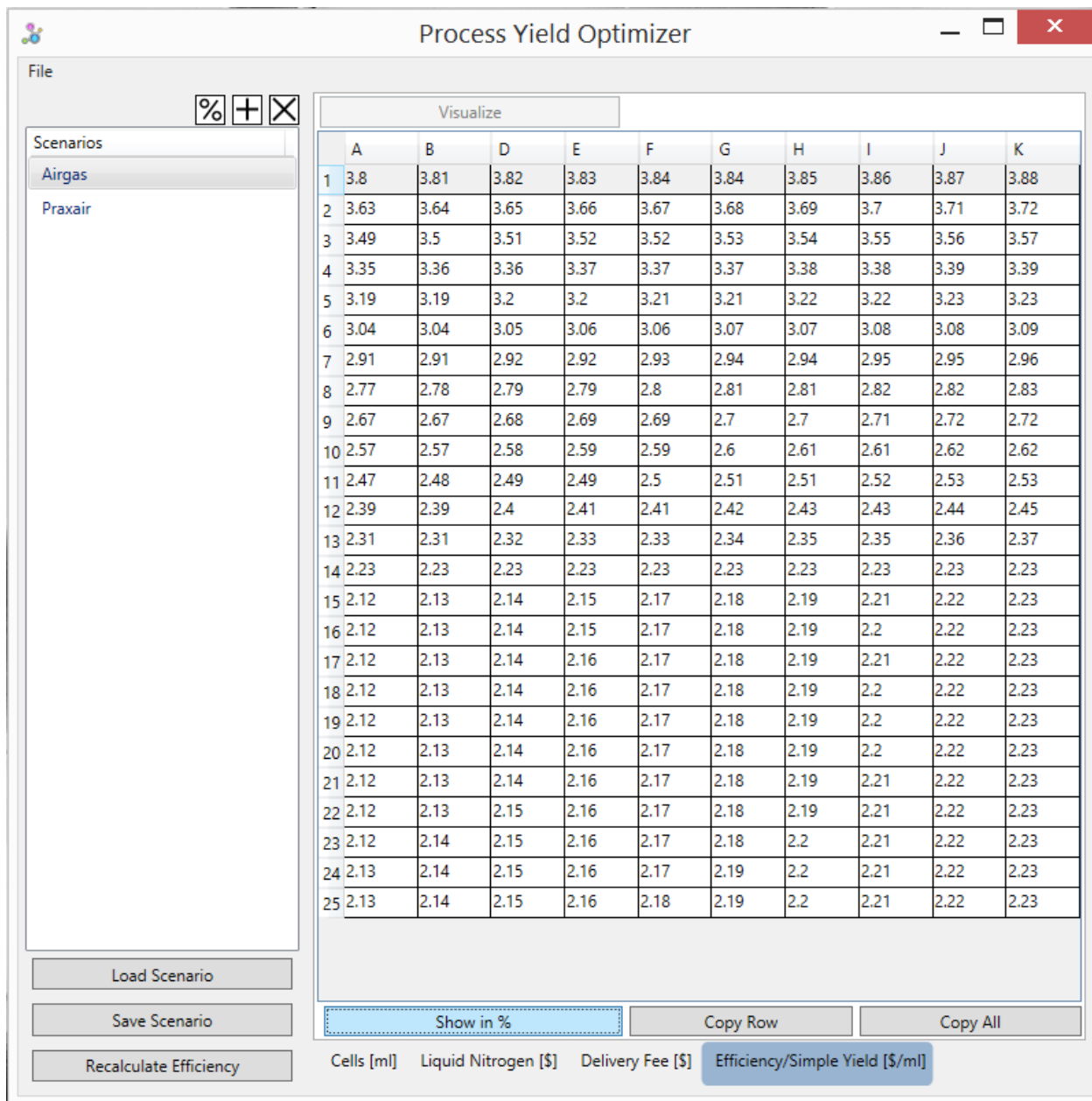
Delivery Fee [\$]

A dialog will pop up and you will have the option to name the efficiency/yield units. For this demo purpose delete [Amount] and type [\$/ml] as shown below.



You can toggle off the percentage with 'Show Actual' button.

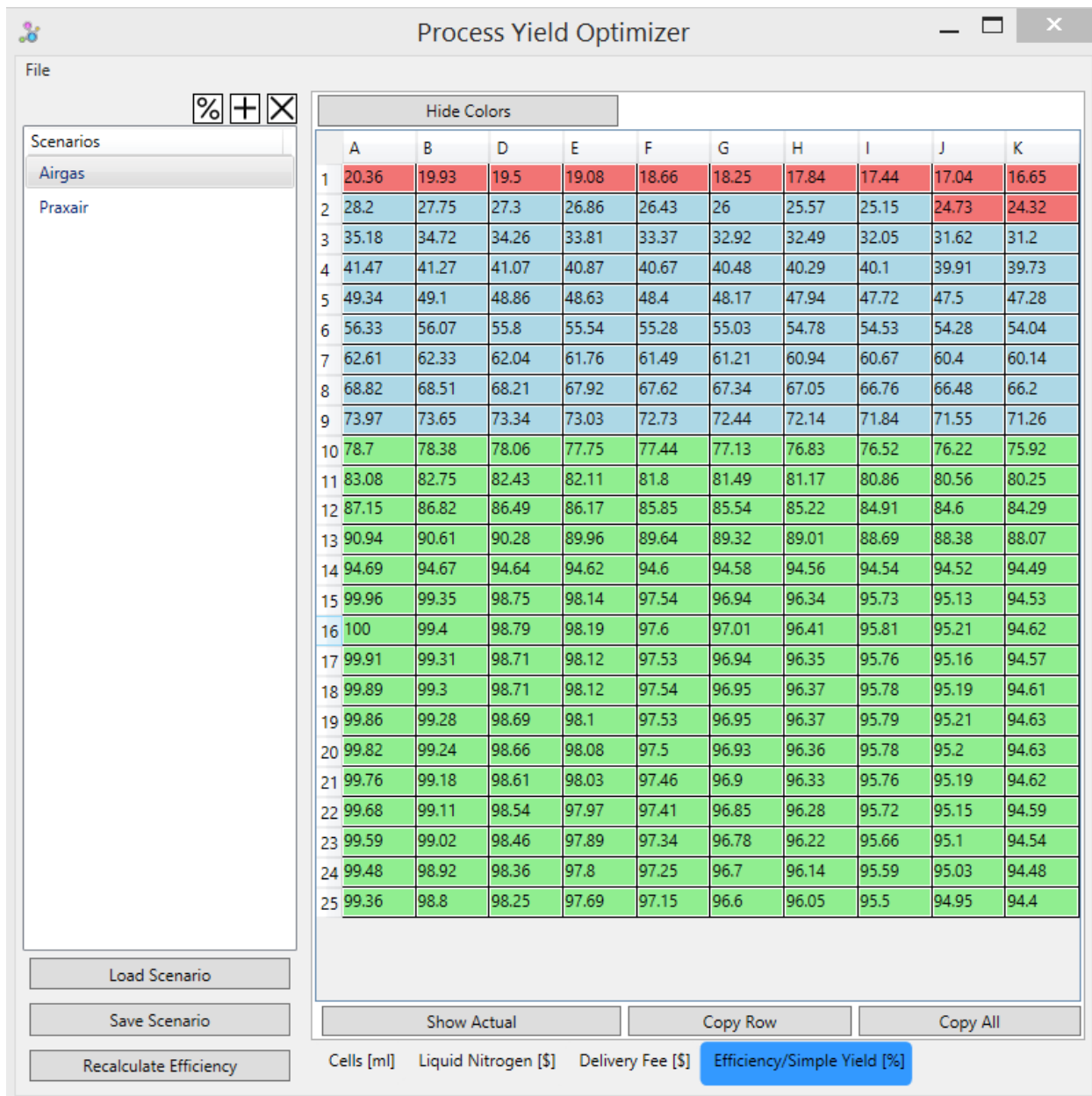
This shows the total cost in \$/ml in the scenario 'Airgas' as shown below.



You can go back to percentage if you want by hitting 'Show in %'. Please click on it and view the values in percentage format.

You can copy rows or all values in either amount or percentage mode to a spreadsheet or table format using the copy buttons.

Lastly you can use the option 'Visualize'. Click on it.



You will notice all the cells changed color.

Cells with simple yield less than or equal to 25% are filled red. Cells with simple yield greater than 25% but less than or equal to 75% are filled blue. Cells with simple yield greater than 75% are filled green.

Step 5:

Mapping Efficiency for Airgas

In Step 4 you were able visualize efficiency for 'Airgas'. You can toggle between percentage and the actual amount and see the colors remain intact throughout the tabs. You can also see the colors are mapped to every performance indicator and the main/first tab 'Cells'.

Process Yield Optimizer

File

% + X

Scenarios

Airgas

Praxair

Add Row

Delete Row

	A	B	D	E	F	G	H	I	J	K
1	500	503	506	509	512	515	518	521	524	527
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21	1152	1153	1154	1155	1156	1157	1158	1159	1160	1161
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23	1174	1175	1176	1177	1178	1179	1180	1181	1182	1183
24	1185	1186	1187	1188	1189	1190	1191	1192	1193	1194
25	1196	1197	1198	1199	1200	1201	1202	1203	1204	1205

Load Scenario

Save Scenario

Recalculate Efficiency

Paste All

Copy All

Paste Row

Copy Row

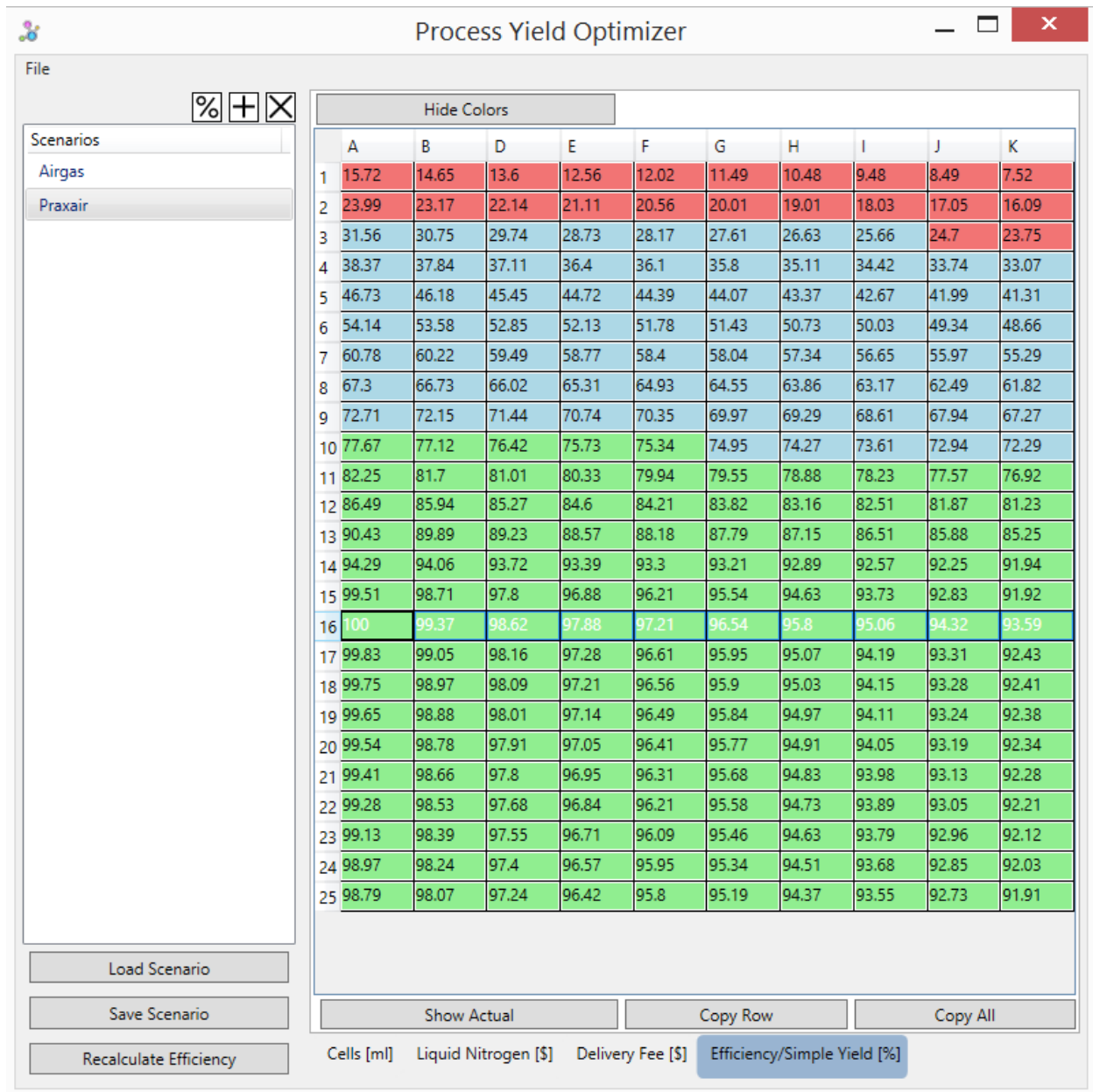
Cells [ml] Liquid Nitrogen [\$] Delivery Fee [\$] Efficiency/Simple Yield [%]

If done right you will see that 'Cells' in the quantity of 1098 ml is the most cost efficient to store with Airgas.

Step 6:

Mapping Efficiency Praxair

Do Step 4 for Praxair on your own and get the following 'Efficiency/Simple Yield [%]' tab. Then hit 'Visualize'.



Switch to the 'Cells' tab and determine that 'Cells' in the quantity of 1098 ml again is the most cost efficient to store with Praxair.

Process Yield Optimizer
✕

File

% + ✕

Scenarios

Airgas

Praxair

Load Scenario

Save Scenario

Recalculate Efficiency

Add Row

Delete Row

	A	B	D	E	F	G	H	I	J	K
1	500	503	506	509	512	515	518	521	524	527
2	533	536	539	542	545	548	551	554	557	560
3	566	569	572	575	578	581	584	587	590	593
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10	854	858	862	866	870	874	878	882	886	890
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17	1108	1109	1110	1111	1112	1113	1114	1115	1116	1117
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19	1130	1131	1132	1133	1134	1135	1136	1137	1138	1139
20	1141	1142	1143	1144	1145	1146	1147	1148	1149	1150
21	1152	1153	1154	1155	1156	1157	1158	1159	1160	1161
22	1163	1164	1165	1166	1167	1168	1169	1170	1171	1172
23	1174	1175	1176	1177	1178	1179	1180	1181	1182	1183
24	1185	1186	1187	1188	1189	1190	1191	1192	1193	1194
25	1196	1197	1198	1199	1200	1201	1202	1203	1204	1205

Paste All

Copy All

Paste Row

Copy Row

Cells [ml]

Liquid Nitrogen [\$]

Delivery Fee [\$]

Efficiency/Simple Yield [%]

Step 7:

What is more cost effective?

Toggle between the 'Show %' and 'Show Actual' views in the 'Efficiency tab' and see that the total cost is lower for Airgas in actual value of \$/ml.

You should come to the same conclusion as the table below. If you 'Copy Row' or 'Copy All' values in 'Show Actual' mode to a spreadsheet or a document's table, you can see the full value amount without any rounding done for formatting.

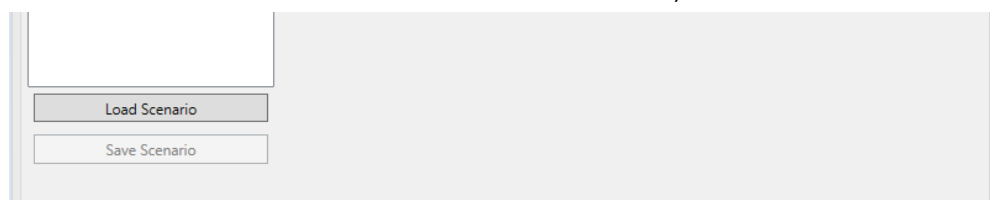
Supplier	Cells [ml]	Total cost per ml (\$/ml)
Airgas	1098 (had lowest cost/ml)	2.12 (rounded 2.115346)
Praxair	1098 (had lowest cost/ml)	2.39 (rounded 2.387659)

When comparing these two scenarios, quantity 1098 ml of cells was the most cost effective case for both suppliers with Airgas having the lowest total cost per ml. Therefore Airgas should be the supplier of choice. It is rare to come to such an easy conclusion in real life, like in the 'DemoSession' so let us look at some other scenarios in the next step.

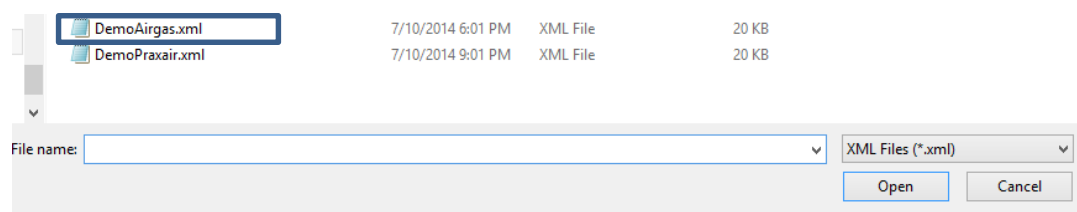
Step 8:

Load Scenario from XML

You will notice a button 'Load Scenario' on the bottom left, click on it.



You will get an OpenFile dialog, please choose to load 'DemoAirgas.xml' included part of the 'Program' folder (See Step 0).



You should notice a new scenario named 'AirgasDemo2' is added to our list of scenarios.

Process Yield Optimizer
— □ ×

File

% + ×

Scenarios

Airgas

Praxair

AirgasDemo2

Load Scenario

Save Scenario

Calculate Efficiency

Add Row

Delete Row

	A	B	D	E	F	G	H	I	J	K
1	500	503	506	509	512	515	518	521	524	527
2	533	536	539	542	545	548	551	554	557	560
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24	1185	1186	1187	1188	1189	1190	1191	1192	1193	1194
25	1196	1197	1198	1199	1200	1201	1202	1203	1204	1205

Paste All

Copy All

Paste Row

Copy Row

Cells [ml]

Liquid Nitrogen [\$]

Delivery Fee [\$]

Repeat this step by loading 'DemoPraxair.xml' included part of the 'Program' folder (See Step 0). You should notice a new scenario named 'PraxairDemo2' is added to our list of scenarios as well.

Process Yield Optimizer																																																																																																																																																																																																																																																																																																								
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<div> <div>% + X</div> <div> <div>Scenarios</div> <div> <div>Airgas</div> <div>Praxair</div> <div>AirgasDemo2</div> <div>PraxairDemo2</div> </div> </div> <div> <div>Load Scenario</div> <div>Save Scenario</div> <div>Calculate Efficiency</div> </div> </div>																																																																																																																																																																																																																																																																																																								
<div> <div>Add Row</div> <div>Delete Row</div> </div> <table> <tr> <th></th><th>A</th><th>B</th><th>D</th><th>E</th><th>F</th><th>G</th><th>H</th><th>I</th><th>J</th><th>K</th></tr> <tr><td>1</td><td>500</td><td>503</td><td>506</td><td>509</td><td>512</td><td>515</td><td>518</td><td>521</td><td>524</td><td>527</td></tr> <tr><td>2</td><td>533</td><td>536</td><td>539</td><td>542</td><td>545</td><td>548</td><td>551</td><td>554</td><td>557</td><td>560</td></tr> <tr><td>3</td><td>566</td><td>569</td><td>572</td><td>575</td><td>578</td><td>581</td><td>584</td><td>587</td><td>590</td><td>593</td></tr> <tr><td>4</td><td>599</td><td>603</td><td>607</td><td>611</td><td>615</td><td>619</td><td>623</td><td>627</td><td>631</td><td>635</td></tr> <tr><td>5</td><td>641</td><td>645</td><td>649</td><td>653</td><td>657</td><td>661</td><td>665</td><td>669</td><td>673</td><td>677</td></tr> <tr><td>6</td><td>683</td><td>687</td><td>691</td><td>695</td><td>699</td><td>703</td><td>707</td><td>711</td><td>715</td><td>719</td></tr> <tr><td>7</td><td>725</td><td>729</td><td>733</td><td>737</td><td>741</td><td>745</td><td>749</td><td>753</td><td>757</td><td>761</td></tr> <tr><td>8</td><td>770</td><td>774</td><td>778</td><td>782</td><td>786</td><td>790</td><td>794</td><td>798</td><td>802</td><td>806</td></tr> <tr><td>9</td><td>812</td><td>816</td><td>820</td><td>824</td><td>828</td><td>832</td><td>836</td><td>840</td><td>844</td><td>848</td></tr> <tr><td>10</td><td>854</td><td>858</td><td>862</td><td>866</td><td>870</td><td>874</td><td>878</td><td>882</td><td>886</td><td>890</td></tr> <tr><td>11</td><td>896</td><td>900</td><td>904</td><td>908</td><td>912</td><td>916</td><td>920</td><td>924</td><td>928</td><td>932</td></tr> <tr><td>12</td><td>938</td><td>942</td><td>946</td><td>950</td><td>954</td><td>958</td><td>962</td><td>966</td><td>970</td><td>974</td></tr> 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<tr><td>19</td><td>1130</td><td>1131</td><td>1132</td><td>1133</td><td>1134</td><td>1135</td><td>1136</td><td>1137</td><td>1138</td><td>1139</td></tr> <tr><td>20</td><td>1141</td><td>1142</td><td>1143</td><td>1144</td><td>1145</td><td>1146</td><td>1147</td><td>1148</td><td>1149</td><td>1150</td></tr> <tr><td>21</td><td>1152</td><td>1153</td><td>1154</td><td>1155</td><td>1156</td><td>1157</td><td>1158</td><td>1159</td><td>1160</td><td>1161</td></tr> <tr><td>22</td><td>1163</td><td>1164</td><td>1165</td><td>1166</td><td>1167</td><td>1168</td><td>1169</td><td>1170</td><td>1171</td><td>1172</td></tr> <tr><td>23</td><td>1174</td><td>1175</td><td>1176</td><td>1177</td><td>1178</td><td>1179</td><td>1180</td><td>1181</td><td>1182</td><td>1183</td></tr> <tr><td>24</td><td>1185</td><td>1186</td><td>1187</td><td>1188</td><td>1189</td><td>1190</td><td>1191</td><td>1192</td><td>1193</td><td>1194</td></tr> <tr><td>25</td><td>1196</td><td>1197</td><td>1198</td><td>1199</td><td>1200</td><td>1201</td><td>1202</td><td>1203</td><td>1204</td><td>1205</td></tr> </table> <div> <div>Paste All</div> <div>Copy All</div> <div>Paste Row</div> <div>Copy Row</div> </div> <div> <div>Cells [ml]</div> <div>Liquid Nitrogen [\$]</div> <div>Delivery Fee [\$]</div> </div>												A	B	D	E	F	G	H	I	J	K	1	500	503	506	509	512	515	518	521	524	527	2	533	536	539	542	545	548	551	554	557	560	3	566	569	572	575	578	581	584	587	590	593	4	599	603	607	611	615	619	623	627	631	635	5	641	645	649	653	657	661	665	669	673	677	6	683	687	691	695	699	703	707	711	715	719	7	725	729	733	737	741	745	749	753	757	761	8	770	774	778	782	786	790	794	798	802	806	9	812	816	820	824	828	832	836	840	844	848	10	854	858	862	866	870	874	878	882	886	890	11	896	900	904	908	912	916	920	924	928	932	12	938	942	946	950	954	958	962	966	970	974	13	980	984	988	992	996	1000	1004	1008	1012	1016	14	1022	1029	1036	1043	1050	1057	1064	1071	1078	1085	15	1087	1088	1089	1090	1091	1092	1093	1094	1095	1096	16	1098	1099	1100	1101	1102	1103	1104	1105	1106	1107	17	1108	1109	1110	1111	1112	1113	1114	1115	1116	1117	18	1119	1120	1121	1122	1123	1124	1125	1126	1127	1128	19	1130	1131	1132	1133	1134	1135	1136	1137	1138	1139	20	1141	1142	1143	1144	1145	1146	1147	1148	1149	1150	21	1152	1153	1154	1155	1156	1157	1158	1159	1160	1161	22	1163	1164	1165	1166	1167	1168	1169	1170	1171	1172	23	1174	1175	1176	1177	1178	1179	1180	1181	1182	1183	24	1185	1186	1187	1188	1189	1190	1191	1192	1193	1194	25	1196	1197	1198	1199	1200	1201	1202	1203	1204	1205
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These xml files are not encrypted and can be used by other programs as well. For example, I can use Advanced Excel to load these values on excel spreadsheets. Session files .pyo are also in xml format as well but have a different/unique extension to not be confusing to the user when trying to use different load and save options. Please do refrain from editing these files manually with values unless you have read the source code and understood the way the data is parsed.

Step 9:

Calculate Efficiency again

Calculate Efficiency for the two new scenarios added in Step 8 (see Step 4 for help) and get the following results once you 'Visualize' these two scenarios.

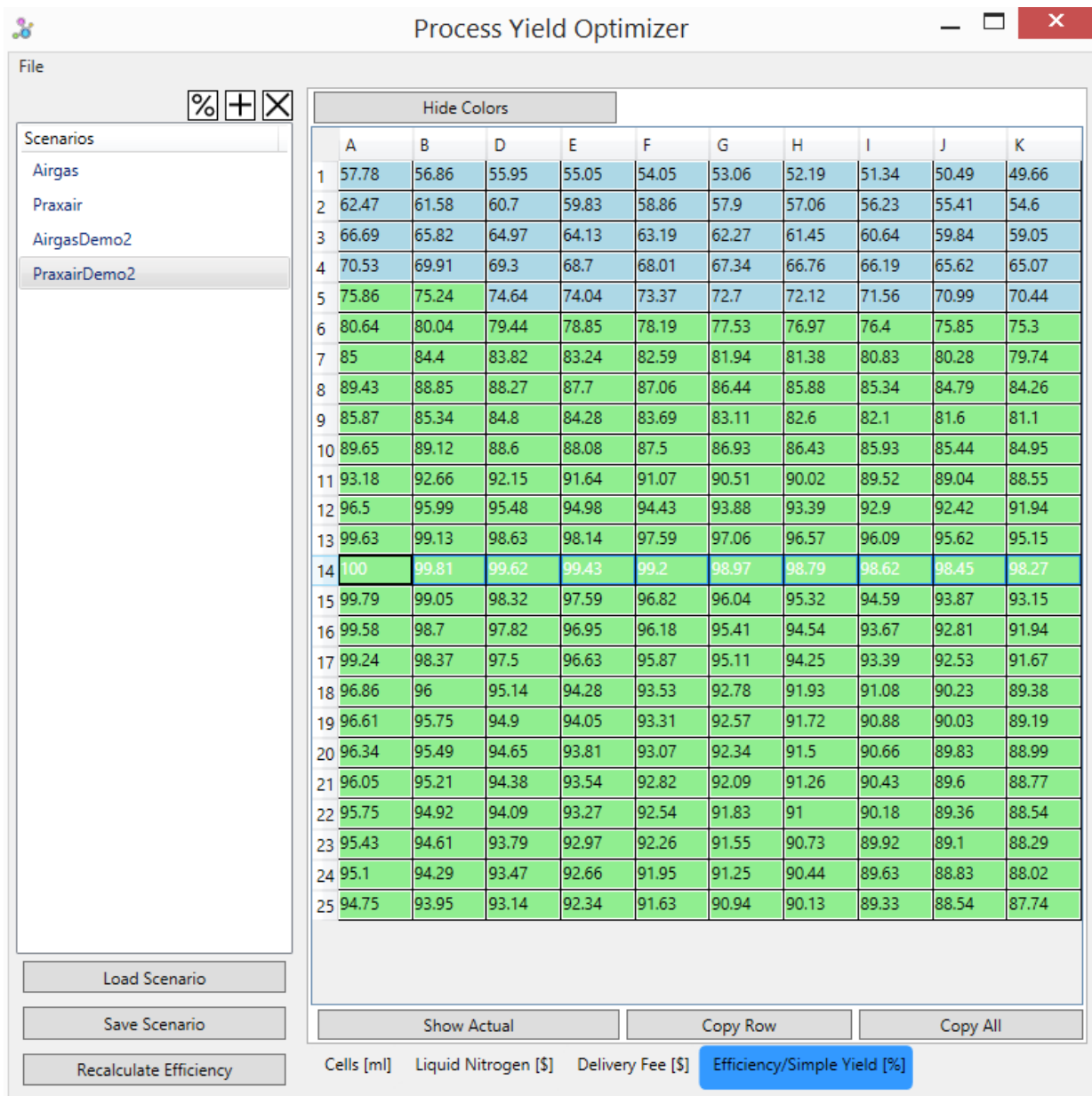
For 'AirgasDemo2' in Show Percentage Mode:

The screenshot shows the 'Process Yield Optimizer' application window. On the left, a 'Scenarios' list includes 'Airgas', 'Praxair', 'AirgasDemo2' (selected), and 'PraxairDemo2'. Below the list are buttons for 'Load Scenario', 'Save Scenario', and 'Recalculate Efficiency'. The main area displays a table with columns A through K and rows 1 through 25. A 'Hide Colors' button is located above the table. The table data is as follows:

	A	B	D	E	F	G	H	I	J	K
1	73.27	72.31	71.36	70.42	69.38	68.35	67.45	66.55	65.67	64.79
2	77.12	76.2	75.28	74.38	73.38	72.39	71.51	70.65	69.79	68.95
3	80.59	79.7	78.82	77.94	76.98	76.03	75.19	74.35	73.52	72.7
4	83.77	83.1	82.45	81.8	81.07	80.35	79.73	79.11	78.51	77.91
5	88.31	87.66	87.02	86.38	85.67	84.97	84.36	83.76	83.16	82.57
6	92.41	91.78	91.15	90.53	89.84	89.15	88.55	87.96	87.37	86.8
7	96.16	95.54	94.92	94.32	93.64	92.98	92.39	91.81	91.23	90.67
8	100	99.4	98.8	98.2	97.55	96.9	96.33	95.76	95.2	94.64
9	81.97	81.48	81	80.52	79.99	79.46	78.99	78.54	78.08	77.63
10	85.99	85.51	85.03	84.56	84.03	83.5	83.05	82.59	82.14	81.69
11	89.74	89.26	88.79	88.32	87.8	87.29	86.83	86.38	85.93	85.49
12	93.25	92.78	92.32	91.85	91.34	90.83	90.38	89.93	89.49	89.05
13	96.56	96.1	95.64	95.18	94.67	94.17	93.73	93.29	92.85	92.41
14	94.34	94.21	94.09	93.96	93.79	93.62	93.5	93.39	93.27	93.15
15	94.64	93.94	93.23	92.53	91.78	91.04	90.34	89.64	88.95	88.25
16	94.52	93.82	93.12	92.43	91.69	90.95	90.26	89.57	88.88	88.19
17	94.26	93.57	92.88	92.19	91.46	90.72	90.04	89.35	88.67	87.99
18	89.45	88.77	88.09	87.41	86.69	85.97	85.29	84.62	83.95	83.27
19	89.3	88.63	87.95	87.28	86.57	85.85	85.19	84.52	83.85	83.18
20	89.14	88.47	87.8	87.13	86.43	85.72	85.06	84.4	83.74	83.08
21	88.96	88.29	87.63	86.97	86.27	85.57	84.92	84.26	83.61	82.95
22	88.76	88.1	87.45	86.79	86.1	85.41	84.76	84.11	83.46	82.81
23	88.54	87.89	87.24	86.59	85.91	85.22	84.58	83.93	83.29	82.65
24	88.31	87.67	87.02	86.38	85.7	85.02	84.38	83.74	83.1	82.47
25	88.06	87.42	86.78	86.15	85.47	84.8	84.17	83.53	82.9	82.27

At the bottom of the window, there are buttons for 'Show Actual', 'Copy Row', and 'Copy All'. Below these buttons are labels for 'Cells [ml]', 'Liquid Nitrogen [\$]', 'Delivery Fee [\$]', and 'Efficiency/Simple Yield [%]' (which is highlighted in blue).

For 'PraxairDemo2' in Show Percentage Mode:



Since the colors are mapped do check out the performance indicators and determine which cell quantity is the most cost efficient for these two scenarios.

Step 10:

Final Conclusion

You should come to the conclusion that for low volume of cells especially for quantity of 770 ml of cells, Airgas is the better supplier. But at higher volume of cells especially at 1022 ml of cells, Praxair is the better supplier. At higher volume of cells Praxair also has lower total cost per ml of cells than Airgas does for its best condition. Praxair costs about \$1.69 per ml of cells at optimal condition while Airgas costs \$1.74 per ml of cells at optimal condition.

Questions/Feedback:

Please email at adithyamurali.github@gmail.com