Forthcoming contributions of the WILIAM model to assess transition policies

Green recovery and just transition

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LOCOMOTION

Low-carbon society: An enhanced modelling tool for the transition to sustainability

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"LOCOMOTION aims to enhance the existing MEDEAS IAMs to provide policy-makers and relevant other stakeholders with and open source, well-documented model to assess the feasibility, effectiveness, costs and impacts of different sustainability policy options"

The project

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Universidad de Valladolid

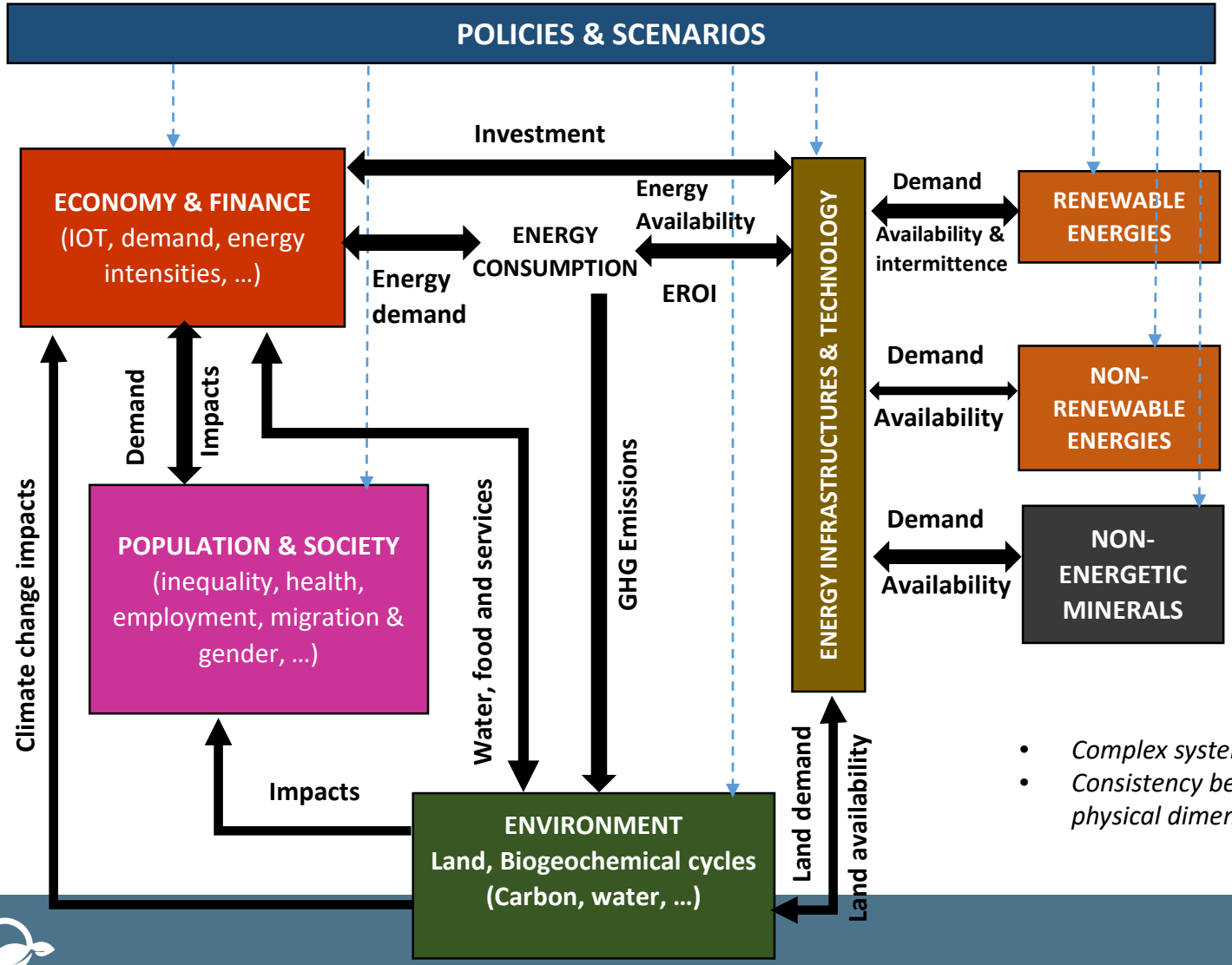
- Duration: 1st June 2019 – 31th May 2023
- Coordinator: Universidad de Valladolid (Spain)
- Partners:

UNIPI, SDEWES, AEA, BC3

CESAR, UoI, CRES, FC.ID

UNU-EHS, EEB, CREAF, CARTIF

WILIAM «Within Limits IAM»



- *Complex systems approach*
- *Consistency between monetary and physical dimensions*

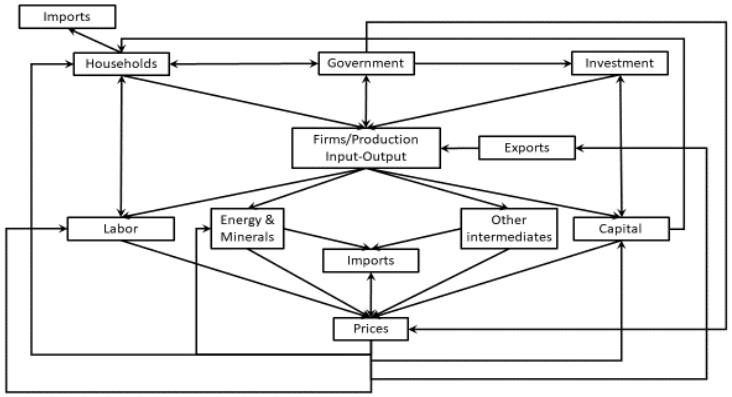
Current state of the WILIAM model

- Still in development → results expected by **June 2022**
- Different modules at different degrees of development maturity.
- Relevant results already obtained during the process of model development:
  - data analysis
  - simulation of other models from the portfolio of the partners to feed/parametrize/model in WILIAM
  - Etc.

Modelling households heterogeinity

The evolution of 60 household types is modelled for each EU country:

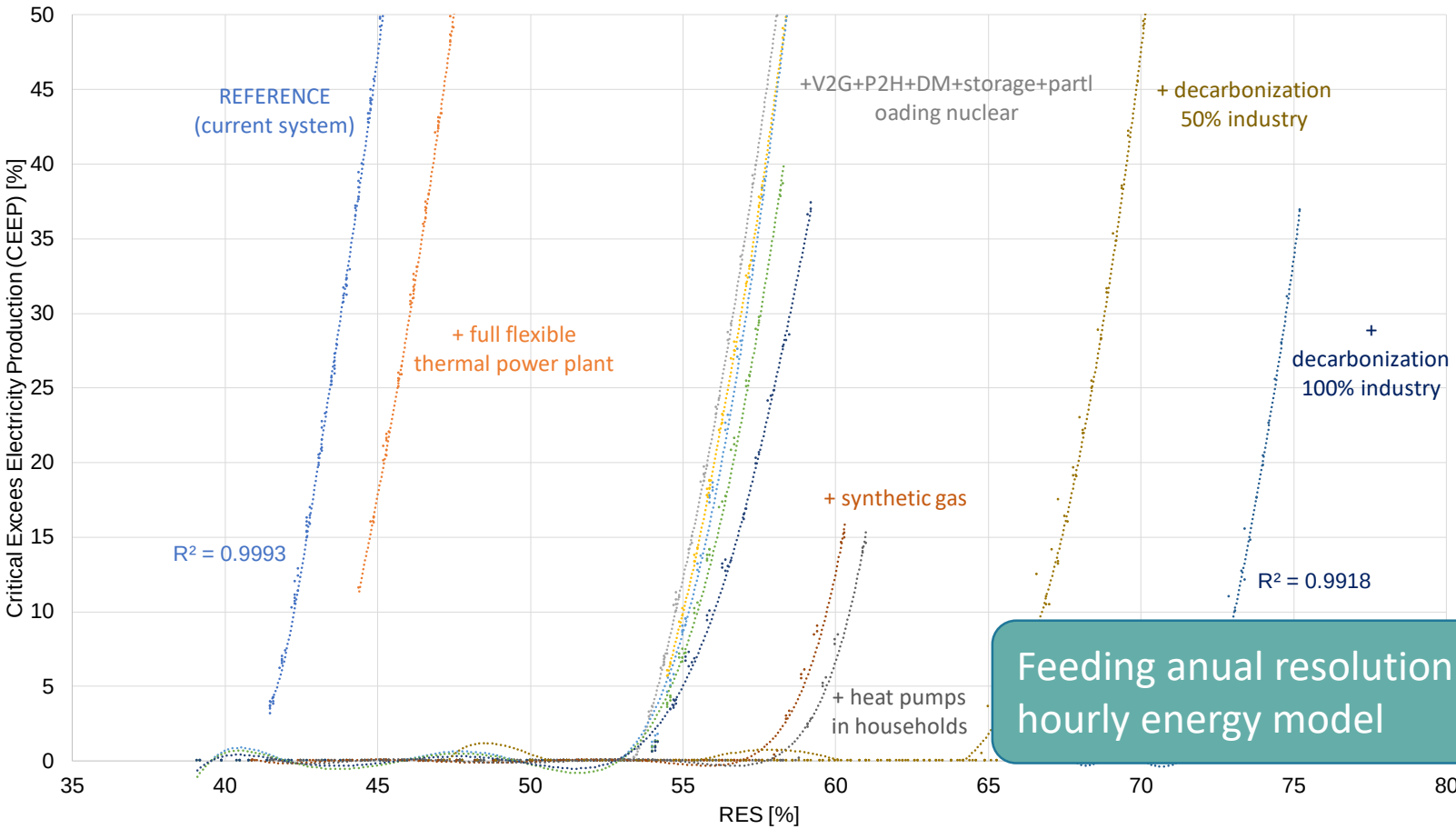
- Rural/urban (x2)
- Income distribution (x5)
- Composition (x6):
  - single adult with children
  - single adult without children
  - couple with children
  - couple without children
  - other household with children
  - other household without children



ADDRESS → *How the energy transition will affect different people in society (income, labour, consumption, well-being, etc.)?*

WP4. Kratena, K. et al., 2021. Household/Consumption sub-module (LOCOMOTION DELIVERABLE No. D4.1)

Technology options for reaching high renewables share

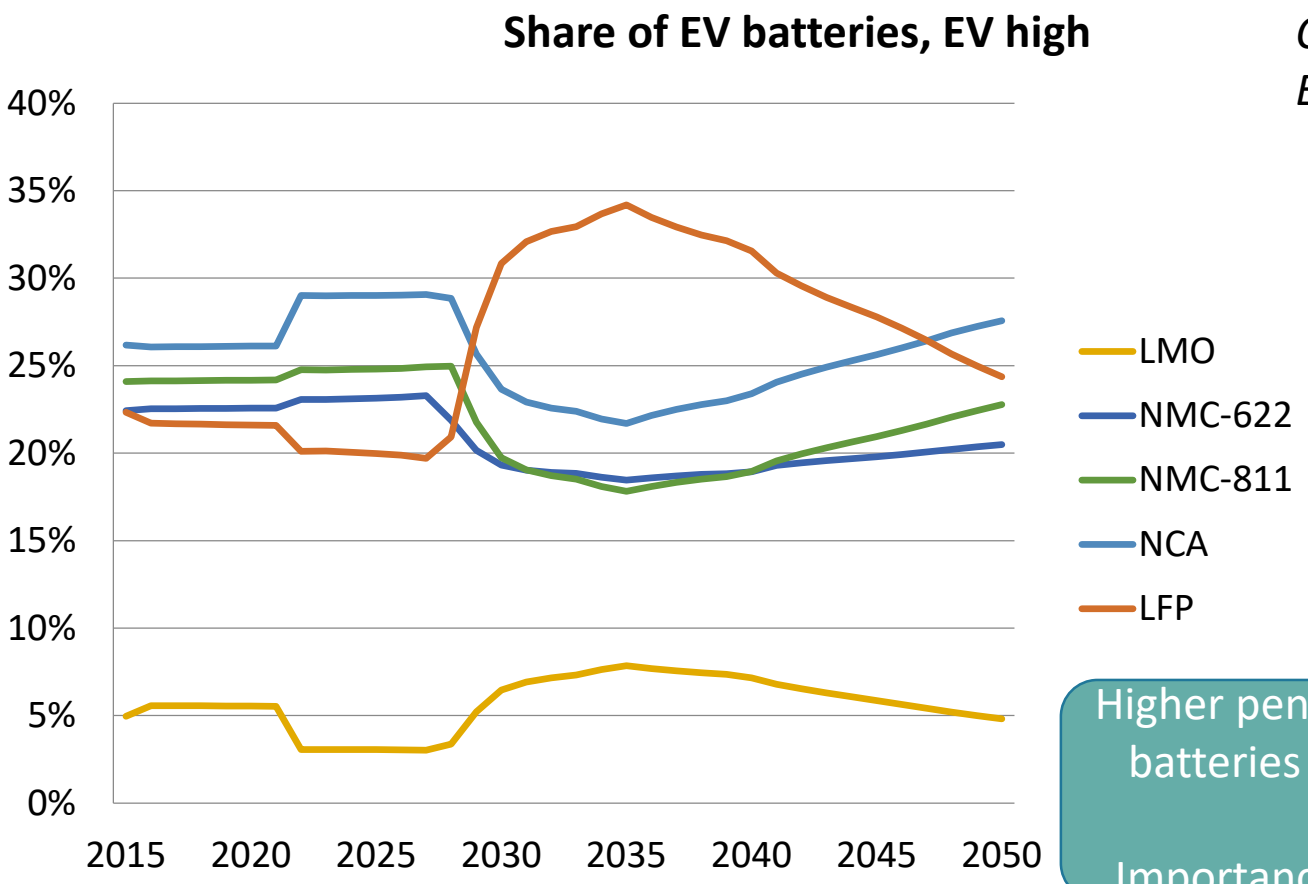


Feeding anual resolution IAM with hourly energy model

Case study: Bulgaria
EnergyPLAN model

Pfeifer et al., 2021. [Flexibility index and decreasing the costs in energy systems with high share of renewable energy](). Energy Conversion and Management 240, 114258.

Electric vehicle batteries and material requirements



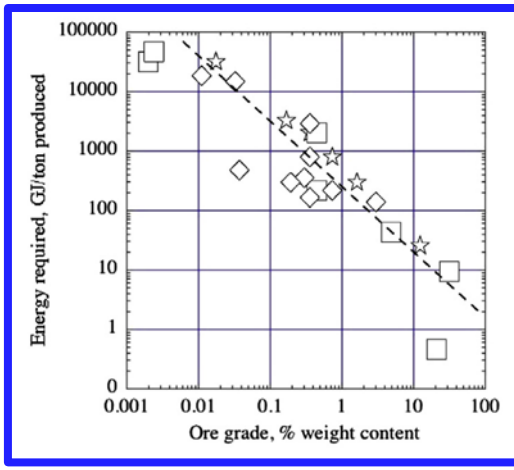
Circular Economy Action Plan
EU Battery Regulation

Higher penetration of less performant batteries due to material scarcities (Cu, Co, Ni, Li).
Importance of non-energy demand!

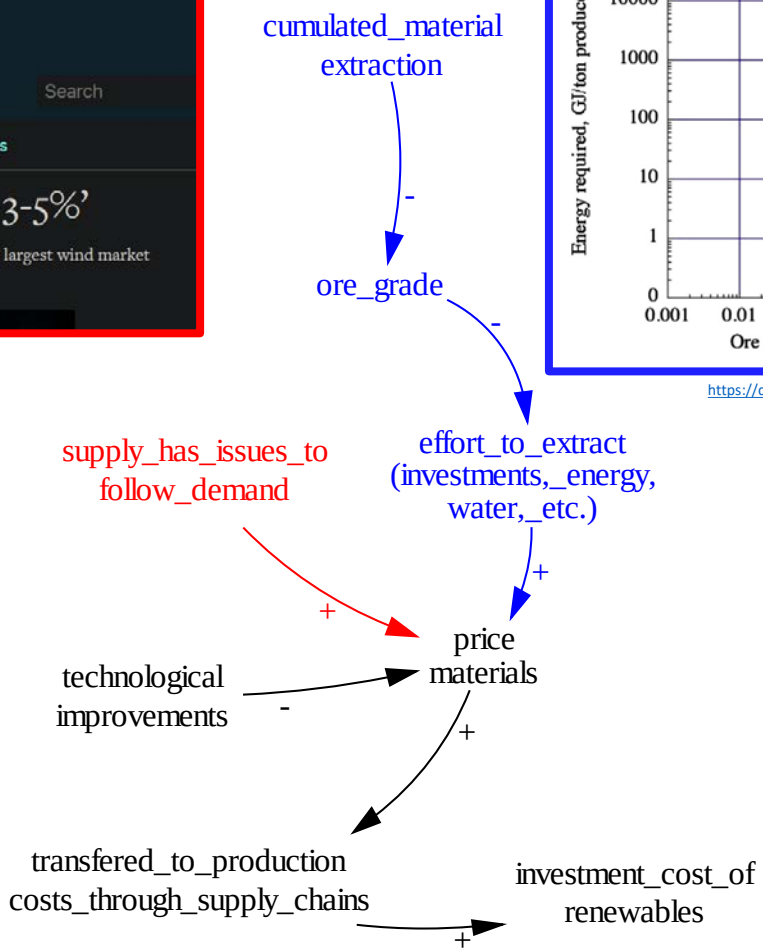
Preliminary results from WILIAM (global)

Pulido Sanchez, D.P., Capellán-Pérez, I.C., Mediavilla Pascual, M., de Castro Carranza, C., Frechoso Escudero, F.A., 2021. Analysis of the material requirements of global electrical mobility. DYNA 96, 207–213.

Linking physical and economic dimensions allows the representation of dynamics from the real world



https://doi.org/10.1016/j.jclepro.2015.06.085



ADDRESS → *How the depletion of natural resources will affect production costs in the future?*

Testing different storylines

Baseline (SSP2)

fossil fuels, inertia, conflict of interests, climate impacts

Baseline with increasing inequality (SSP3)

fossil fuels, inertia, conflict of interests, climate impacts, protectionism, inequalities; national security

Green Growth (market tools and technological development)

economic growth, absolute decoupling, global economic convergence; fast diffusion of low carbon technologies, sector coupling, efficiency improvements

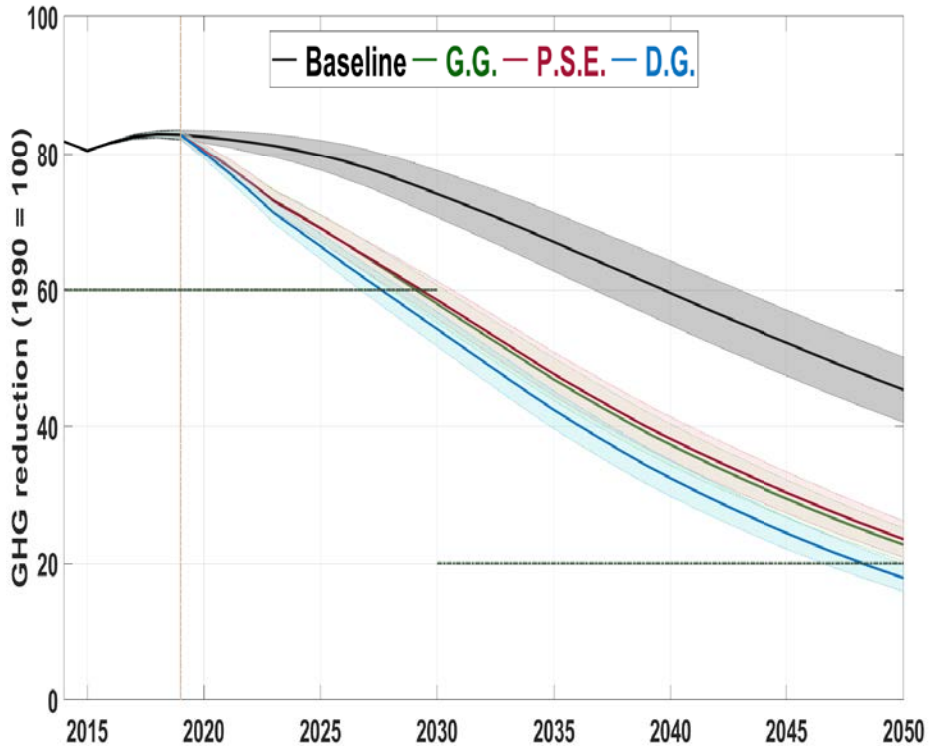
Green Deal (Green Growth complemented with social policies)

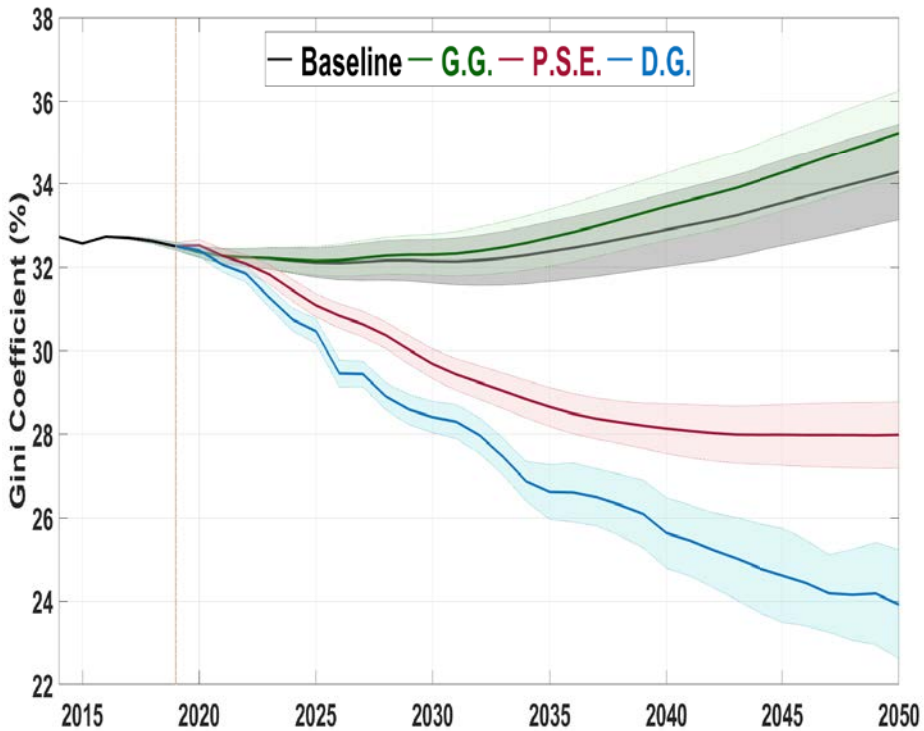
Features of Green Growth + social inequality reduction; public investments; welfare state; public intervention

Post-growth (voluntary downscaling)

relocalization, sharing economy, self-organization, commons, conviviality, voluntary behavioural changes; sufficiency; reducing material throughput

Testing different storylines





Similar reductions in emissions can result in ***radically different social consequences*** in terms of income distribution, employment, and fiscal stability.
Need of radical social policies to address inequalities: job guarantee, working time reduction

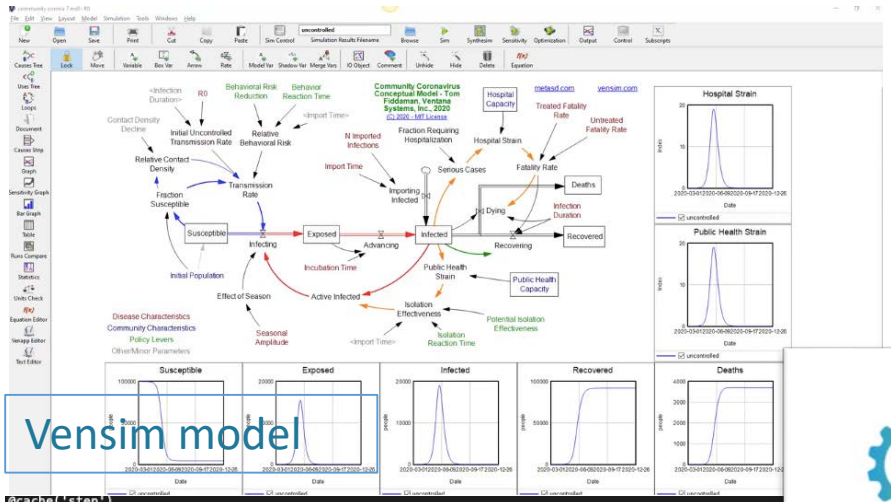
Case study: France
EUROGREEN model

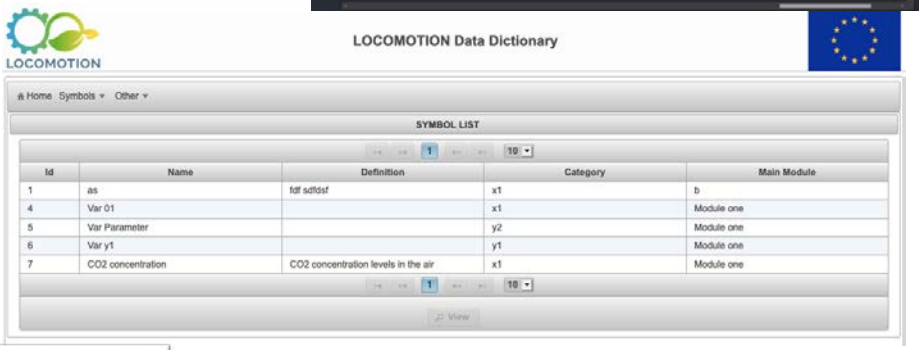
D'Alessandro et al., 2020. Feasible alternatives to green growth. Nature Sustainability 1–7

Saliency/transparency/usability/interoperability

Set-up of a common modelling framework:

- Distributed and coordinated programming
- Rules for naming & documentation
- Development of apps: *dataweb dictionary*, *sonarqube*
- Final model in open source code





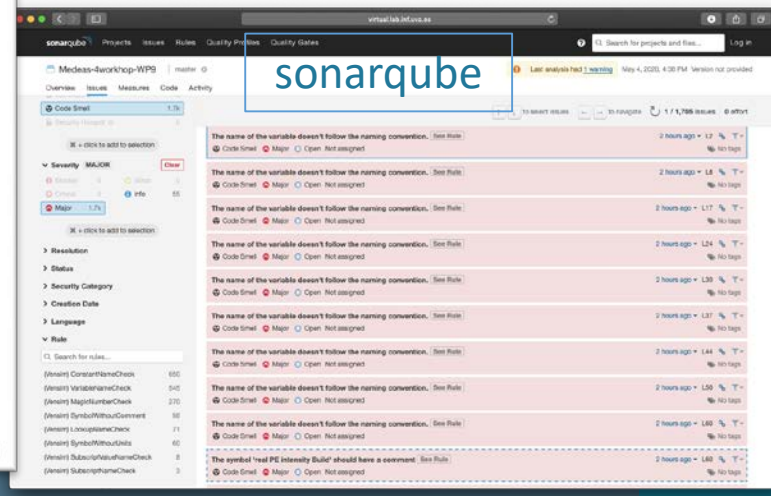

```
@cache('step')
def aux2():
    """
    Real Name: aux2
    Original Eqn: DELAY FIXED ( Matriz IA def[SecReg,SecReg1], TIME STEP, 0)
    Units:
    Limits: (None, None)
    Type: component

    b''
    """
    return _delay_matriz_ia_def_roundtime_step__time_step___time_step_0_time_step__time_step()


@cache('step')
def matrices_ia_regionales():
    """
    Real Name: Matrices IA Regionales
    Original Eqn: Matriz IA def[SubEU, SubEU1]
    Units:
    Limits: (None, None)
    Type: component

    b''
    """
    return utils.xrmerge([
        matriz_ia_def(),
```

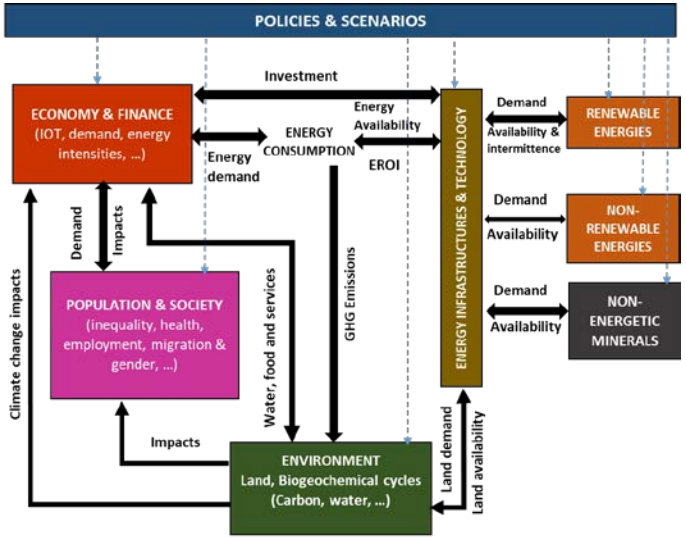
python translation



Final comments

- Main challenge: consistent interlinkage between all the represented dimensions.
- Results expected for next June 2022.

- WILIAM expected to answer questions such as:
  - *How can we reach 100% renewables in different countries?*
  - *What are the main policies to achieve sustainable energy systems?*
  - *How the energy transition will affect the economic structure of different countries?*
  - *How the energy transition will affect different people in society (income, labour, consumption, well-being, etc.)?*
  - *What are the monetary, energy and materials investments/requirements to achieve the transition to zero carbon economies?*
  - *How can the monetary investments can be financed?*
  - *Which adaptation options to climate change impacts would be more relevant in the future?*
  - *What are the potential limits to growth that biophysical constraints may impose on economic production?*



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