PAUL SCHERRER INSTITUT

PSI

The open-source TIMES\MIRO App

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Webinar series on „Possibilities to achieve the 1.5oC Target under consideration of open energy system modelling", 20th May 2022

Open-source: a *must* or a *plus* criterion in research

Sustainable, secure and competitive energy supply (HORIZON-CL5-2022-D3-01)

Expected Outcome:

Projects are expected to contribute to all the following outcomes:

- …
- Provide regional, national and European public authorities and network operators, with an **open source tool** to allow them to better plan and optimise the development of renewable and low emission energy sources and the enhancement of infrastructure (including storage) to meet the future energy needs in a geographical area, while minimising the total investment and operation cost, hence satisfying the future final uses of energy (sometimes used as a feedstock) by consumers, at lowest cost and with better quality of service.

Innovationen für Energiewende: 7. Energieforschungsprogramm

… Die Bundesregierung wird die Vergleichbarkeit und Transparenz energiesystemanalytischer Modellierung durch eine wirksame **Open-Source-, Open-Data- und Open-Access** Strategie stärken, um die Überprüfbarkeit der daraus abgeleiteten Handlungsoptionen sicherzustellen. Um eine Transparenz der Modellierungsergebnisse auch langfristig zu gewährleisten, wird der Aufbau einer vernetzten, offenen und systematischen Dateninfrastruktur für systemanalytische Forschungsvorhaben unterstützt…

Research Program Energy-Economy-Society (EWG) Call 2021-2022 for Research Proposals

….

Criteria:

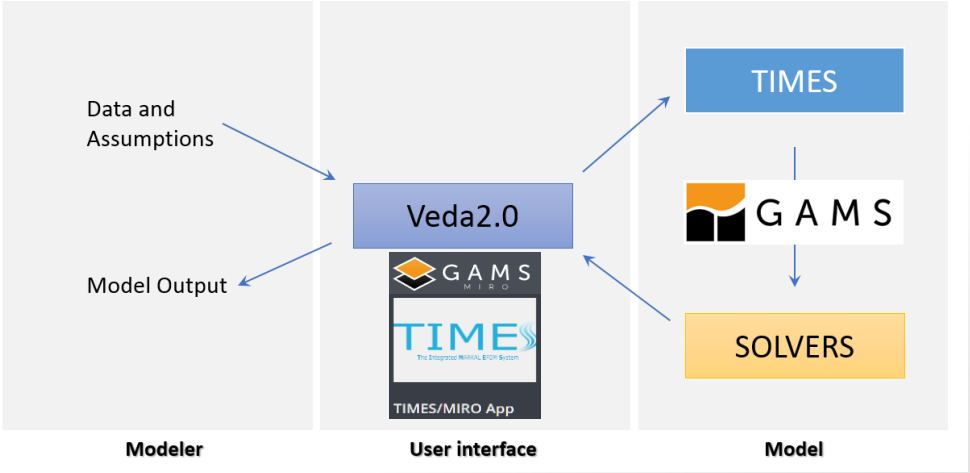
….

Knowledge transfer:

Are knowledge transfer and publications planned? Is an **open access / data / model strategy** included?

TIMES: an open-source energy systems modelling framework

- TIMES is a energy systems model generator developed by IEA-ETSAP
- It is used for 15 years in informing energy and climate policy analysis, in more than 50 countries
- TIMES is open-source – since 2019 it is also available in Github
- TIMES is data-intensive and needs an interface to efficiently handle input and output data
- An open-source interface would enhance the open-source character of the framework



https://iea-etsap.org

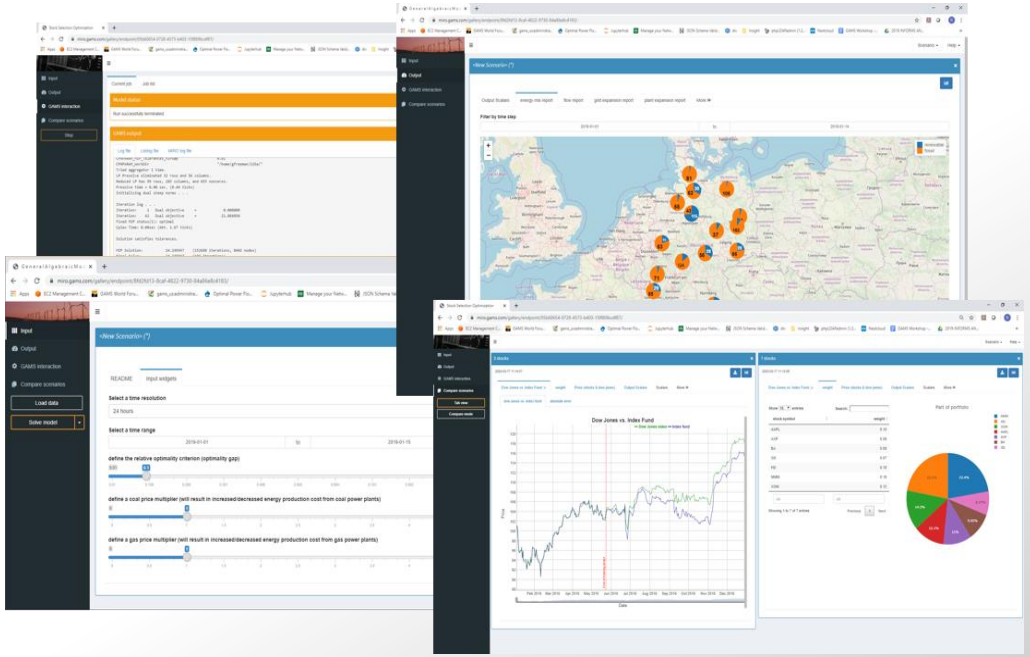
Design principles of the TIMES/Miro App

- Based on the GAMS MIRO framework
- Intuitive and user-friendly interface
- Easy to import data and TIMES models
- Powerful data exploration and edit
- Efficient interaction with GAMS models
- Support for solving models on the cloud
- Flexible visualizations of the results
- Turn models into interactive applications

Fiand, F., Panos, E., Blesl, M., Goldstein, G. (2022). A TIMES\MIRO App. Final report to ETSAP, https://iea-etsap.org/projects/ETSAP_TIMES_MIRO_App_Project_Report.pdf

What is the GAMS MIRO

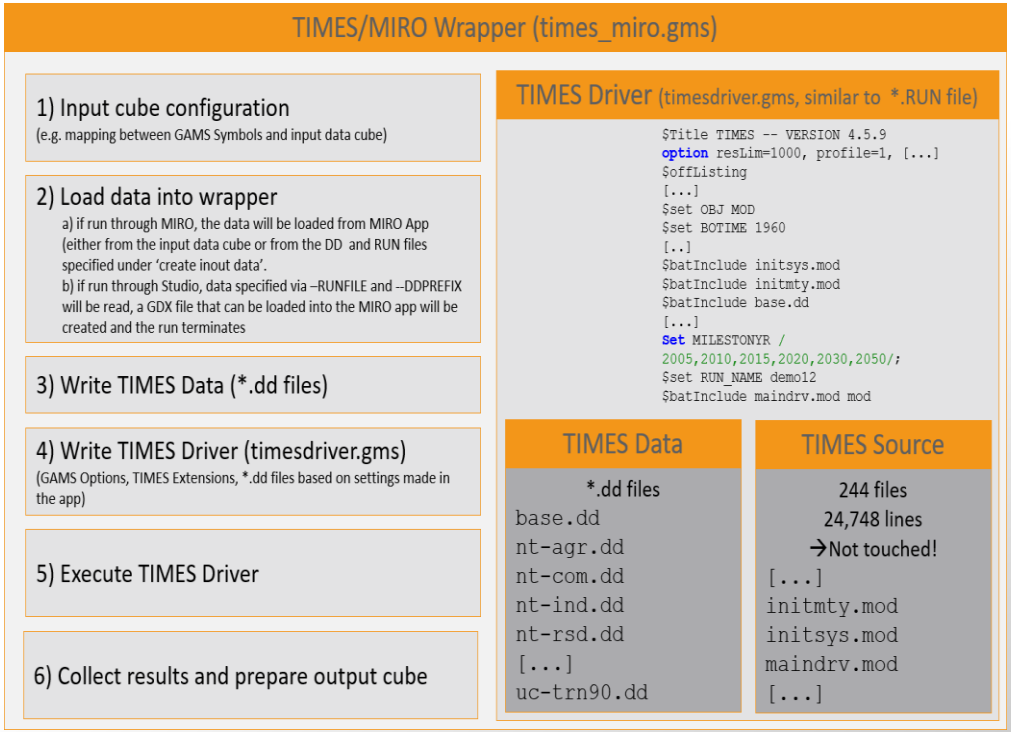
- Deployment, open-source, framework (Github) based on R/Shiny to turn GAMS models into interactive (web) applications
- Can expose selected model parameters and variables to an intuitive user interface
- GAMS MIRO applications are tailored to the end-user needs: input data widgets, maps, charts for visualisations, etc…
- A GAMS MIRO application is deployed in a single self-contained file
- Built-in data/results scenario database



Install GAMS MIRO for free: https://www.gams.com/miro/index.html

TIMES\MIRO App Implementation insights

- TIMES\MIRO App code (about 1000 lines) is based on GAMS and Python (Github)
- TIMES\MIRO App is a wrapper around the TIMES code that creates TIMES data and TIMES driver
- The wrapper code is fully customizable regarding the parameters and variables exposed to TIMES\MIRO App



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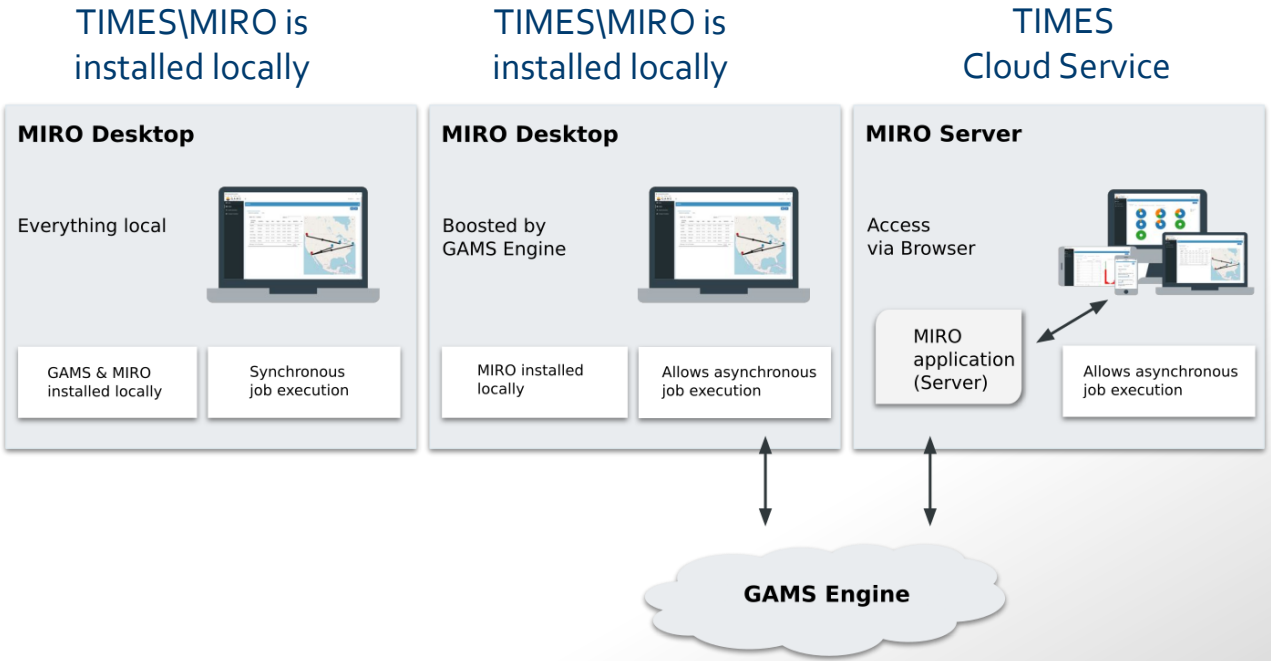
Ways to use the TIMES\MIRO App



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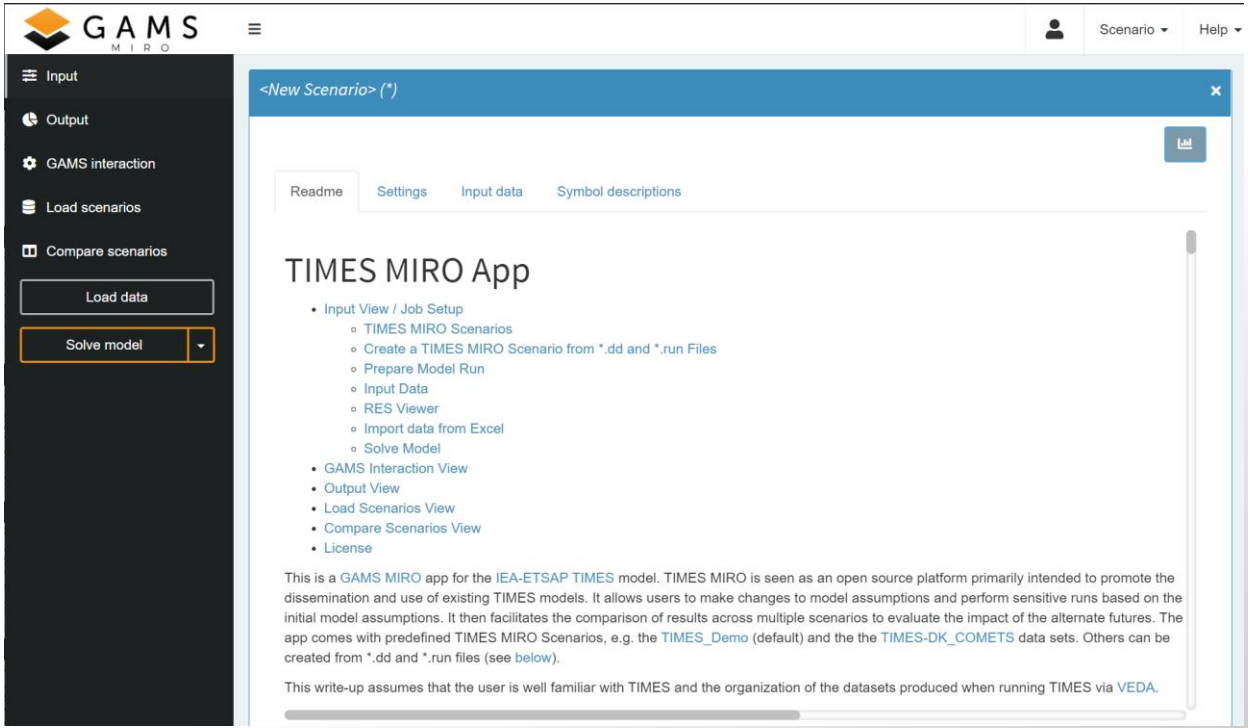
Intuitive interface

- Navigation bar with the basic modelling tasks
- Tabbed interface for data views and settings
- Tabs functionality depends on the selected modelling task



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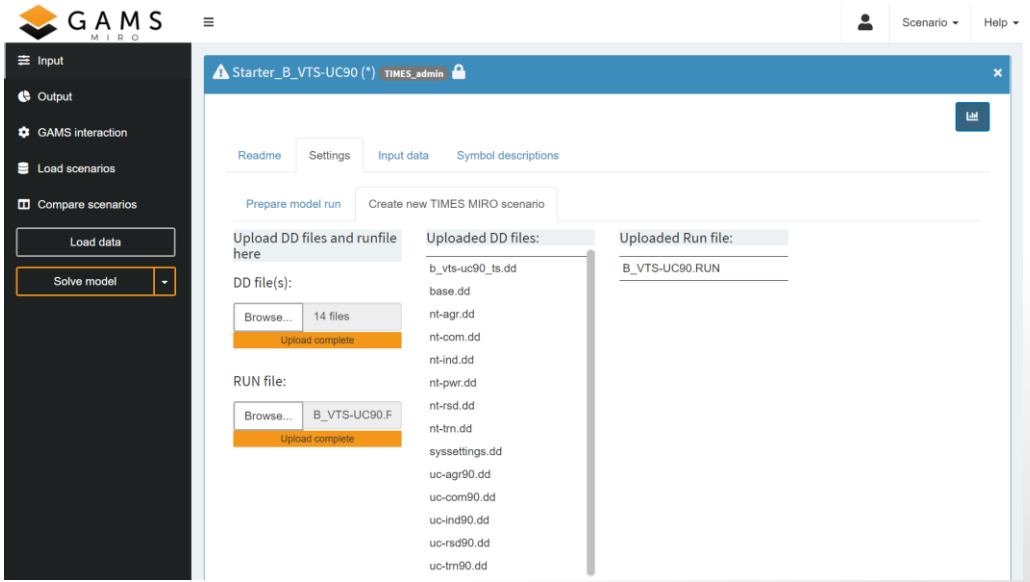
Easy to import data of an existing TIMES-based model

a) Via a set of .DD and .RUN files



b) Via an Excel file (flat structure)

siname	typ	dd	uc_n	all_reg	allyear	prc	com_grp	all_ts	lim	cur	uni	uni#1	uni#2	value
ACT_BND	Par	my_dd	-	Starter	2020	EEBIOGAS-CT-X0	-	ANNUAL	UP	-	-	-	-	0.5
ACT_BND	Par	my_dd	-	Starter	2020	EEBIOGAS-CT-X0	-	ANNUAL	LO	-	-	-	-	0.1

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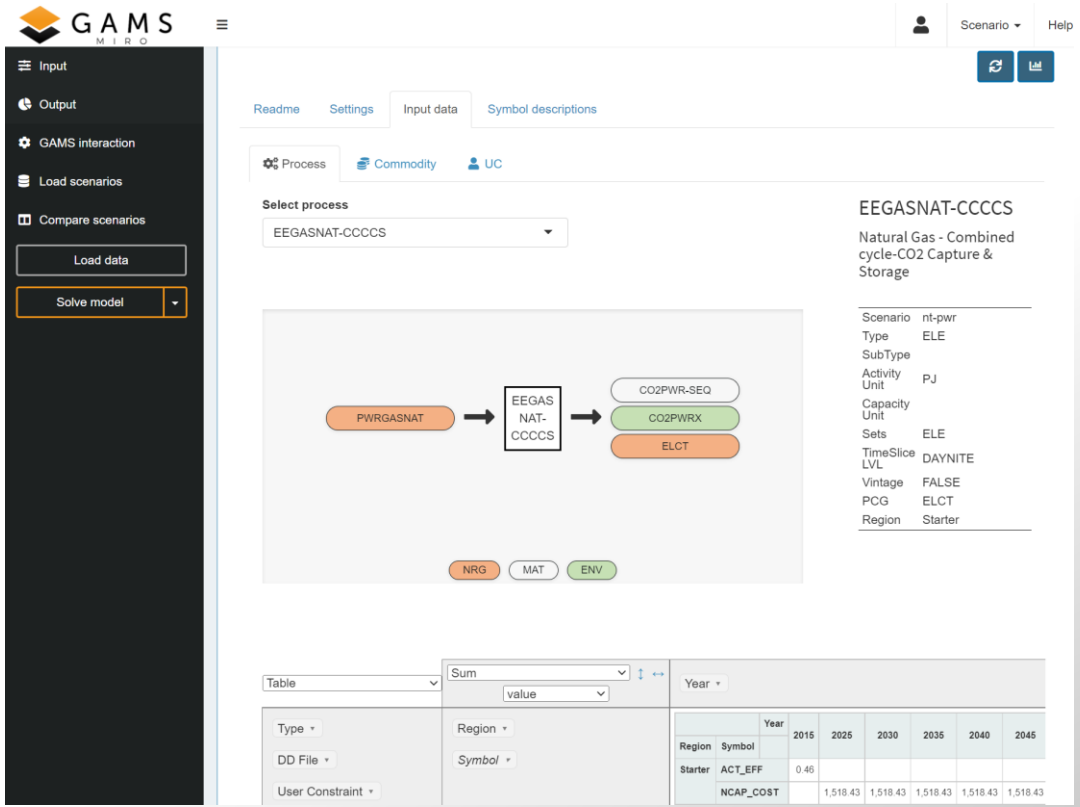
Explore the TIMES-based model structure and data edit

- Powerful reference energy system visualization
- Process-centric view shows for a chosen process input & output commodities and data related to the process
- Commodity-centric view shows for a chosen commodity the processes producing and consuming it, as well as data
- User constraint-centric view shows the definition of a user constraint



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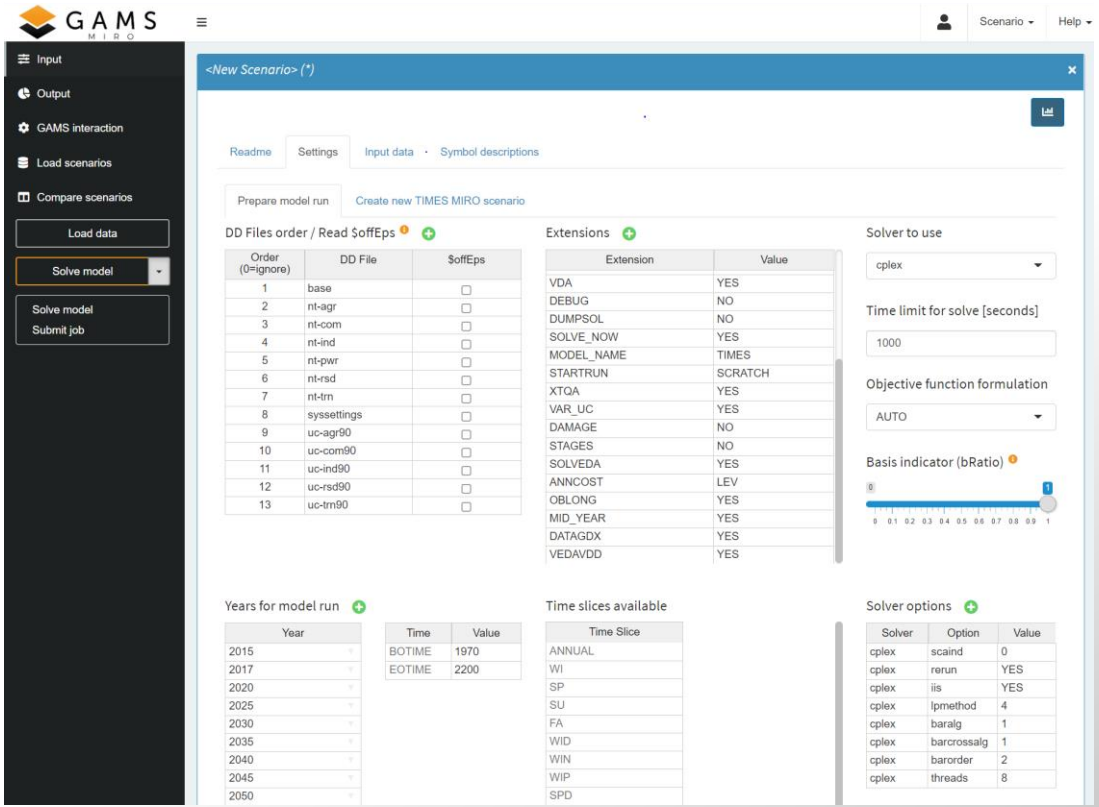
Flexible setup of a scenario and options for solving it

- Select the data/scenario files to be included in the model run
- Select TIMES model extensions
- Select the years for the model run
- Select solver and options
- Press solve



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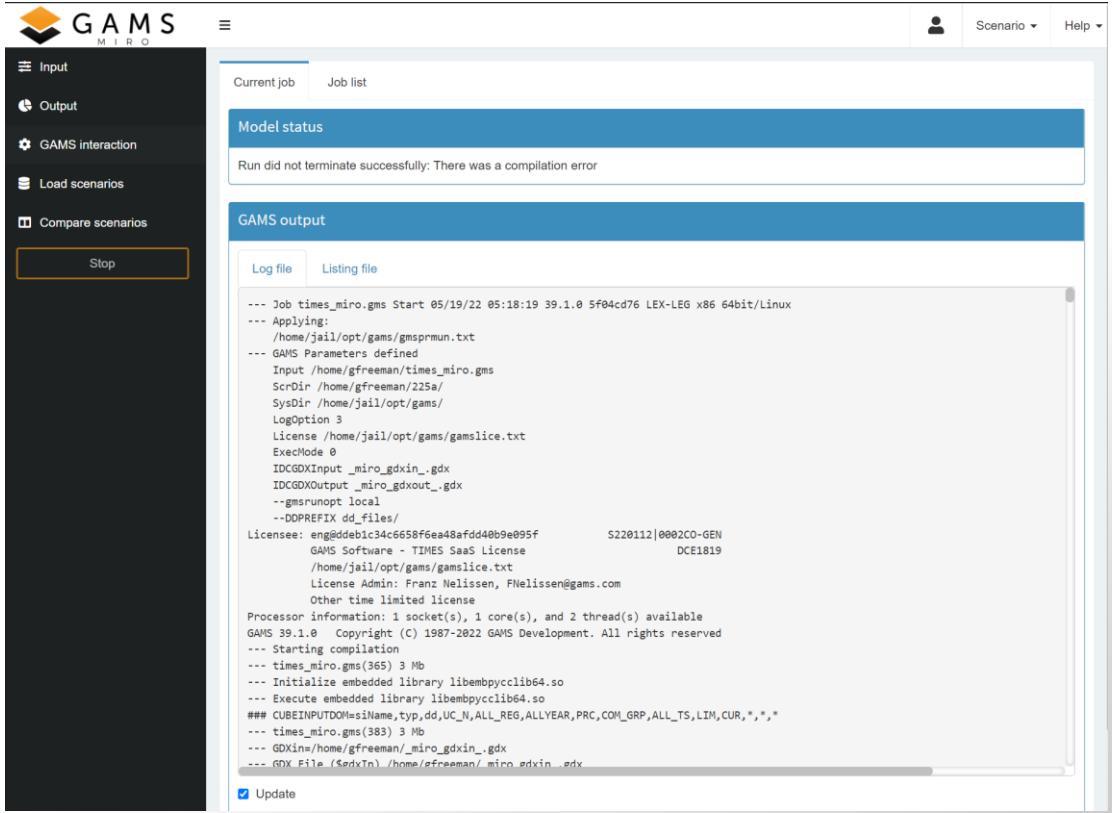
Efficient GAMS interaction

- From the desktop version of TIMES\MIRO App the user can solve locally or on the server
- The web version of the App solves on the TIMES cloud
- The GAMS execution can be synchronous or asynchronous
- Log and LST files available for each run with error reporting
- Solution results are loaded automatically into TIMES\MIRO App



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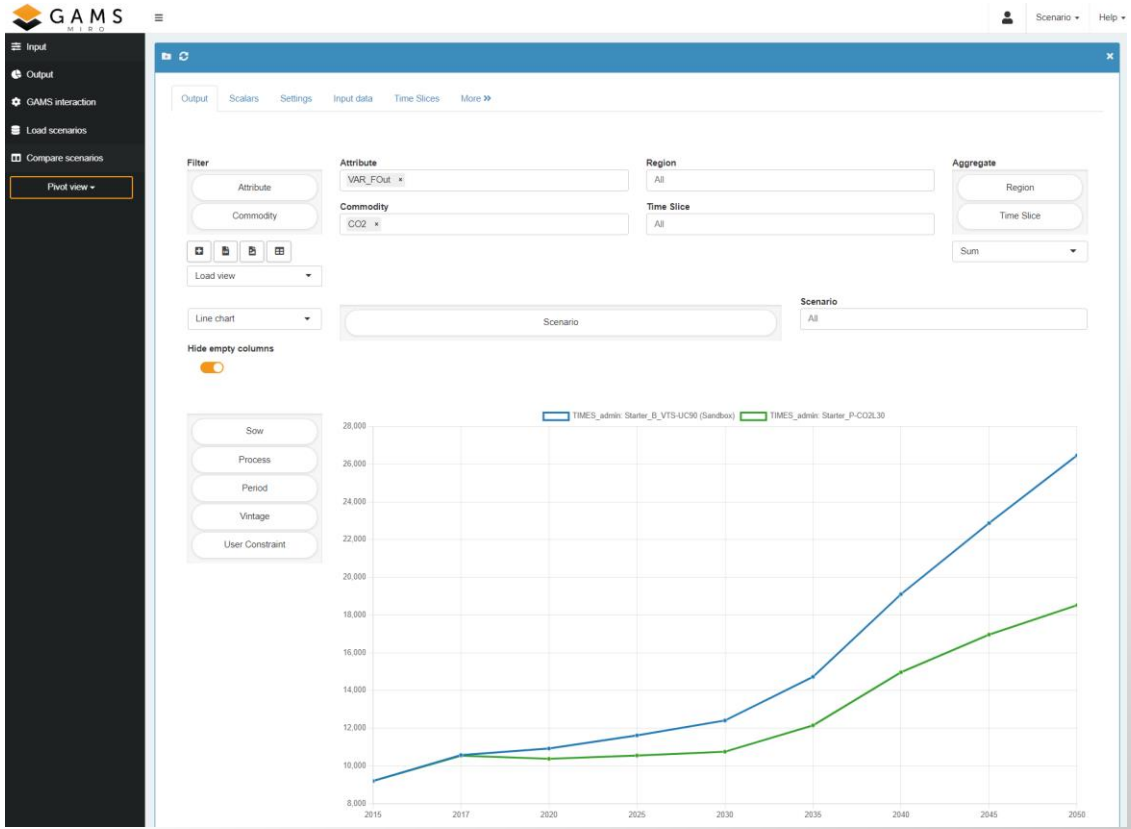
Flexible visualization of the results and scenario comparison

- Search and filtering mechanisms to find and load multiple scenarios for comparison
- Pivot view for slicing and dicing of multiple scenario results and their convenient comparison
- Result views can be saved and reused when results are updated
- Scenario results can be exported as a CSV file for further processing



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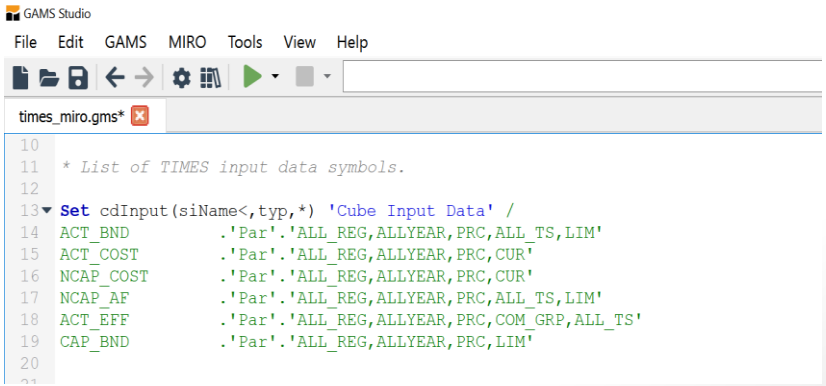
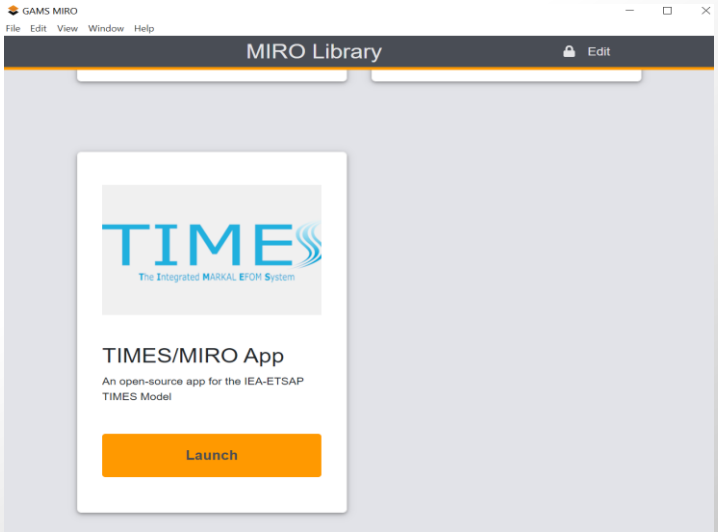
Turns models into tailor-made interactive applications

- The wrapper ***times_miro.gms*** has a set ***cdInput*** defining model parameters exposed to TIMES\MIRO
- TIMES modellers can edit the set to include some of the TIMES parameters, or even expose parameters to end-users with a different and user-friendly name
- The modified TIMES\MIRO App can be recompiled in GAMS Studio and re-deployed



- TIMES\MIRO App is deployed using a single-self-contained file, with a logo and description
- It can be launched locally via the GAMS MIRO software or on the web via the browser



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Conclusions

The open-source TIMES\MIRO App:

- is a lightweight, flexible and powerful interface for TIMES-based models
- extremely smooth learning curve in using it
- based on the innovative open-source GAMS MIRO engine
- can be installed locally or on a MIRO server (TIMES cloud)
- a free GAMS demo license is sufficient to use the App locally and solve on TIMES Cloud servers

The open-source TIMES\MIRO App can be used to:

- provide an alternative interface for experienced users to interact with large and complex TIMES models
- develop tailor-made interactive applications of TIMES models for stakeholders and end-users
- encapsulate model complexity and hide it from the new and inexperienced users in TIMES
  - can be used for example to develop customized interfaces of TIMES suitable for training purposes
- act as an entry point for institutes and companies in the TIMES modelling at a zero- or low-cost

Try TIMES\MIRO: https://miro.gams.com **Install TIMES\MIRO:** https://github.com/GAMS-dev/TIMES_MIRO

Mein Dank geht an

- Fred Fiand (GAMS)
- Markus Blesl (IER)
- Gary Goldstein (DWI)