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Explore sustainable European futures

UNIVERSITY OF COPENHAGEN

Expert consultation on transboundary effects of EU decarbonization pathways

Wusheng Yu
Francesco Clora

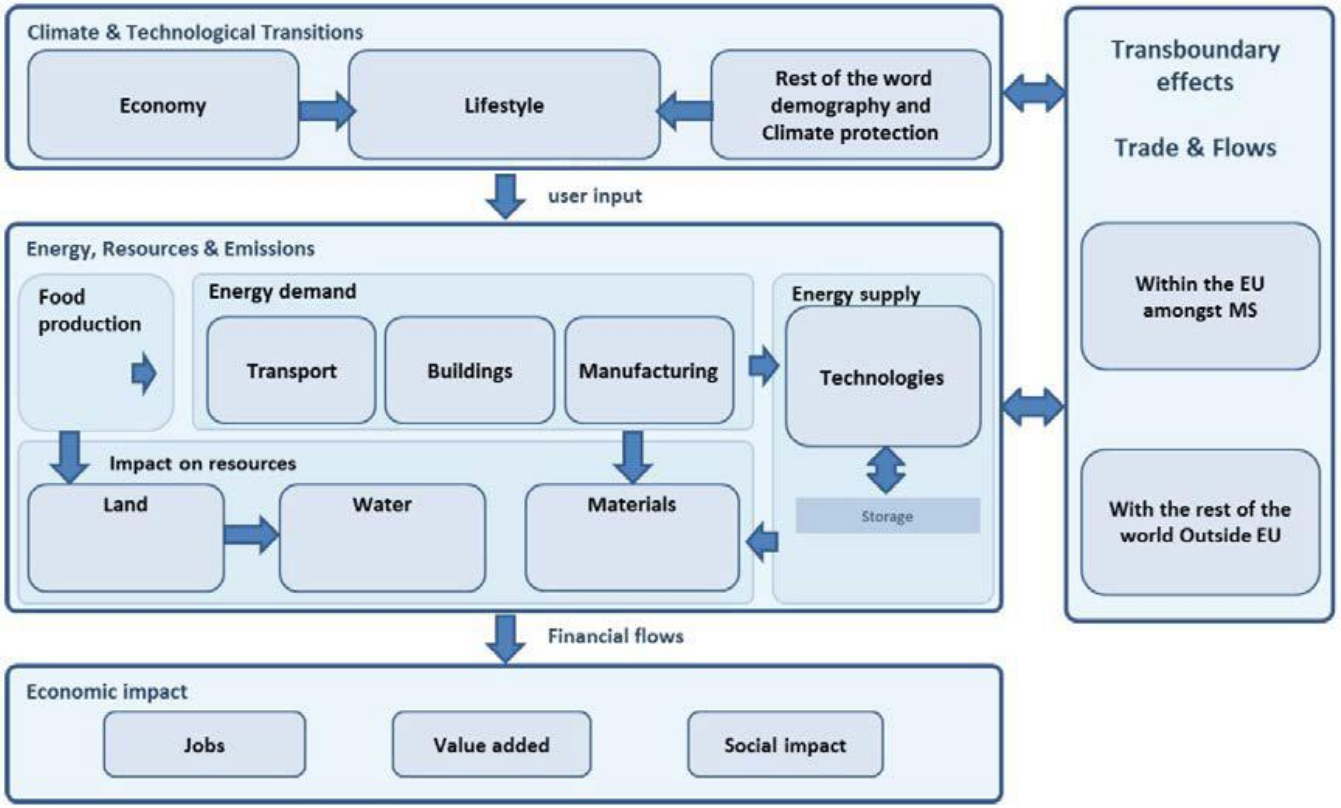
EUCALC

Agenda

- Introducing WP7 on transboundary effects
  - Modelling approach
    - Model
    - Baseline
  - GTAP-EUCalc interaction
    - Conceptual framework
    - Practical implementation
    - Pre-simulated scenarios
- Questions for discussion at the workshop
  - Baseline and model development
  - Scenario design and implementation
  - Results exploitation

WP7 transboundary effects in the EUCalc

Symbiotic relationship between the "core" modules and the transboundary effects module



Modelling Approach

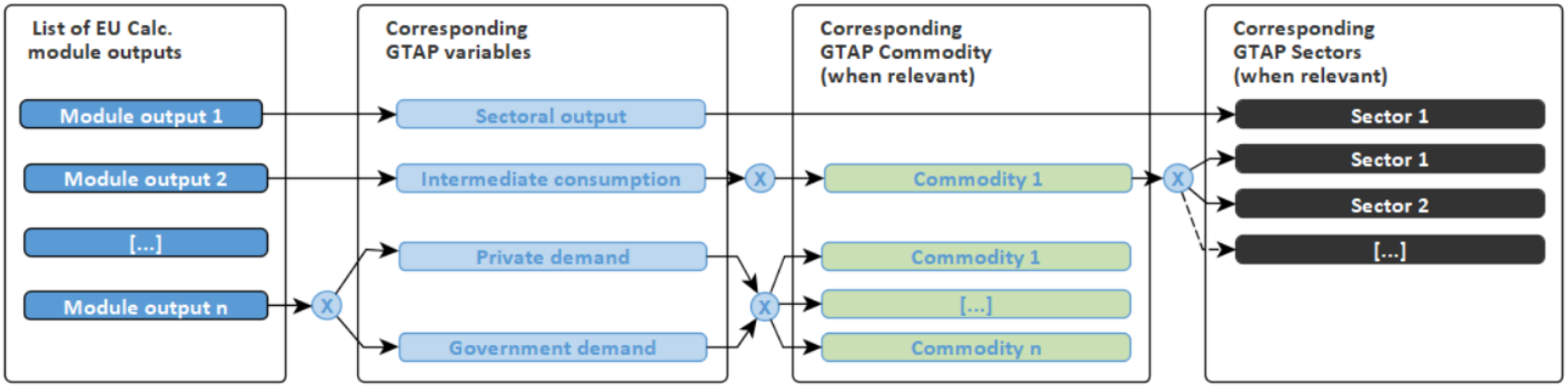
- EU de-carbonization pathways imply changes in energy demand/supply/technologies from a future BaU base case
  - alter economic structures of individual MSs & trade linkages among them and between them and the R.O.W.
- Modelling intra-EU & EU-ROW trade effects requires economic models with inter-sectoral & international linkages
  - GTAP, a global CGE model/database well suited for this purpose
  - We adopt its energy-climate focused version (GTAP-E) as the starting point of our modelling exercises
- The basic approach
  - Establish a baseline scenario of world economy (incl. all EU MSs)
  - Use inputs from EUCalc 'core' modules to formulate alternative EU de-carbonization pathways as CGE model scenarios
  - Impose alternative scenarios onto the CGE model to simulate trade effects, to be included in EUCalc pathway explorer

Baseline construction

- A baseline data set towards 2050
  - **GDP**: EU Reference Scenario 2016 (European Commission et al., 2016) and OECD-SSP2 (Dellink et al., 2017);
  - **Population**: EUROSTAT, EU 2015 Ageing Report and SSP2 projections for IIASA (Kc and Lutz, 2017);
  - **Labor force**: EUROSTAT, EconMap2.4 (Fouré and Fontagné, 2016) and EU 2015 Ageing Report
  - **Capital stock**: EconMap2.4 (Fouré and Fontagné, 2016);
  - **Total factor productivity** (TFP): EconMap2.4 (Fouré and Fontagné, 2016) and EU 2015 Ageing Report
- Issues with implementing the baseline in the model
  - Sectoral productivity differentials
  - Trade policy and trade costs trends
  - Trade elasticities, trade-income relationship
  - Treatment of land and natural resource supply

GTAP-EUCalc Interaction Conceptual Framework

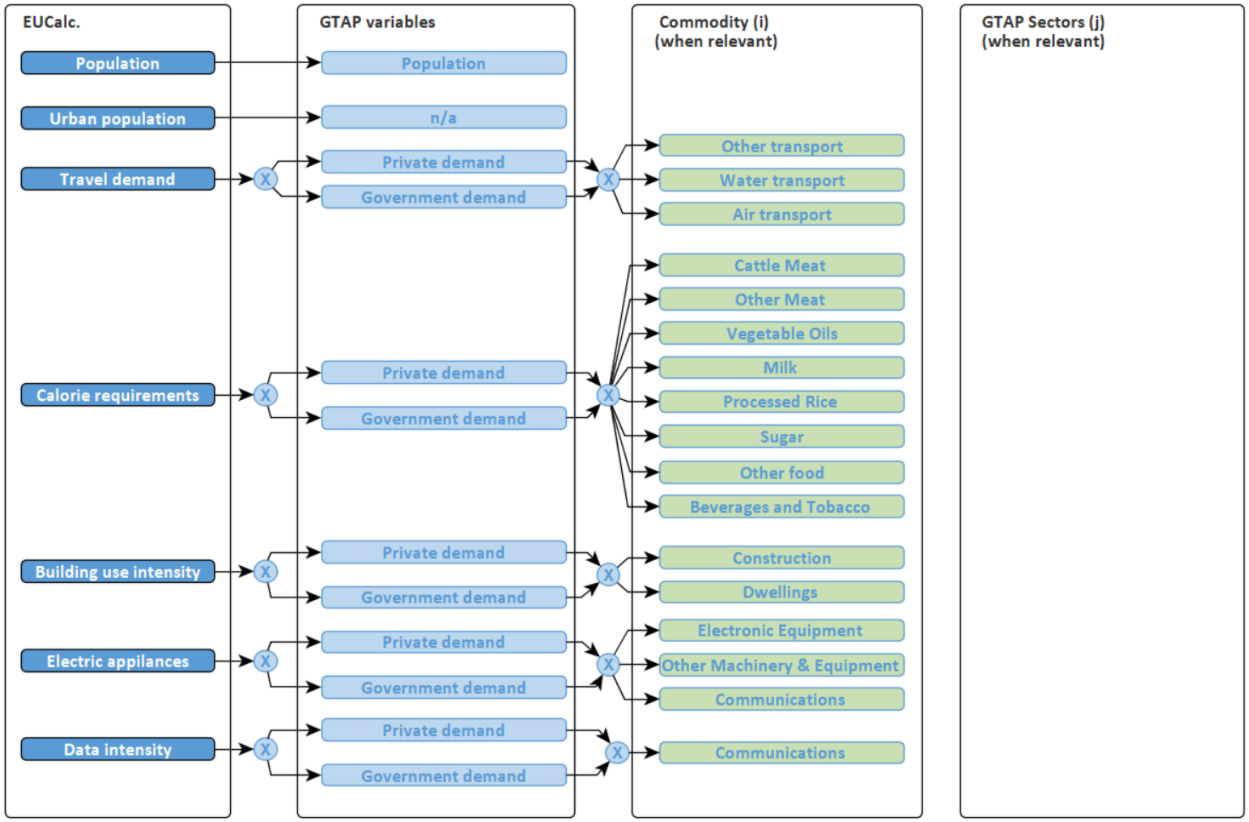
- Develop "connection points" between core modules of EUCalc and GTAP
  - **EUCalc core modules**: bottom-up, engineering model
  - **GTAP**: top-down, economic model
- Conceptual linkages developed in Deliverable 7.2



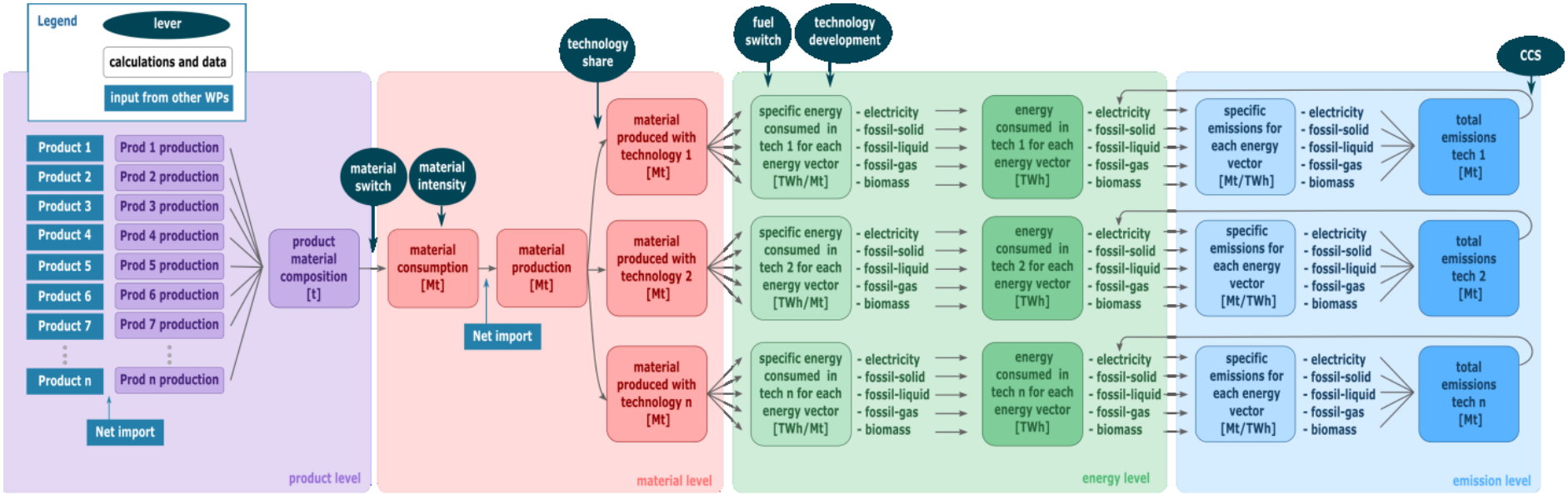
Projected transformations in sectoral productivities due to decarbonization measures will be implemented in GTAP as technological changes

GTAP-EUCalc Interaction "Lifestyle" module (WP1)

WP1 projects potential scenarios on the demand side of the EUCalc model



GTAP-EUCalc Implementation "Manufacturing" module (WP3)



Calculation tree in the "manufacturing" module

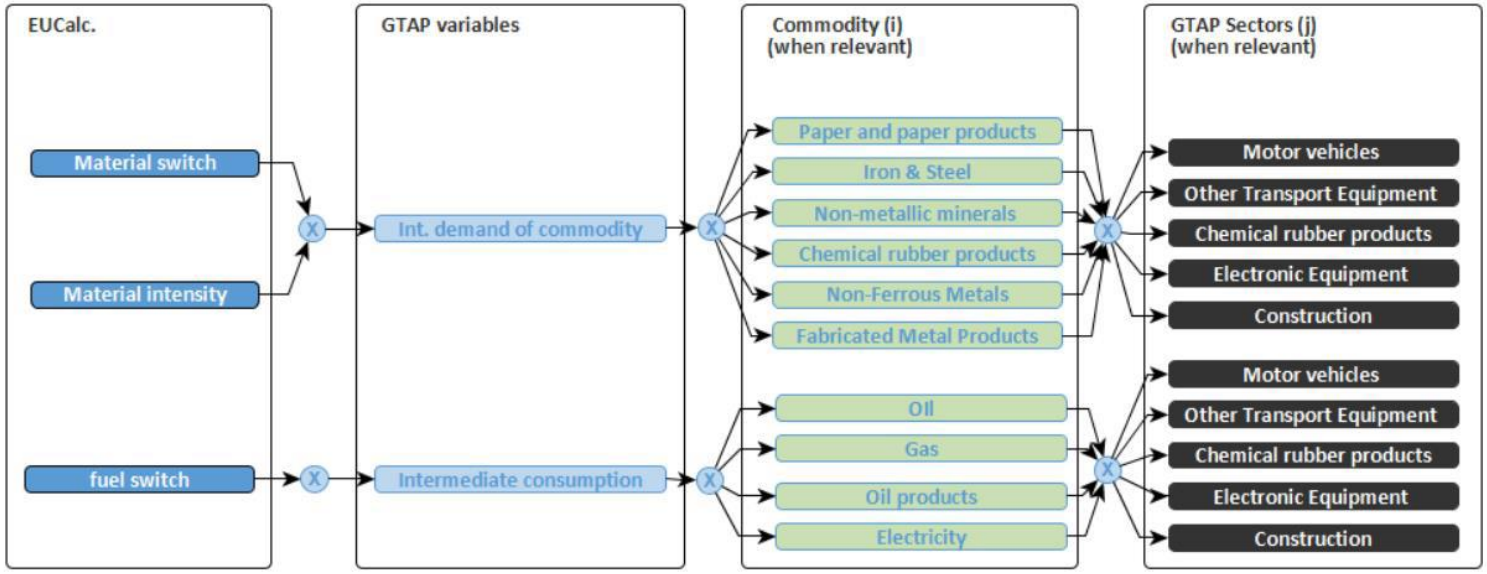
GTAP-EUCalc Implementation "Material switch" lever (WP3)

The lever allows the EUCalc user to change the "percentage of material in a product that is expected to be substituted by 2050 by a less carbon-intensive material"

Name/Unit	1	2	3	4
Substitution of **steel** by **chemicals** (carbon fibers) in **cars** [%]	5	10	15	20
Substitution of **steel** by **chemicals** (carbon fibers) in **trucks** [%]	2	5	10	15
Substitution of **steel** by **aluminium** in **cars** [%]	10	25	40	60
Substitution of **steel** by **aluminium** in **trucks** [%]	5	15	30	50
Substitution of **steel** by **timber** in **buildings** [%]	2	5	10	20
Substitution of **concrete** by **timber** in buildings [%]	10	20	40	60
Substitution of **chemicals** by **paper** (cellulose) in **renovated surface** [%]	2	5	10	20
Substitution of **chemicals** by **natural fibers** in **renovated surface** [%]	10	20	30	40

GTAP-EUCalc Implementation "Manufacturing" module (WP3)

Together with the other sectoral outputs, levers are "translated" in GTAP variables to be exogenously shocked



Two main questions arising on:

- Sensible vs "solvable" sectoral disaggregation
- User-driven vs price-driven changes in quantities

GTAP-EUCalc Implementation "Material switch" lever (WP3)

- The changes to the economic system due to "material switch" can be implemented in GTAP via changes in intermediate consumption

- In GTAP, such changes can be driven by:
- **Tax instrument**
  - Tax on the use of intermediate consumption
  - Tax on sectoral emission intensities
- **or Cost-neutral quantity changes** ("twist" parameter approach)

- Issues with different sectoral classifications:
- e.g. substitution of *steel* by chemicals (*carbon fibers*) in cars [%]
  - *Steel* is part of the *iron & steel* sector in GTAP
  - *Carbon fibers* are part of the *chemical & rubber products* in GTAP
- Some "scaling" of the size of the switches has to be conducted

Representative EUCalc Scenarios

- User-defined scenarios are ***virtually unlimited*** due to the presence of the many levers across sectors
  - Formulating model scenarios in itself not a trivial task
  - and we cannot simulate all of them in the CGE model!!!
- Calculations within the EUCalc core modules will be done in "real-time"
  - Simulations in CGE models: numerical solutions cannot be obtained in "real-time"
  - Successful model solutions cannot be guaranteed a priori
- Therefore, pre-computing of the most important and relevant representative scenarios is needed
  - Results from these scenarios to be included in the EUCalc Pathway Explorer

Representative EUCalc Scenarios

- We could potentially simulate three sets of scenarios to create an "envelope" for a wider set of scenarios:
  - Identical ambition levels in all sectors and countries;
  - Different ambitions across sectors, with sectoral ambition levels being kept the same across EU MSs
  - Individual deviations by MSs from EU-wide ambition, i.e. each EU MS is assumed to deviate its level settings (uniform across sectors) from the 'core' scenarios
- Are the above scenarios the most important, representative, and relevant scenarios? Are there other important ones to consider?

What results to present in EUCalc Pathway Explorer?

- Results from GTAP
  - changes in bilateral import and export flows for each/every country (region) pairs and each/every product, % from the baseline
  - Very large matrix, difficult to present/display

- Deriving key indicators from the raw results?!
  - Overall trade balance/self sufficiency ratio
  - Trade balance/self sufficiency ratio by products or for key products only
  - Overall trade dependency/exposure indices
  - Distinguish between intra- and extra-EU trade flows