

## ANNEX XIII: TOOLS FOR ANALYSIS OF A FUTURE ENERGY REVOLUTION

### BASIC TRAINING COURSE ON VEDA-TIMES

3 - 5 JUNE 2019, IEA, PARIS, FRANCE

Participation fee: Each course is free of charge for ETSAP Contracting Parties.

The following training fees apply: Participants from

- Companies €1200
- Institutions €1000
- University Staff €750
- Private persons €750
- Students/PhD €300

per person per course.

Payment is only possible through bank transfer after the completion of the training course and having received an email confirmation by Dr. G. Giannakidis.

Note: VEDA-TIMES has to be installed prior to the training course on your laptop, following the instruction available at [www.kanors.com/vedasupport/](http://www.kanors.com/vedasupport/)

#### MONDAY 3 JUNE - INTRODUCTION AND BASE ELEMENTS

9.00-9.15	All participants	Presentation of the program and round table
9.15-10.30	Presentation:	Introduction to the TIMES model generator
10.30-10.45	Morning break	
10.45-13.00	Presentation:	Overview of VEDA Front End (FE)
	Hands-on:	The VEDA-TIMES DemoS models
		Supply curve and simple demand
13.00-14.00	Lunch break	
14.00-15.30	Hands-on:	Overview of VEDA Back End (BE)
		Results analysis with VEDA-BE for the first DemoS
15.30-15.45	Afternoon break	
15.45-16.30	Hands-on:	Next step with DemoS
16.30-17.00	Open questions	

#### TUESDAY 4 JUNE - THE DEMOS MODELS - PART 1

9.00-10.30	Presentation:	The VEDA-TIMES DEMOs: electricity generation
10.30-10.45	Morning break	

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10.45-13.00	Hands-on:	The VEDA-TIMES DEMOs: electricity sophistication
13.00-14.00	Lunch	
14.00-15.30	Presentation:	User constraints in TIMES
	Hands-on	The VEDA-TIMES DEMOs: user constraints
15.30-15.45	Afternoon break	
15.45-16.30	Hands-on:	Implementing alternative scenarios in VEDA-TIMES
16.30-17.00	Open questions	

### WEDNESDAY 5 JUNE - THE DEMOS MODELS - PART 2

9.00-10.30	Hands-on:	The VEDA-TIMES DEMOs: multi-regional approach
10.30-10.45	Morning break	
10.45-13.00	Hands-on:	VEDA-FE SubRes and demand module
13.00-14.00	Lunch	
14.00-16.30	Hands-on:	Technologies with multiple inputs and outputs Increase complexity in the DemoS

## REFERENCES

### TIMES Documentation and Demo Models

- Part I: [TIMES concepts and theory](#)

Part I provides a general description of the TIMES paradigm, with emphasis on the model's general structure and its economic significance. Part I also includes a simplified mathematical formulation of TIMES, a chapter comparing it to the MARKAL model, pointing to similarities and differences, and chapters describing new model options.

- Part II: [Comprehensive Reference Manual](#)

Part II constitutes a comprehensive reference manual intended for the technically minded modeler or programmer looking for an in-depth understanding of the complete model details, in particular the relationship between the input data and the model mathematics, or contemplating making changes to the model's equations. Part II includes a full description of the sets, attributes, variables, and equations of the TIMES model.

- Part III: [The Operation of the TIMES code \(organization of the TIMES modelling environment\)](#)

Part III describes the organization of the TIMES modeling environment and the GAMS control statements required to run the TIMES model. GAMS is a modeling language that translates a TIMES database into the Linear Programming matrix, and then submits this LP to an optimizer and generates the result files. Part III describes how the routines comprising the TIMES source code guide the model through compilation, execution, solve, and reporting; the files produced by the run process and their use; and the various

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switches that control the execution of the TIMES code according to the model instance, formulation options, and run options selected by the user. It also includes a section on identifying and resolving errors that may occur during the run process.

- Part IV: [Building a TIMES model using VEDA-FE](#)

Part IV provides a step-by-step introduction to building a TIMES model in the VEDA-Front End (VEDA-FE) model management software. It first offers an orientation to the basic features of VEDA-FE, including software layout, data files and tables, and model management features. It then describes in detail twelve Demo models that progressively introduce VEDA-TIMES principles and modeling techniques.

### VEDA-TIMES Demo Models

This is a set of VEDA-TIMES models that start from an energy balance of EU27 and focuses on building a model incrementally employing a standard approach to describing the underlying Reference Energy System (RES) and careful naming conventions. The model starts with a simple supply curve feeding a single demand and grows step by step to build out the RES adding new commodities, technologies and regions; introducing new parameters and more advanced TIMES modelling features along the way. There are twelve steps with some variants in this set of basic and intermediate [demo models](#).

- Part V: [Analysing results from TIMES models using VEDA-BE](#)

Part V describes the VEDA Back-End (VEDA-BE) software, which is widely used for analyzing results from TIMES models. It provides a complete guide to using VEDA-BE, including how to get started, import model results, create and view tables, create and modify user sets, and step through results in the model Reference Energy System. It also describes advanced features and provides suggestions for best practices.