Advanced TIMES-VEDA Training course

1st Draft Program

Technical-economic modelling with the TIMES model generator: Intermediate and advanced levels

Date: Fall/Winter 2011, the exact dates need to be confirmed

Hosted by Suggestions are welcome

Venue: XXX

Contact XXX

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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/

Day 1 TIMES Intermediate

09.00	09.15	All participants	Presentation of the program and round table
09.15	10.00	Presentation	Overview of a simple multi-region TIMES model Overview of the RES and the reference scenario
10.00	10.45	Hands-on	Time slice and peak equations Interpolation settings
10.45	11.15	Presentation	Overview of TIMES parameters
11.15	11.30	Coffee break	
11.30	13.00	Hands-on	Building alternative scenarios: GHG caps and taxes, technology costs, etc.
13.00	14.00	Lunch	
14.00	15.00	Hands-on	Running mitigation cases with GHG permit trading
15.00	15.30	Presentation	Types of user constraints and examples
15.30	15.45	Coffee break	
15.45	16.45	Hands-on	Building a non-dynamic user constraint (absolute and share constraints)
16.45	17.00	Open questions	

Day 2 TIMES Intermediate-Advanced

09.00	09.15	Presentation	TIMES documentation, Users' Guide, Tutorial, Support Website.
09.15	10.15	Presentation Hands-on	Building a dynamic user constraint (i.e. growth/decay constraints)
10.15	11.15	Presentation Hands-on	Introduction to Sub-RES and transformation files Testing examples
10.15	10.45	Hands-on	Using the vintage feature
11.15	11.30	Coffee break	
11.30	13.00	Presentation Hands-on	Modelling complex processes 1
13.00	14.00	Lunch	
14.00	15.30	Presentation Hands-on	Theory on partial equilibrium variant (elastic demands) Running mitigation scenarios with price-elasticities for demands
15.30	15.45	Coffee break	
15.45	16.30	Hands-on	Lumpy investment function
16.30	17.00	Open questions	

Day 3 TIMES Stochastic

09.00	10.00	Presentation	Stochastic version of TIMES: principles and examples
10.00	11.30	Hands-on	Defining and implementing hedging strategies
11.30	12.00	Coffee break	
12.00	13.00	Hands-on	Running TIMES in stochastic mode and result analysis
13.00	14.00	Lunch	
14.00	15.30	Hands-on	How to model complex processes 2 (some of the processes described below)
15.30	15.45	Coffee break	
15.45	16.45	Hands-on	How to model complex processes 2 (some of the processes described below)…
16.45	17.00	Open questions	

Modelling complex processes 1:

- Dual fuel and dual demand technologies,
- Defining input/output EFF for multi-input/multi-output process such as dual input heat pump
- CHP

Modelling complex processes 2:

- Modelling storage processes: types, attributes, equations
- Refineries
- Carbon capture and sequestration,
- Building insulation,
- Electricity transmission lines and pipeline (corridor approach),

Alternate and Modified Objective functions
Climate module

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 notes[1]
   - 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=C000050221&_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. Waaub. 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 Reseaarch 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 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
23. 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
24. 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
25. Chen W. 2005. The costs of mitigating carbon emissions in China: findings from China MARKAL-MACRO modeling. http://www.etsap.org/Applications/cwyEPMarkalMacro.pdf
26. 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