Accounting for changes in investment flows in a soft-linked hybrid model

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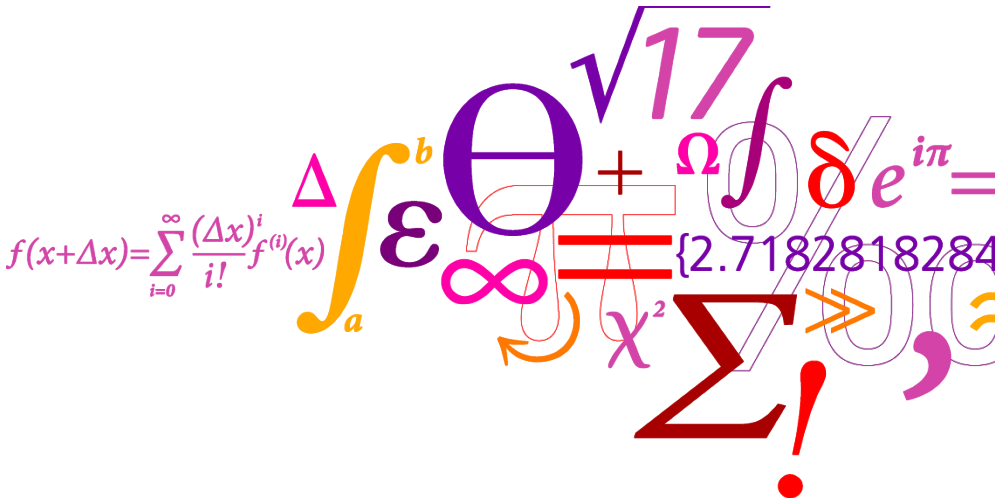


DTU Management Engineering
Department of Management Engineering

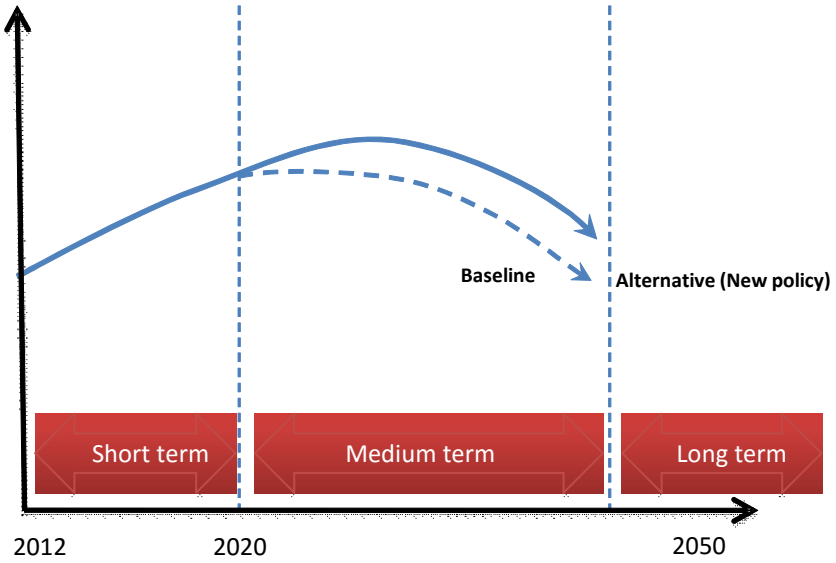
TIMES-DK and IntERACT developers

Agenda

- What is IntERACT
- Modelling approach
- Model setup and Linking approach
- Cockpit
- Summary

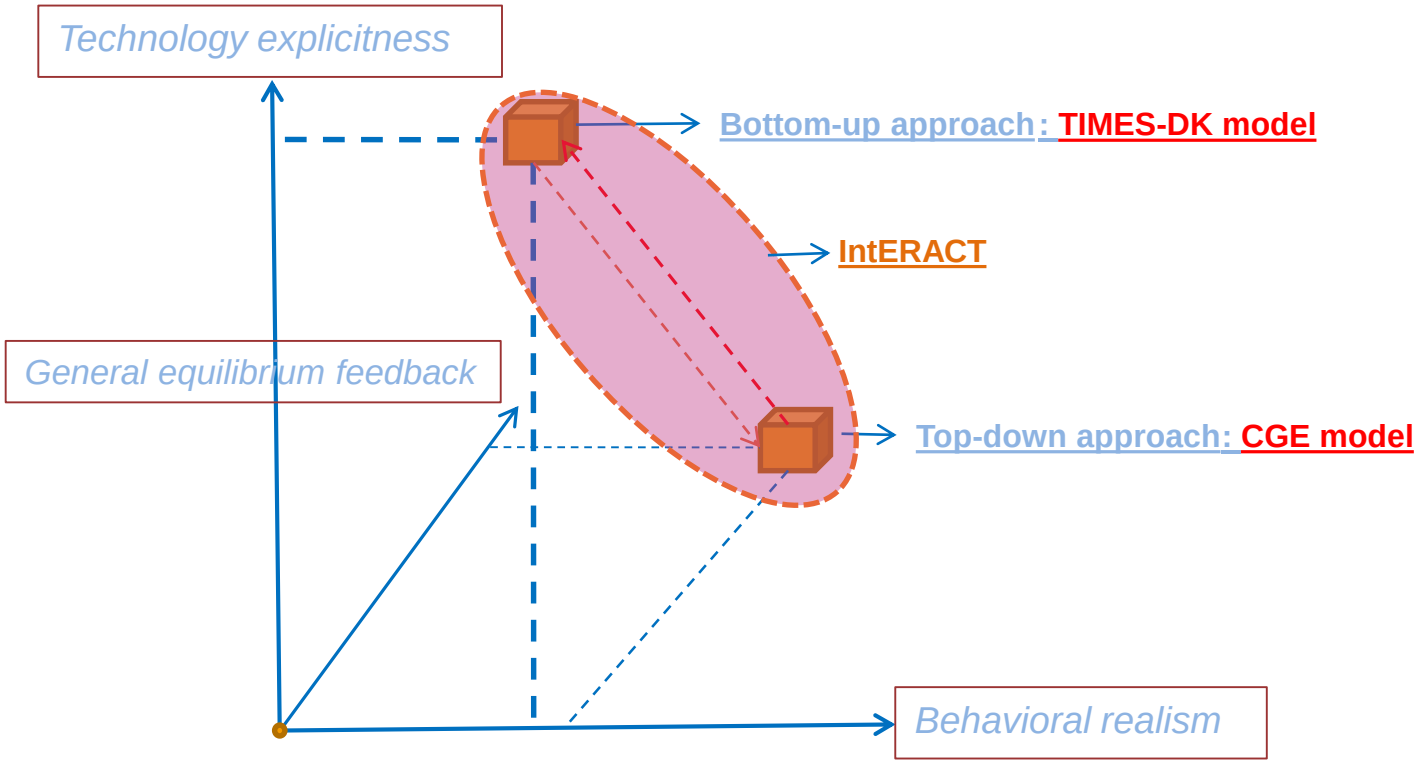
What is IntERACT?

- Purpose-built hybrid model for identifying cost efficient policies to further the Danish transition to a low carbon emission economy by 2050



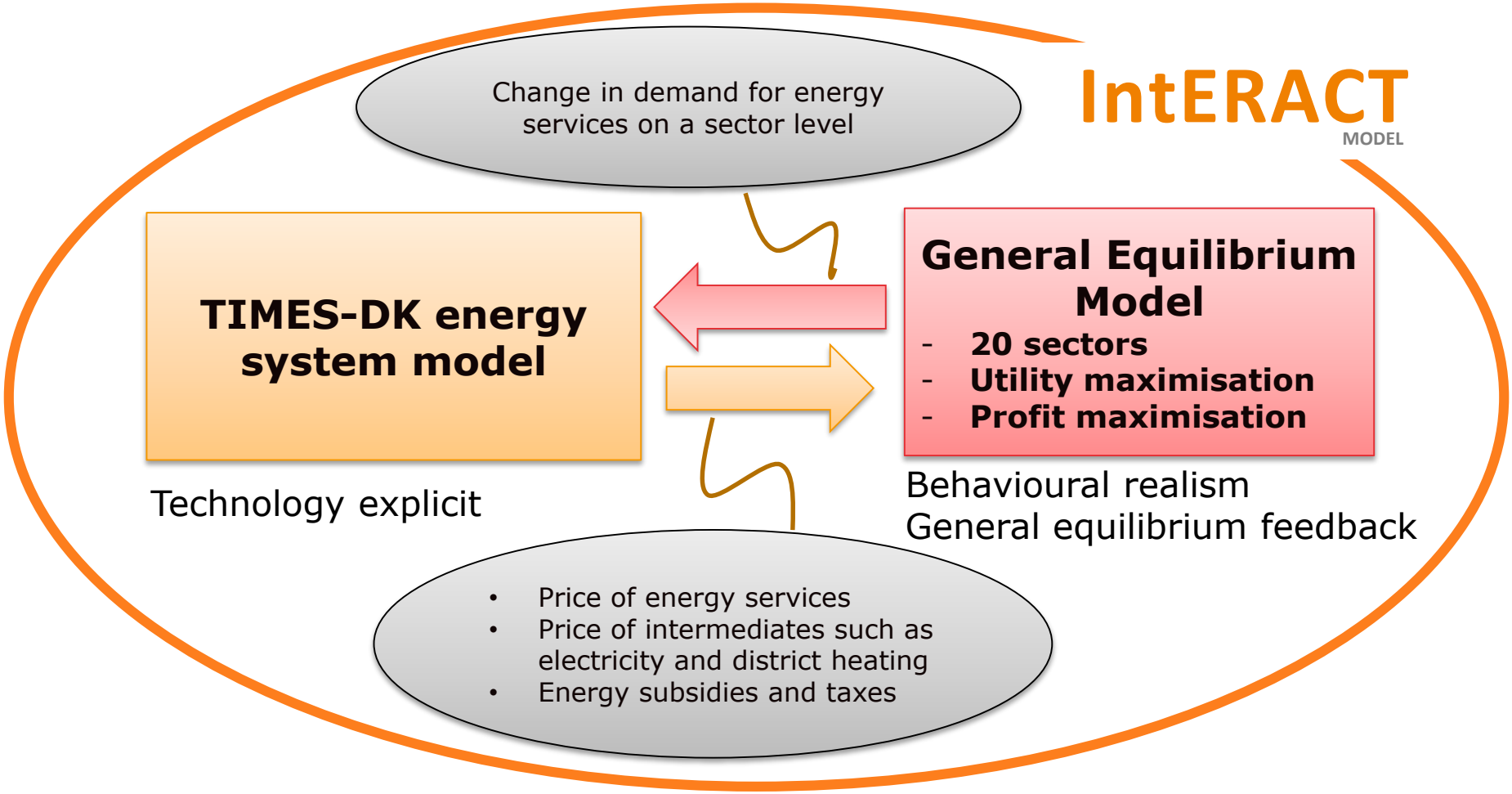
www.ens.dk/interact

IntERACT: Hybrid model capturing the Danish economy and energy system



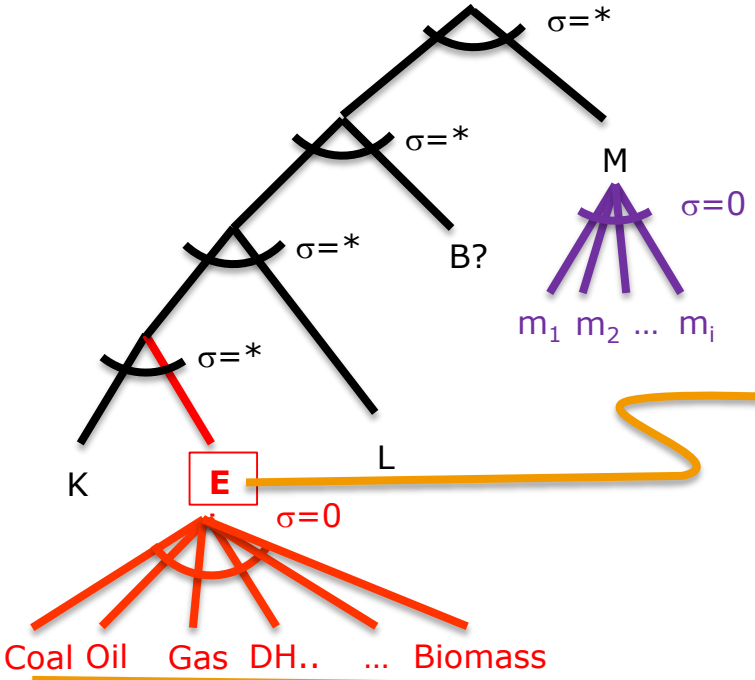
Note: Adapted from Jaccard (2009)

Model setup

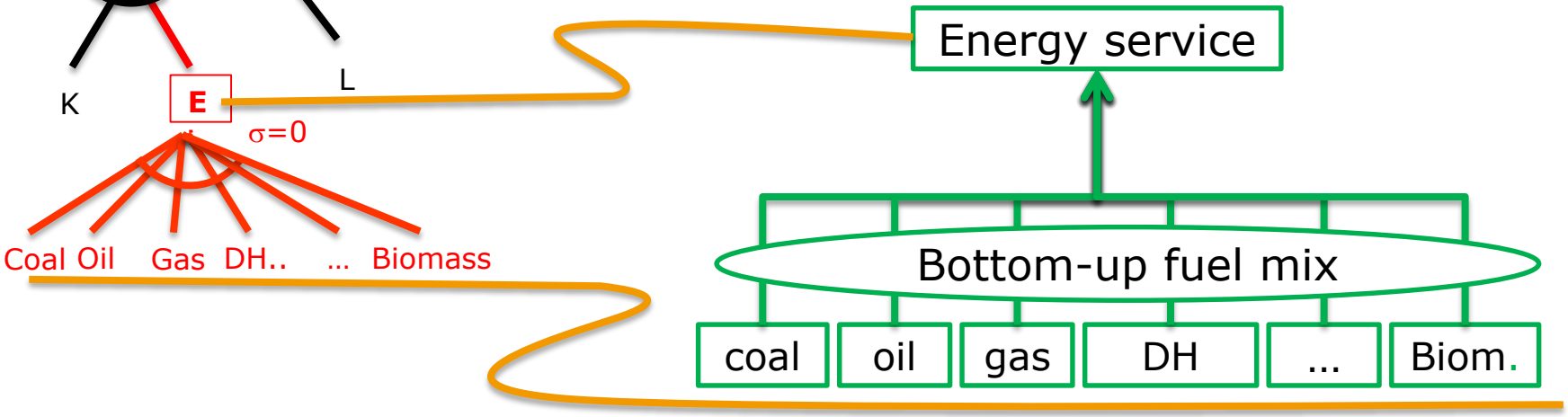

Change in demand for energy services on a sector level
IntERACT MODEL
TIMES-DK energy system model
General Equilibrium Model
- 20 sectors
- Utility maximisation
- Profit maximisation
Technology explicit
Behavioural realism
General equilibrium feedback
• Price of energy services
• Price of intermediates such as electricity and district heating
• Energy subsidies and taxes

Energy service as a crux for linking

- The assumption is that firms and households make economic decision based on the (relative) prices of energy services.
- TIMES-DK determines the price of energy services and fuel mix (technology decisions happens in TIMES-DK).



- This is implemented in the CGE using **price-wedge** and as **Leontief-shares**.
- Agents maximise profit and utility using the costs of the energy service (relative prices as usual).



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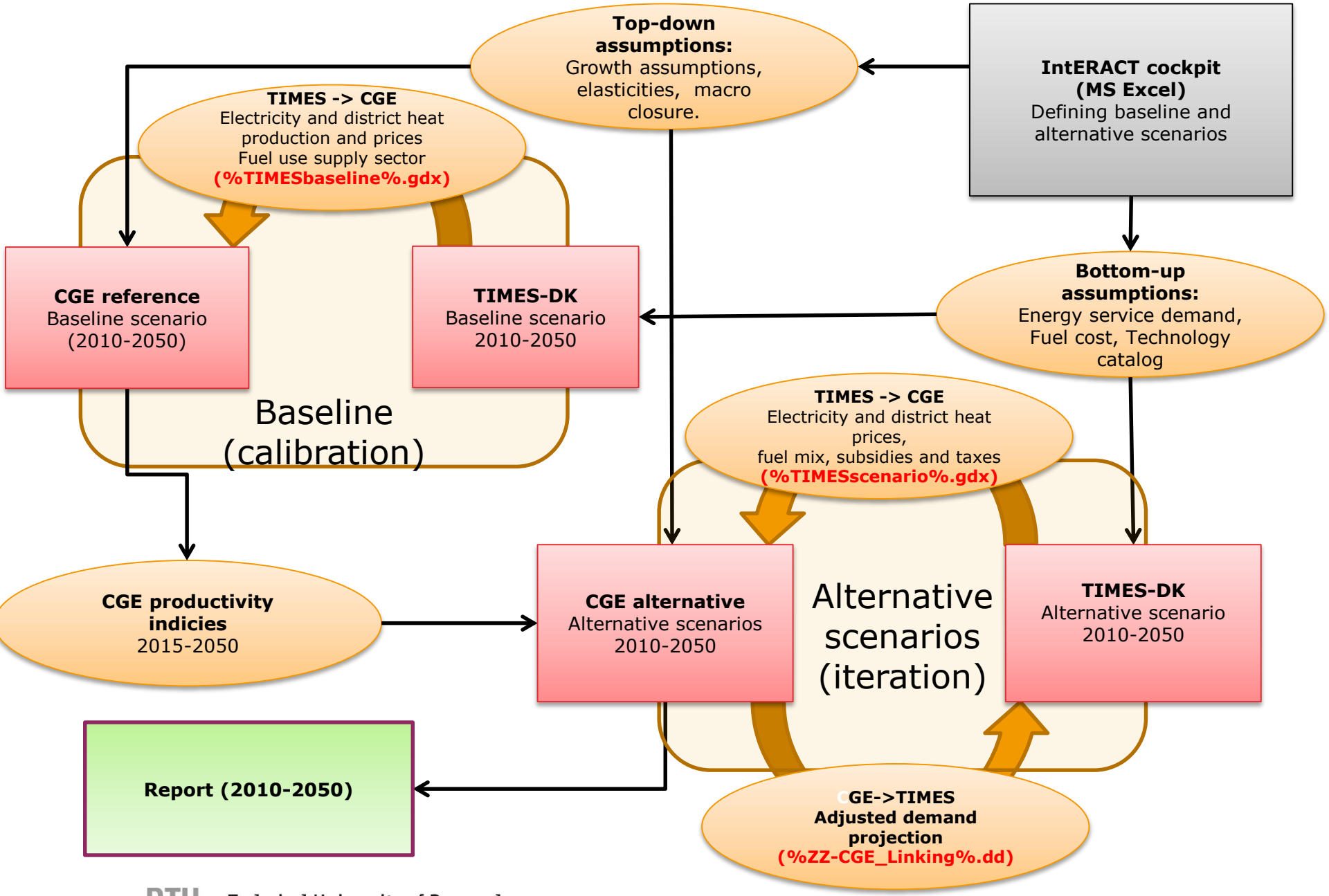
* Elasticities haven been estimated in the spring of 2015, find more info at: www.ens.dk/interact

Accounting investment flows

- This soft-linking approach transfer energy (service) prices and fuel uses from TIMES to the CGE-model.
- Using the properties of the standard zero profit condition in the CGE-model the change in investment flow (capital demand) is calculated residually based on the change in energy service price and the change in fuel input.
- This suggest one possible approach for taking investment flows from bottom-up models into account.
- This approach is implicitly based on the assumption that only capital input and fuels input changes between different TIMES-DK scenarios.
- However if other inputs (labour and materials) also changes significantly between the scenarios then the calculated change in investment flow (capital demand) may suffer from a bias of some order of magnitude.



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Model setup

Baseline scenario

- Common data (e.g. Economic projection from Danish Ministry of Finance)
- The CGE model is calibrated using
  - Economic projection from the Danish Ministry of Finance and Information, and
  - TIMES-DK stand alone optimisation to set up some prices and fuel mix.
- CGE productivity indices are calculated so that the CGE-model match the Energy system in the TIMES-DK baseline.

Alternative scenarios

- Models are soft-linked and solved in an interative process (5 ys steps up to 2050)
- The main tests have been done for power sector only model (3-5 iterations to solve the combined models).

IntERACT: Cockpit

The model is run in its own MS Excel user-interface

Scenario choice

IntERACT scenario name	TIMES scenario name	Description	Iterations	Baseline	Sensitivity CGE					
					Armington elasticites	Armington elasticites fuels	Production nest elasticities	Consumer nest elasticities	Public balance closure	Payment balance closure
Baseline	DORS_Baseline	Baseline with ETS	5	Yes	Central	Central	Central	Central		alance
Alternative	DORS_Alternative	Alternative with ETS eq zero from 2025	5	No	Central	Central	Central	Central		alance
					Central	Central	Central	Central		alance
					Central	Central	Central	Central		alance
					Central	Central	Central	Central	Lumpsum	Balance
					Central	Central	Central	Central	Lumpsum	Balance
					Central	Central	Central	Central	Lumpsum	Balance
					Central	Central	Central	Central	Lumpsum	Balance

IncomeTax
EnergyTax
ImbalanceTax
Lumpsum

These buttons are for testing and debugging:

Write 00SetGlobal.inc | Write VTRUNarg.cmd | Export to GDX

Select IntERACT scenario to run

Baseline

Run IntERACT

Dataset	IntERACT6
Numeraire	pfx
Modelname	IntERACT
VEDA base path	c:\VEDA\VEDA_FE
VEDA work directory	\GAMS_WrkTIMES_DK
VEDA source directory	\Gams_srcTIMESv361
GAMS path	c:\GAMS\24.1\
CGE path	C:\IntERACT-git\IntERACT\
TIMES GDX path	c:\VEDA\VEDA_FE\GAMS_WrkTIMES_DK
TIMES source path	c:\VEDA\VEDA_FE\Gams_srcTIMESv361
This spreadsheet	C:\IntERACT-git\IntERACT\Cockpit\[Cockpit-IntERACT_.xlsm]Cockpit
IntERACT Scenario name	Baseline
TIMES Scenario name	DORS_Baseline
Calibrate baseline	1

Note: Empty means default path

Summary

- IntERACT model developed a generic and rather efficient methodology for linking a TIMES-model to CGE-model
- This methodology offers a way of taking the macro economic impact of changes in investment flow from TIMES model into account
- Currently the automated iterative linking is functioning for power sector; exchanging information related to prices, production and demand for electricity and district heat.
- Work is currently underway testing the iterative linking and expanding it to the other parts of the energy system.

Thank you for your attention

For more information, feed-back or question please contact:

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