

Training course

2nd Draft Program

Technical-economic modelling with the TIMES model generator:

Date: May 16-17(18), 2011

Hosted by The Institute for Energy of the Joint Research Centre of the European Commission

Venue: Westerduinweg 3, NL-1755 LE Petten, The Netherlands (details at <http://ie.jrc.ec.europa.eu/>)

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References see list in Appendix

Participation fee: The course is free of charge for ETSAP Contracting Parties
Participants of companies, institutions & universities pay €1200, €1000 & €750, respectively.
For two days, the participation fee is reduced to €800, €700 and €550, respectively.

Note: VEDA-TIMES has to be installed prior to the training course, following the instruction available at www.kanors.com/vedasupport/

Monday, May 16, 2011

TIMES basics 1: The tutorial model

9.00-9.15	All participants	Presentation of the program and round table
9.15-10.15	Presentation:	Elements of Energy Technology Systems Analyses
10.15-11.00	Presentation:	Linear Economic Models
11.00-11.30	Coffee break	
11.30-13.00	Presentation: Hands-on:	Overview of a simple TIMES model Building a tutorial TIMES model from scratch with VEDA-FE
13.00-14.00	Lunch	
14.00-15.00	Hands-on:	Results analysis with VEDA-Back End
15.00-15.20	Coffee break	
15.20-16.00	Hands-on:	Building scenarios for the tutorial TIMES model Scenario results analysis with VEDA-Back End
16.00-16.45	Hands-on: Hands-on:	Use of VEDA-TIMES to build the 2-region tutorial model Results analysis with VEDA-BE
16.45-17.00	Open questions	

Tuesday, May 17, 2011

TIMES Basic 2: The DEMO model

9.00-9.30	TIMES documentation:	Users' Guide, Tutorial, The VEDA-TIMES support web-site
9.30-10.00	Presentation:	From an energy balance to final consumption split by end-use
10.00-11.00	Presentation:	The VEDA-TIMES DEMO description and analysis by VFE browse
11.00-11.30	Coffee break	
11.30-13.00	Hands-on:	The BaU scenario with the VEDA-TIMES DEMO
13.00-14.00	Lunch	
14.00-15.00	Hands-on:	How to run build alternative scenarios with the VEDA-TIMES DEMO
15.00-15.20	Coffee/tea break	
15.20-16.30	Hands-on:	How to run and analyse results for the VEDA-TIMES DEMO
16.30-17.00	Open questions	

Wednesday, May 18, 2011

TIMES Basic 3: How to

9.00-11.00	How to do.... (time slices, simple/standard user constraints, ...)
11.00-11.30	Coffee break
11.30-13.00	How to do.... (cont.) Modelling tips with VEDA-FE and VEDA-BE
13.00-13.30	Lunch

Documentation

Before the training, please familiarise with the topics illustrated by the following references.

Priorities: **You must do...**; *I would do...*; You could do...

Energy Systems Analysis, Linear Economic Models

1. Nebojsa Nakicenovic (IIASA), **Energy Primer, Excerpt from CLIMATE CHANGE 1995, Impacts, Adaptation and Mitigation of Climate Change: Scientific – Technical Analyses Contribution of Working Group II to the Second Assessment Report of the Intergovernmental Panel for Climate Change, WMO – UNEP, Cambridge University Press, 1996, 878 pages, Chapter B., pages 75-92**
2. Gargiulo M., 2008. *Getting started with TIMES-VEDA. Draft 2.1., chapter 4: Getting Started with Problem, GC Tosato; http://www.etsap.org/Docs/Files_Times_Tutorial.zip*
3. Dorfman R., Samuelson P. A., Solow R. M.: *Linear Programming and Economic Models, McGraw-Hill Book Company, New York 1958; Dover Publications, New York, 1987 (passim)*
4. Gale D.: *The Theory of Linear Economic Models, The University of Chicago Press, Chicago and London, 1960, 1989*

The MARKAL/TIMES models generators

5. Loulou R., U. Remne, A. Kanudia, A. Lehtila and G. Goldstein. 2005. Documentation for the TIMES Model. Energy Technology Systems Analysis Programme (ETSAP).
 - Part I. 78 p. <http://www.etsap.org/Docs/TIMESDoc-Intro.pdf>
General description of the TIMES paradigm, general structure, economic significance, simplified mathematical formulation of TIMES, model options.
 - Part II. 349 p. <http://www.etsap.org/Docs/TIMESDoc-Details.pdf>
Comprehensive reference manual intended for the technically minded modeller or programmer looking for an in-depth understanding of the complete model details, model mathematics, full description of the sets, attributes, variables, and equations of the TIMES model.
 - Part III. 20 p. <http://www.etsap.org/Docs/TIMESDoc-GAMS.pdf>
Description of the GAMS control statements required to run the TIMES model
6. Gargiulo M., 2008. *Getting started with TIMES-VEDA. Draft 2.1. Energy Technology Systems Analysis Programme 180 p. With contributions of G. Goldstein, A. Kanudia, A. Lehtila, Uwe Remme, GC Tosato. http://www.etsap.org/Docs/Files_Times_Tutorial.zip*
This very complete manual explains how to start building a technical-economic model of your energy system, and its possible developments over time, with TIMES-VEDA. This Users' Guide is intended for beginners who want to represent their energy systems with a TIMES model. It illustrates step-by-step how to build an energy model, from the simplest case with one commodity and one technology to a complex model encompassing the entire energy system with hundreds of technologies.
7. Specific notes¹
 - Interpolation rules: <http://www.etsap.org/Docs/TIMES-Interpolate.pdf>
 - New VDA parameters: <http://www.etsap.org/Docs/TIMES-VDA.pdf>
 - Elastic demands: <http://www.etsap.org/Docs/TIMES-ED-Shaping.pdf>
 - Climate module: <http://www.etsap.org/Docs/TIMES-Climate-Module.pdf>

Data management systems

“ANSWER-TIMES user manual” downloadable from <http://www.noblesoft.com.au/answer/ANSWERv6-TIMES-User-Manual.zip>

Getting_Started_TIMES-VEDA_V2p7.pdf, downloadable from <http://www.etsap.org>
VEDA training material at www.kanors.com/vedasupport

¹ Information on these topics is also available in the “Getting started” guide or in the MARKAL/TIMES documentation reports.

Applications: models built with MARKAL-TIMES (non-exhaustive list)

Global Models

<http://www.etsap.org/applicationGlobal.asp>

8. Loulou, R., M. Labriet and A. Kanudia. 2009. Deterministic and Stochastic Analysis of alternative climate targets under differentiated cooperation regimes. Energy Economics, Volume 31, Supplement 2, International, US and EU Climate Change Control Scenarios: Results from EMF22, p.S131-143
http://www.sciencedirect.com/science?_ob=ArticleURL&_udi=B6V7G-4WK4SMM-1&_user=10&_coverDate=12%2F31%2F2009&_rdoc=8&_fmt=high&_orig=browse&_srch=doc-info%28%23toc%235842%232009%23999689999.8997%231573215%23FLA%23display%23Volume%29&_cdi=5842&_sort=d&_docanchor=&_view=c&_ct=23&_acct=C00050221&_version=1&_urlVersion=0&_userid=10&md5=e250621a34ff61030da0958bbe3641f1
Use of TIAM to assess different climate policies.
9. Labriet, M., R. Loulou, A. Kanudia. 2008. Is a 2 degrees Celsius warming achievable under high uncertainty? Analysis with the TIMES integrated assessment model. Cahier du GERAD, G-2008-30, 29 p.
<http://www.gerad.ca/fichiers/cahiers/G-2008-30.pdf> (adapted version published in Environmental Decision Making under Uncertainty, J.A. Filar and A.B. Haurie (eds), pp.51-77).
Stochastic analysis of climate policies with ETSAP-TIAM
10. Drouet L., Vielle M., Labriet M. and R. Loulou. 2008. A master program that will drive the coupling of GEMINI-E3 and MARKAL/TIMES models. Working paper.
<http://gemini-e3.epfl.ch/webdav/site/gemini-e3/shared/A%20master%20program%20that%20will%20drive%20the%20coupling%20of%20GEMINI-E3%20and%20MARKAL%20TIMES%20models>
Discussion on the coupling of techno-economic MARKAL/TIMES model to a computable general equilibrium GEMINI-E3 model.
11. Vaillancourt, K., Labriet, M., Loulou, R. and J-P. Waub. 2007. The Role of Nuclear Energy in Long-Term Climate Scenarios: An Analysis with the World-TIMES model. Cahier du GERAD, G-2007-29, 26 p.
<http://www.gerad.ca/fichiers/cahiers/G-2007-29.pdf> (also published in Energy Policy, Vol.36, Issue 7, pp.2296-2307)
Analysis of the future role of nuclear energy with the World TIMES model.
12. Syri S., Lehtilä A., Savolainen I. and T. Ekholm. 2007. Global energy and emissions scenarios for effective climate change mitigation - Modelling study with the ETSAP/TIAM model. VTT Technical Research Centre of Finland.
http://www.etsap.org/Applications/VTT_scenarioreport.pdf
13. International Energy Agency, Energy Technology Perspectives. Yearly publication.
<http://www.iea.org/techno/etp/index.asp>
Use of MARKAL for policy analysis based on a detailed representation of technology options.
14. Biberacher M. 2006. Fusion in the global energy system – GIS and TIMES
<http://www.etsap.org/Docs/Fusglob.pdf>
Example of linkage between TIMES and a Geographic Information System
15. Labriet M. 2005. Greenhouse Gas Abatement: Techno-Economic Modeling of Global Cooperative and Non-Cooperative Scenarios. PhD Thesis, UQAM, Canada.
Last chapter available at: <http://www.gerad.ca/fichiers/cahiers/G-2005-07.pdf>
Full thesis available upon request.
Example of linkage between the World integrated MARKAL and game theory in order to define globale climate policies.

Regional Models (<http://www.etsap.org/applicationRegional.asp>)

16. Pan European TIMES model used to assess renewable energy policies in EU27.
<http://www.res2020.eu/>
17. Pan European TIMES model (PEM) used within the New Energy Externalities Development for Sustainability (NEEDS) project. <http://www.needs-project.org/>
<http://www.etsap.org/Applications/NEEDS-TIMES-PEM-summary-MB.pdf>
18. Alfstad T. 2005. Development of a least cost energy supply model for the Southern African Development Community region. Thesis, University of Cape Town.
<http://www.etsap.org/Docs/ERC%20SADC%20energy%20supply%20model.pdf>
19. Mäkelä J. 2000. Development of an Energy System Model of the Nordic Electricity Production System. Thesis, Hlesinki University of Technology.
<http://www.etsap.org/Docs/Times-Nordic-DiplArbeit-Jussi-1.pdf>

National Models (<http://www.etsap.org/applicationNational.asp>)

20. System for the Analysis of Global Energy Markets (SAGE) used by the Energy Information Administration, US Dept of Energy, for the International Energy Outlook. <http://www.eia.doe.gov/oiaf/ieo/>
21. Strachan N., Kannan R., and S. Pye. 2007. Final report on DTI-DEFRA scenarios and sensitivities, using the UK MARKAL and MARKAL-MACRO energy system models. Prepared for the Dept of Trade and Industry (DTI) and the Dept of Environment, Food and Rural Affairs (DEFRA). Policy Studies Institute & UK Energy Research Centre http://www.ukerc.ac.uk/Downloads/PDF/U/UK_MARKAL_3rd_final_report_FINAL.pdf
22. Labriet, M, H. Cabal, Y. Lechón, G. Giannakidis, A. Kanudia, 2010. The implementation of the EU Renewable Directive in Spain. Strategies and challenges. Energy Policy, Vol. 38, Issue 5, pp.2272-2281. http://www.ciemat.es/recursos/doc/Areas_Actividad/Energia/ASE/2009/1458967980_191201011271.pdf
23. Simões S., Cleto J., Fortes P. And J. Seixas. Estimate of CO2 Marginal abatement costs for Portugal using the TIMES_PT model. <http://www.etsap.org/Applications/PortugalMAC.ppt>
24. Das A. and E. Ahlgren. 2007. Analysis of the impact of enhanced use of renewable and advanced fossil fuel technologies for power generation in Indonesia, Philippines and Vietnam and development of appropriate policies and institutional frameworks. Chalmers University of Technology, Sweden, 33 p. <http://www.etsap.org/Docs/Chalmers-EC-Asean-2007-summary.pdf>
25. Blesl M. 2006. The role of CHP and district heating in Europe (CASCADE-MINTS). http://www.etsap.org/Applications/Blesl_Seoul-role-of-CHP-DH.pdf
26. Chen W. 2005. The costs of mitigating carbon emissions in China: findings from China MARKAL-MACRO modeling. <http://www.etsap.org/Applications/cwyEPMarkalMacro.pdf>
27. Barreto L. 2001. Technological Learning in Energy Optimisation Models and Deployment of Emerging Technologies. PhD. Swiss Federal Institute of Technology. <http://www.etsap.org/Docs/BARRETO-thesis.pdf>

ETSAP Reports

27. *Final Report of Annex X (2005-2008): Global Energy Systems and Common Analyses*, <http://www.etsap.org/index.asp> (passim)
28. Final Report Annex VIII (2002-2005): Exploring Energy Technology Perspectives http://www.etsap.org/FinReport/ETSAP_Annex8_FinalReport_Rev5.pdf
29. Final Report Annex VII (1999-01): Contributing to the KYOTO Protocol <http://www.etsap.org/reports/annex7.pdf>