$-SMART BLEND OPTIMIZER – STEP-BY-STEP HANDS ON

1. Installation and Requirements

- Microsoft (MS) Windows 7, 8 or 10
- Apple MAC's: require Windows Emulator
- Microsoft (MS) Office or EXCEL, versions 2007, 2010, 2016, 365
- MS Excel Solver add-in installed

2. Optimizer file names

- SmartBlend-MG for motor gasoline
- SmartBlend-DF for Diesel
- SmartBlend-FO for Bunker Fuel and Fuel Oil

3. Installation Directory

Copy distributed software to any LOCAL directory (not CLOUD or Network)

Preferably root directory of your PC; example: C:/ara/SmartBlend-MG_17_4

4. To Start Using the Optimizer

Step 1) Starting the Optimizer

To open, double click on C:/ara/SmartBlend-MG_17_4 You will also see a sub-folder labeled Cases This is where your examples (called "cases") are stored.

A message will ask you to accept EULA license agreement to see the beginning screen. Next click BEGIN button.
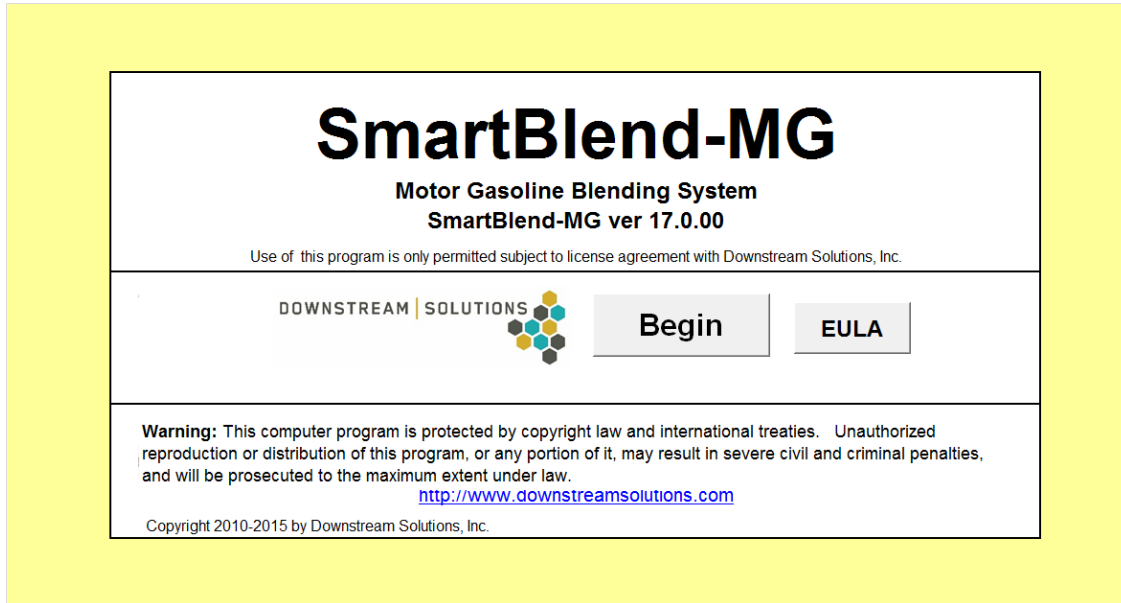
The next display allows you to select a case to OPEN, or create a new case.
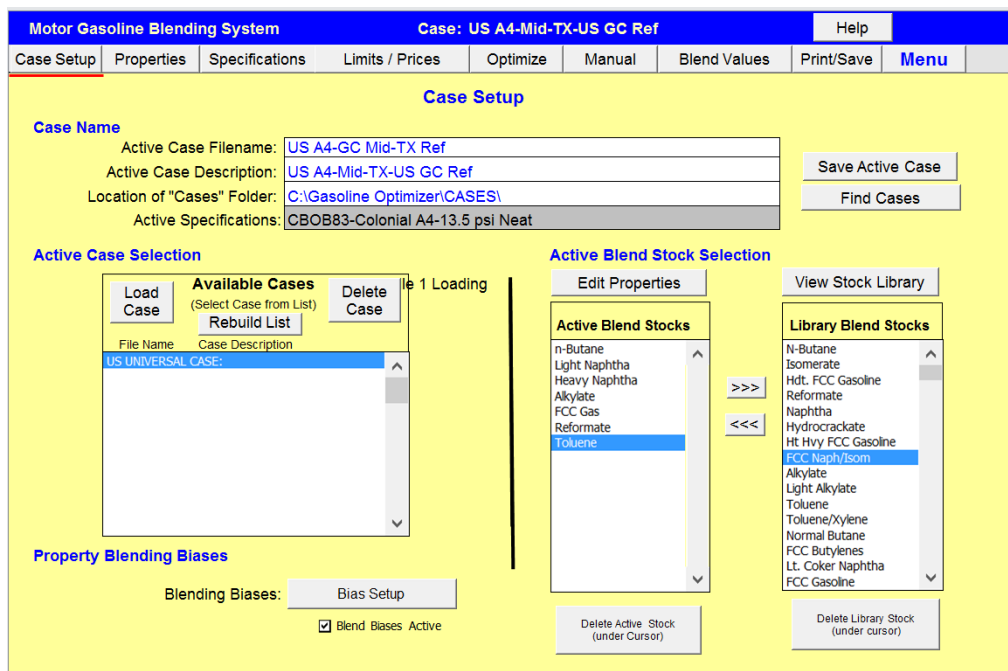
STEP **2) Create a Case or Open an Existing Case**

The Optimizer comes with a few customizable cases. You can open one of them and adding your own blend components properties up to 15 components:

	Blend Qualities				Component Qualities														
	Minimum Spec Quality	Maximum Spec Quality	Optimum Blend Qualities	Manual Blend Qualities	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Specification Name: CBOB83-Colonial A4-13.5 psi Neat					n-Butane	Light Naphtha	Heavy Naphtha	Alkylate	FCC Gas	Reformate	Toluene	0	0	0	0	0	0	0	0
Density, API	51	70	67.8692	69.41133	107	74.5	63.9	70.5	58.8	40.8	28.4								
RVP, psi	11.000	13.500	13.46	12.37	60.5	12.1	4.88	9.5	7.95	3.8	1								
Sulfur, ppm W	0	80	46	31	10	34	20	20	32.4	0	20								
Olefin, Vol %	0	25	5.1	3.2	0	0.035	0.05	0.5	32.3	0.48	0								
Aromatic, Vol %	0	50	31.3	19.7	0	1.97	7.17	0	21.75	50.7	100								
Benzene, Vol %	0	3.8	0.4	0.3	0.22	0.35	0	0	0.88	0.08	0.1								
Sulf, ppm W	0	20	0.0		0	0	0	0	0	0	0								
RON, Clear	-	-	87.0	89.6	91.8	67	62	92.1	91.67	99.1	110								
xx	-	-	-	-	89.8	66.5	61	91.6	85.46	93.2	104								
MON, Clear	-	-	80.000	84.4	87.80	66.00	60.00	91.10	79.25	87.30	98.00								
xx	-	-	-	-		66.50	61.00												
xx	-	-	-																
Oxygen, Wt %	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00									
Oxygenate, Vol %	0	0	0	0	0	0	0	0	0	0									
Index, deg F	-	1220	970.9667	1017.40	110.0	888.0	1157.5	1178.5	1117.0	1531.5	1253.5								
TVL 20, deg F	107	-	107.10	116.10	-127.7	115.3	163.0	140.7	140.3	175.7	194.7								
Initial BP, deg F	-	-		85.3		86	121	28.9	28	32	224								
10 pct evap, deg F	-	-	100.1	111.1	12	116	165	121	130	152	227								
30 pct evap, deg F	-	-	139.1	155.8				189	165		228								
50 pct evap, deg F	-	-	162.2	175.9	18	159	208	240	190	272	228								
70 pct evap, deg F	-	-	280.8	274.3				257	284		228								
90 pct evap, deg F	-	-	334.4	323.1	38	237	286	277	352	487.5	229								
Final BP, deg F	-	-	411.5	400.5	105	294	335	397	460	500	235								

You can add or change the names of your blend components, plus the blend properties like RVP, RON, MON, Sulfur, Aromatic, and so on.

STEP **3) See the Blend Component Properties**

Click on "Properties" Tab on the menu bar and you are able to see the Blend Properties just created previously. Here it is possible to add more components or modify any blend properties:

Motor Gasoline Blending System — Case: US A4-Mid-TX-US GC Ref — Help

Case Setup | Properties | Specifications | Limits / Prices | Optimize | Manual | Blend Values | Print/Save | **Menu**

Blend Stock Properties

Blend Stock Name: n-Butane

Properties	Value
Density, API	107
RVP, psi	60.5
Sulfur, ppm W	10
Olefin,Vol %	0.0
Aromatic, Vol %	0
Benzene, Vol %	0.22
Mercaptan Sulf, ppm W	0
RON, Clear	91.8
MON, Clear (1)	87.8
Oxygen, Wt %	0
Oxygenate, Vol %	0
Drivability Index, deg F	110
TV/L 20, deg F	-127.7
Initial BP, deg F	
10 pct evap, deg F	12
30 pct evap, deg F	
50 pct evap, deg F	18
70 pct evap, deg F	
90 pct evap, deg F	38
Final BP, deg F	105
Average BP, deg F	22.7

Select Stock
n-Butane
Light Naphtha
Heavy Naphtha
Alkylate
FCC Gas
Reformate
Toluene

Delete Active Stock (under Cursor)

Navigation
Go to Case Setup Screen to Select Active Stocks.

Case Setup

Go to ActiveCase Screen to View or Input Blend Stock Data in Spreadsheet Format.

View Input

STEP **4) Select the Blend Specifications**

Click on "Specifications" tab to select the right specifications. The Optimizer comes with 25 built-in Worldwide Specs. You can select the one depending on the location/country/region you are dealing with. If you are dealing with Europe, you can select for example EU95, if you are dealing with Singapore you can select Singapore 95R. It is also possible create your own specifications directly or by cloning an existing one.

Here it is very important to select the property specifications that are going to be used during the optimization. For example, checking the MON means that property specification is active for the optimization. Unchecking the Benzene content(%) property specification it means this is not active during the optimization.

STEP **5) Inventory and Price**

Click on "Limits/Prices" tab to select the blend component inventory and prices. What you need to do is just add the blend components inventory, Bbl,(1) the blend component prices(2) and the Blend batch size(3) you want to make.

After inserting blend inventory and prices, you are ready to Optimize clicking on the "Optimize" (4) tab.

STEP **5) Optimize**

At this point, it is possible to Optimize the blend and analyze the results. Optimize means maximizing blend profit while meeting all the constraints, e.g. specs, batch size, etc.

Motor Gasoline Blending System			Case: US A4-Mid-TX-US GC Ref			Help	
Case Setup	Properties	Specifications	Limits / Prices	Optimize	Manual	Blend Values	Print/Save	Menu

Optimum Blend

Blend Ethanol	Std LP Report	LP Details	Blend Values	EPA Model	Biases

Feasible: Optimized

Objective Function = **147.60**   ☑ Blend Ethanol before EPA   ☑ Blend Biases Active?   Status of the Optimization
Last Run at: 01/26/17 2:31 PM   Blend Biases: Active.   5 Limits Hit (***)

Blend Stock	Amount, Bbl	Vol% in Blend	% of Option	Marginal Value	Blend Property with Biases	Result at Optimum	Spec Binding
1 n-Butane	8,253.6	6.30	27.5	0.00	Research Octane Number (RON)	87.0	>0 (NotActive)
2 Light Naphtha	30,000.	22.89	100.0	0.37	Motor Octane Number (MON)	80.0	*** >80
3 Heavy Naphtha	2,798.6	2.14	9.3	0.00	(RON + MON)/2	83.5	*** >83.5
4 Alkylate	30,000.	22.89	100.0	0.50	API Gravity	67.5567	51.0><70.0 (NotActive)
5 FCC Gas	60,000.	45.78	100.0	2.03	Sulfur content, ppm W	29	<80
6 Reformate		0.00	-	0.00	Mercaptan sulfur, ppm W	0.000	<20 (NotActive)
7 Toluene		0.00	-	0.00	Reid vapor pressure, psia	13.50	*** 11><13.5
8					10% Distilled, deg F	105	73.9><131
9					50% Distilled, deg F	157	150.1><235
10					90% Distilled, deg F	318	0.01><365
11					End Point, deg. F	399	<430
12					Driveability Index, deg F	947	<1220 (NotActive)
13					V/L 20, deg F	107.0	*** >107.0 (NotActive)
14					Olefins, volume percent	14.9	<25
15					Aromatics, volume percent	10.6	<50
					Benzene, volume percent	0.50	<3.8
	Total Blend	131,052.2 Bbl	Cost	50.9737	Oxygenates, volume percent	0.0	*** 0<0 (NotActive)
	Blend Minimum	1,000. Bbl	Sales Price	52.1000	Oxygen, weight percent	0.0	0><0 (NotActive)

Optimized Recipe

Profit, $/Bbl **1.1263**

% Evaporated	
N/A	
E200, %	57.4
E300, %	81.7

Total Profit, $k **147.6027**

Driveability Index: 947
V/L=20, deg. F: 107.0
V/L=20 with 10 %Ethanol, deg. F: 120.7

Octane Blending Method: Ethyl Corr (Regular)

PROFIT

Notes: The above Specs are for CBOB83-Colonial A4-13.5 psi Neat.
*** shows a limiting specification

Specifications selected for the Optimization

Warnings:

The Ethyl Octane equations are composition dependent.
Rerun the optimizer until the Blend Composition does not change significantly.

After the Optimization we can see the "Status" of the Optimization, in this case the optimization is feasible, i.e. Specs, and Batch Size are met.

In this last screen we have the "Optimized Recipe", the "Specifications selected for the Optimization" and the most important thing, "The Profit".

STEP **6) Considerations**

The $-Smart Blend Optimizer is a powerful tool, with a friendly interface that allows us to predict in the shortest amount of time if you can have profit with the Blend Components, the Blend Inventory and the Specifications you have. All of them (Blend Properties, inventory, price) are taken into account during the Optimization.

STEO **7) Information on the Optimizer**

The Optimizer uses Linear Programming. The result of the optimization takes into account simultaneously Blend Properties, Specs, Blend inventory and prices.

 It is a single Blend Optimizer, meaning it is optimizing one blend at the time.

All the non-linear blend properties are calculated non-linearly, for example the RON and MON have built-in the RT-70 equation and the RVP the Chevron equation.

The Optimizer has also integrated important features such as:

1) Calculating the blend properties after adding Ethanol;

2) Analyzing whether the optimized batch meets the EPA rules for reformulated gasoline;

3) Manual blending tool where the user can insert manually the blend recipe, and see the expected blend properties.

 For Pricing and Info contact lee@refautom.com