AUTOMATIC CREATION OF END-USE B-Y TEMPLATES FROM AN ENERGY BALANCE IN VEDA FE

DECEMBER 23, 2013

INTRODUCTION AND MOTIVATION

A fairly robust method to model the stock of existing technologies, in simple terms – for end-use sectors, has emerged where one starts with the energy balance, aggregates fuels (depending on the sector), allocates uses to different energy services and provides information on efficiency and availability of technologies. This note describes a new feature of VEDA FE that automates the creation of base-year templates with bare minimum input from user. This includes composing names and descriptions of technologies and fuels based on information provided on a single Excel sheet in an intuitive format.

This facility could be useful in training new users as well as for advanced users in some situations:

1. New users could focus on the approach and content of modeling and models, without losing any time and energy on syntax.
   a. The standard VEDA tables, which are created automatically, can provide syntax training to new users.
2. This facility can be user to rapidly create place-holder models for sectors that are not under immediate focus in larger model building exercises.

CREATING B-Y TEMPLATES WITH THE NEW FEATURE

Figure 1 shows sheet "EB_REG1" of file EB_EuroStat2010.xls that is provided as a part of this functionality.

The partial energy balance shown here refreshes automatically when cells A1/A2 are modified. A1 expects the standard 2-char code of EU30 countries and A2 expects a year from 2005-2008. Both cells support only single values – no commas or wild cards are recognized. Sheet EB_REG1 can be copied any number of times, as EB_<Region name>, to create a multi-region model.

	A	B	C	D	E	F	G	H	I	J	K	L
1	DE		Price	2	12	6	15	8	1	1	1	3
2	2008		Unit	PJ	PJ	PJ	PJ	PJ	PJ	PJ	PJ	PJ
3			~EB	COA	OIL	GAS	ELC	HET	SOL	GEO	IWA	BIO
4				Solids	PetroProd	Gas	Electricity	Derived heat	Solar	Geo	Indust Waste	Bio and waste
5			Primary									
6			Primary production	2339	0	1011	0	0	32	21	0	1989
7			Imports	1437	1542	6688	195	0	0	0	0	2
8			Exports	46	1121	906	289	0	0	0	0	13
9												
10			Input to Transformation									
11			blast-furnace plants	197	0	0	0	0	0	0	0	0
12			coke-oven plants	315	25	4	0	0	0	0	0	0
13			thermal power stations	2953	38	1653	0	0	0	1	6	888
14			district heating plants	26	6	209	0	0	0	2	0	67
15			gas-works	0	0	0	0	0	0	0	0	0
16			nuclear power stations	0	0	0	0	0	0	0	0	0
17			refineries	0	0	0	0	0	0	0	0	0
18												
19			Final Consumption									
20		AGR	agriculture	0	0	23	41	0	0	0	0	0
21		RSD	households	43	716	2594	654	333	15	17	0	453
22		IND	industry	400	178	1767	1135	267	0	0	0	300
23		COM	services	12	387	923	556	283	0	0	0	1
24		TRA	transport	0	2496	0	77	0	0	0	0	261

FIGURE 1 ENERGY BALANCE OF GERMANY FROM EUROSTAT 2010 – FOCUSED ON FINAL ENERGY USE

The formatting of this sheet is more rigid compared to other VEDA FE templates. Contents of cells formatted in deep golden color, like C1, should not be modified at all. The only exception is ~SecData-* cells, where the sector name should be updated at the end of the tag. Similarly, cells formatted green, like cell C6, should not be modified as these are keywords from the table with EuroStat data. However, it is possible to insert rows/columns in the energy balance if one wants to set it up without the Eurostat support provided here.

Cells that users can modify have the silver-gray color, like D2.

USER INPUT

- o Row 3: short names of primary/secondary fuels that will feed the sector-fuel technologies for enduse sectors
- o Row 2: units of primary/secondary fuels.
- o Row 1: prices of these fuels. An exogenous supply of these fuels will be created so that the template can be tested even before other parts of the model are developed.
    - o The exogenous supply, EB_FuelSupp, should be appropriately restricted when endogenous supply of these fuels is added.
- o Col B: short names for enduse sectors

	A	B	C	D	E	F	G	H	I	J	K	L	M
1	DE		Price	2	12	6	15	8	1	1	1	3	
2	2008		Unit	PJ	PJ	PJ	PJ	PJ	PJ	PJ	PJ	PJ	
3			~EB	COA	OIL	GAS	ELC	HET	SOL	GEO	IWA	BIO	
4				Solids	PetroProd	Gas	Electricity	Derived heat	Solar	Geo	Indust Waste	Bio and waste	Total
19			Final Consumption										
20		AGR	agriculture	0	0	23	41	0	0	0	0	0	64
21		RSD	households	43	716	2594	654	333	15	17	0	453	4826
22		IND	industry	400	178	1767	1135	267	0	0	0	300	4047
23		COM	services	12	387	923	556	283	0	0	0	1	2162
24		TRA	transport	0	2496	0	77	0	0	0	0	261	2834
25													
26													
27			~SecData-Split: RSD										
28			Use	COAOIL	COAOIL	GAS	ELC	HET	SOL	GEO	SLU	BIO	
29				non-gas fossil	non-gas fossil	Natural Gas	Electricity	Derived Heat	Solar	Geothermal	Industrial Wastes	Bioenergy	Desc
30			SH		0.5	0.6	0.2	1	0.5	0.5			0.4 Space Heating
31			SC				0.1						Space Cooling
32		PJ	WH		0.4	0.3	0.05		0.5	0.5			0.55 Water Heating
33			LT				0.35						Lighting
34		PJ	AP				0.25						Appliances
35			OT		0.1	0.1	0.05						0.05 Other

FIGURE 2 FINAL ENERGY CONSUMPTION SPLIT BY ENERGY SERVICES FOR RESIDENTIAL SECTOR

After naming the sectors and primary/secondary fuels, the next step is to aggregate the fuels to be tracked, define energy services and split fuel consumption by service, as shown in Figure 2.

USER INPUT

- o Cell C27: the last part of this tag, after ":", should be a sector name
- o Row 28: names of sector fuels – the final energy commodities that will be used by enduse technologies.
  - o Fuels can be aggregated by putting the same value in columns. For example, coal and oil have been aggregated into COAOIL in the example shown above.
  - o A fuel technology will be created that will consume COA and OIL to produce RSDCOAOIL (respecting the share of coal and oil).
  - o Aggregation schemes can be sector-specific.
- o Col C: short names of energy services
- o Col M: description of energy services
- o Range D30-L35: splits of fuel by service; each column should add up to 1.
  - o There is a formula to compute "Other" that can be replaced by the user.

FIGURE 3 SYSTEM SETTINGS DECLARATIONS WITH THE ENERGY BALANCE

- o Col B: units of energy services.
  - o Any commodity without unit specification will be given the default unit
  - o Default units, and some other fundamental parameters are declared on the sheet shown in Figure 3.

Figure 4 shows two tables that are beside the table used to split fuel consumption by energy service, which can be used to declare EFF and AF of technologies. Both parameters default to 1, if the table (or value) is missing.

The yellow cells, like O30, are formulas.

Z	AA	AB	AC	AD	AE	AF	AG	AH	AI	AJ	AK
	~SecData-AF: RSD										
	Use	COAOIL	COAOIL	GAS	ELC	HET	SOL	GEO	SLU	BIO	
		non-gas fossil	non-gas fossil	Natural Gas	Electricity	Derived Heat	Solar	Geothermal	Industrial Wastes	Bioenergy	Desc
	SH			0.3	0.3	0.3	0.3	0.3	0.3	0.3	Space Heating
	SC				0.2						Space Cooling
	WH			0.8	0.8	0.8		0.8	0.8	0.8	Water Heating
	LT				0.5						Lighting
	AP				0.5						Appliances
	OT			1	1	1				1	Other

FIGURE 4 TWO TABLES IN THE SAME ROWS AS THE SPLIT DECLARATIONS, FOR EFF AND AF OF TECHNOLOGIES

This set of three ~SecData-* tables is expected for each sector.

Using the declarations described so far, VEDA FE creates the following, when pointed to the energy balance workbook when creating a new model:

- o The model folder
- o B-Y templates by region
    - o Each sector has two sheets: one for fuel technologies and the other for enduse devices (by fuel)
    - o Sheet "Secondary Fuels" has the exogenous supply for primary and secondary fuels used by fuel technologies.
- o Empty B-Y Transformation file
- o SysSettings file
    - o **Discount rate and G_YRFR need to be updated in this file before launching a run.**

Any additional parameters for the technologies should be defined via the B-Y transformation file. The same model can have some B-Y created from an energy balance and others created manually. Templates that are based on an energy balance workbook have a book icon (VT) instead of the regular checkbox. All other standard data component of VEDA FE, like SubRES, trades and regular scenarios, can be added as usual.

There is an additional icon on the navigator that shows a balance (representing the link with energy balance). This icon reflects whether the energy balance workbook and the templates it generated are consistent or not. The SYNC process includes recreation of the B-Y templates (that were created from the balance to begin with).

Mechanics of this process are shown in this video:

The energy balance file will be available in a new standard folder \VEDA\EB, after updating to version 4.3.65.

WORKING WITH MODELS THAT HAVE AUTO-GENERATED B-Y TEMPLATES

This section is very important to understand and follow in order to use this feature effectively. All the standard VEDA tables that are created based on information provided on the energy balance sheet are completely linked to this sheet. But this happens only when B-Y templates are created, during the SYNC process.

In short, any user-specified information can be modified in the energy balance sheet of auto-generated B-Y templates so long as the overall structure is not changed. Meaning, users can:

- o Modify any numerical value
- o Modify any user-specified short name or description
- o Add or remove elements in the fuel-service matrix. Meaning, a fuel can be split across more or less services (Figure 2)
    - o The full set of technologies (all combinations of final energy commodities and enduse services) will be created, but those without any entry in the fuels-services split table will be ignored in the FI_T table that is created.

And these are the modifications that cannot be done in the B-Y templates:

- o Add or remove enduse services
    - o Removal can be handled via the split table though
- o Add or remove primary/secondary fuels
    - o Removal can be handled via the split table though
- o Change the aggregation scheme of primary/secondary fuels into the final energy commodities

For modifications in the second list, one must start from the original energy balance workbook.

Important: all changes done in the B-Y templates should be restricted to the energy-balance sheet. All other sheets will be recreated from scratch each time B-Y templates are created from the energy balance workbook.

Following the VEDA philosophy, the consistency between the energy balance workbook and the B-Y templates is tracked via a new icon, which is blue () when these files are synchronized. It turns red (), when either the balance or B-Y are modified. Depending on which one is modified later, the following synchronization options are presented:

- o If energy balance workbook is newer: B-Y templates are created from scratch
    - o SysSettings is not processed if it already exists

- If B-Y template is newer: the energy balance sheet is copied to the energy balance workbook and Eurostat formulas are reinstated (that are removed when B-Y templates are created.

Hovering on the energy balance icon displays the file name, with path. single click initiates synchronization between energy balance workbook and the B-Y templates. Ctrl+Click to open the energy balance workbook.

The option to delink the B-Y templates from the energy balance workbook is presented at the synchronization step.

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