

Macroeconomic dynamics of the energy transition: at the crossroads of engineering and economics

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Outline

Combining insights from energy engineering and economics

Computing the global potential and energy returns of wind and solar Power
(Elise Dupont)

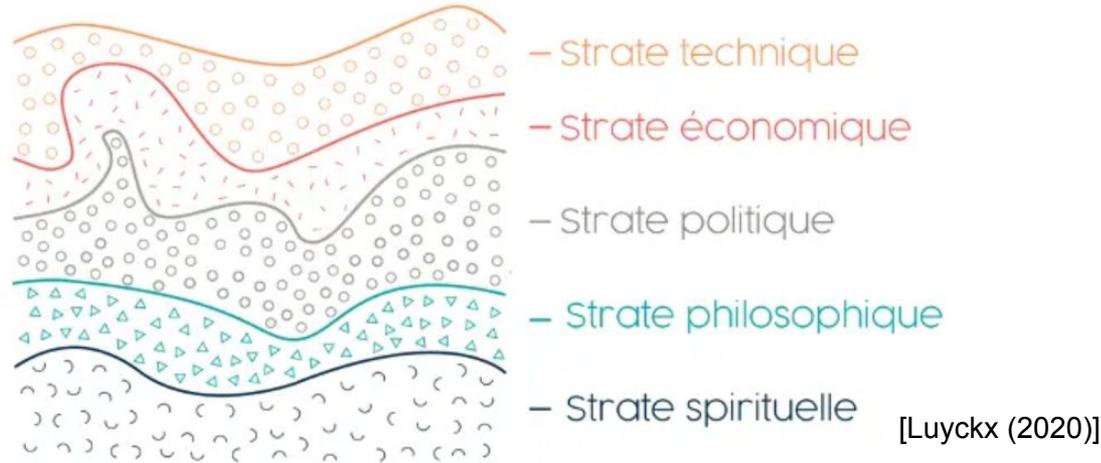
Presentation of our Stock-Flow Consistent energy-economy model

Simulation results

Doing interdisciplinary research: advantages and obstacles

Energy engineering and economics: the two first strata of integral ecology

LES STRATES DE L'ÉCOLOGIE INTÉGRALE



➔ My research question: What would be the impact on the world economy of a transition towards a 100% renewable energy system ?

Net energy analysis

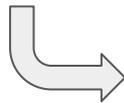
Energy input



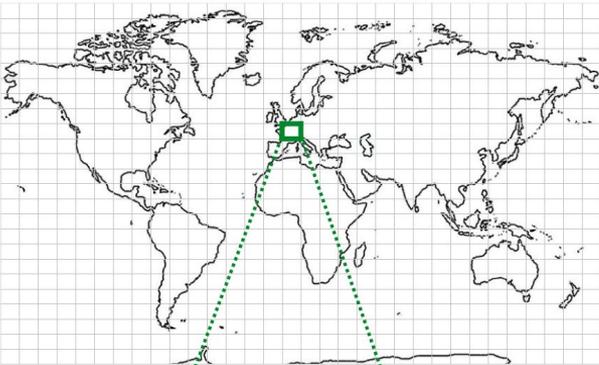
Energy output
= Gross energy

Net energy = Energy output - Energy input [Joules]

EROI = $\frac{\text{Energy output}}{\text{Energy input}}$ [dimensionless]

 Energy Return On Investment

Construction of global EROI curves for wind and solar Power (Elise Dupont)



Grid-cell approach

Mesh resolution: $0.75^\circ \times 0.75^\circ = 115\,200$ cells

Average cell size $\sim 4000\text{ km}^2$

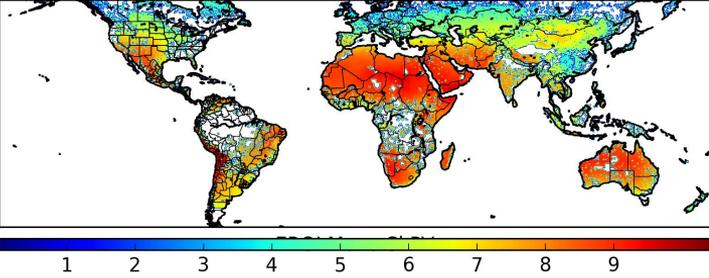
- Area [km^2]
- Land cover [f]
- Mean wind profile [m/s]
- Global Horizontal Irradiation [W/m^2]

Calculate theoretical net potential and associated EROI in each cell for **onshore** and **offshore wind, solar PV**

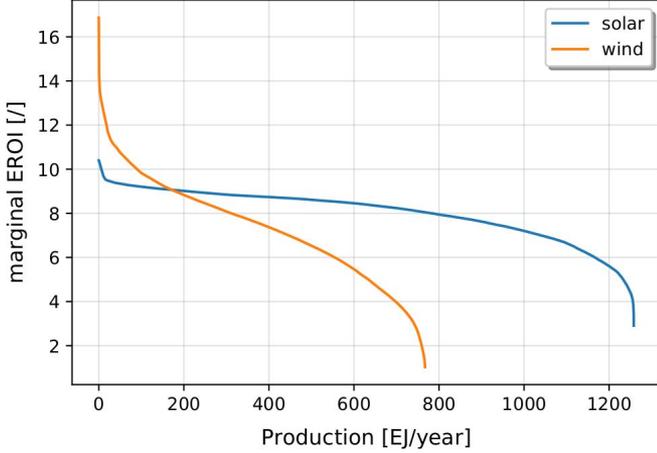
[Dupont (2018)]

[Dupont (2020)]

Construction of global EROI curves for wind and solar Power (Elise Dupont)



EROI of photovoltaic panels



[Dupont (2021a)]

[Dupont (2021b)]

Stock-Flow Consistent economic modeling

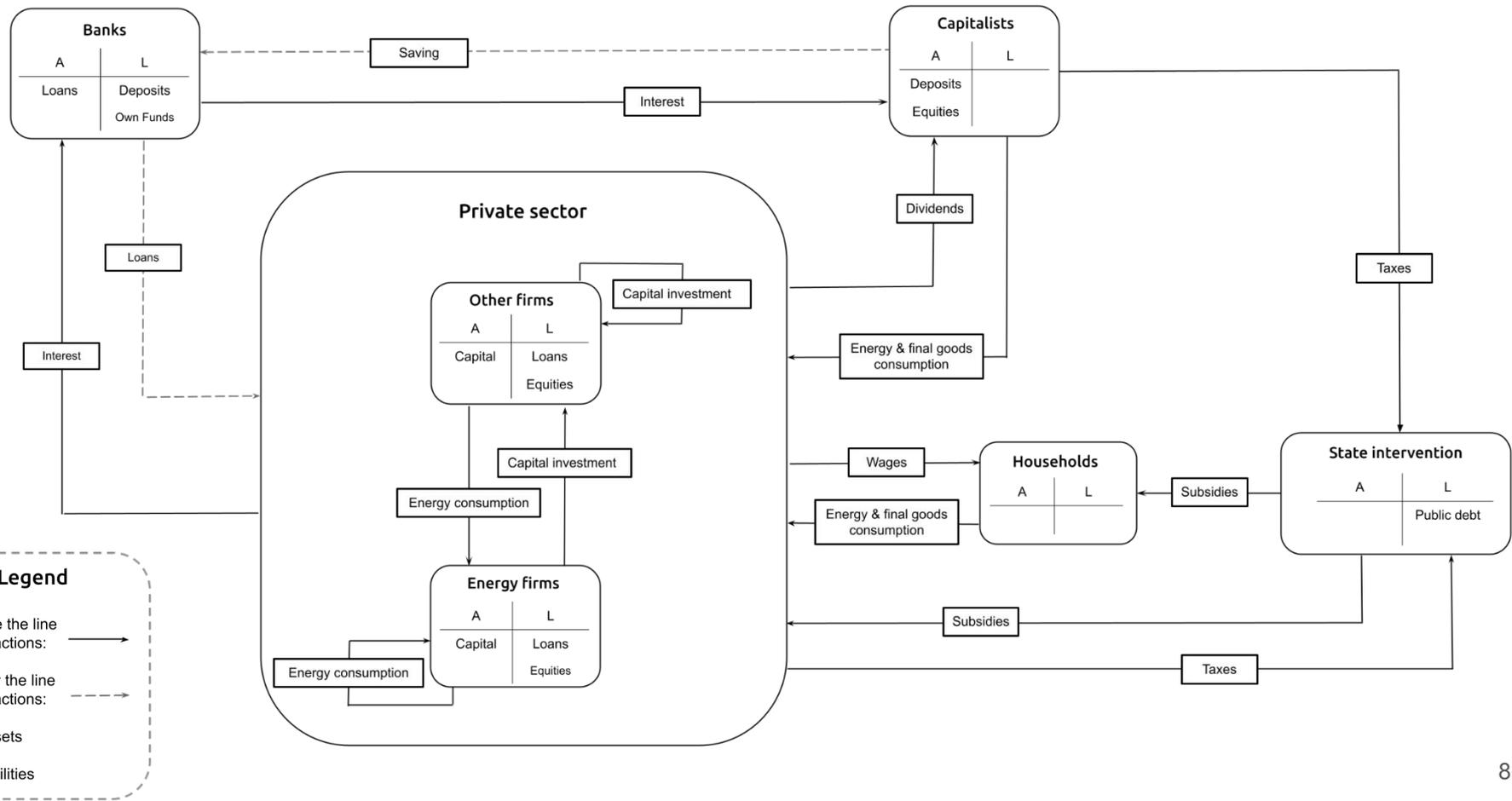
What are Stock-Flow Consistent models ?

Basically, system dynamics models (sets of differential equations) with “conservation laws”

Write the balance sheet of each actor/sector in the economy

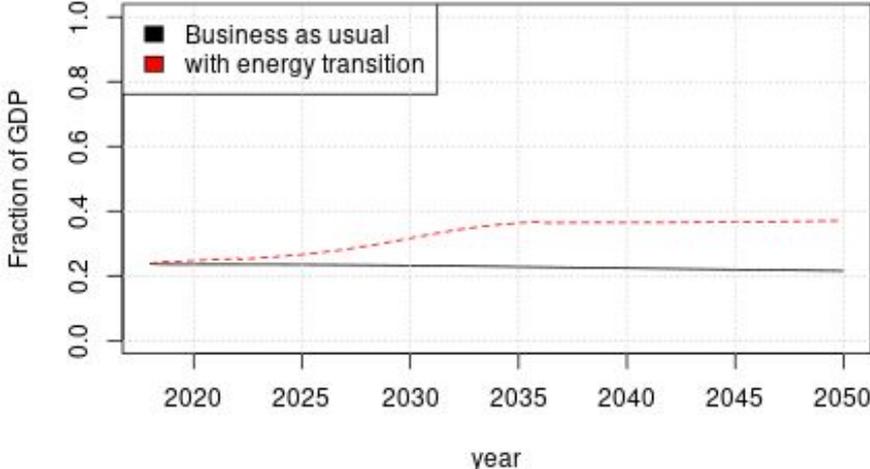
All economic interactions between two agents must be reflected on the balance sheets of both agents  simulate all economic, monetary and financial flows explicitly

Overview of our Stock-Flow Consistent energy-economy model

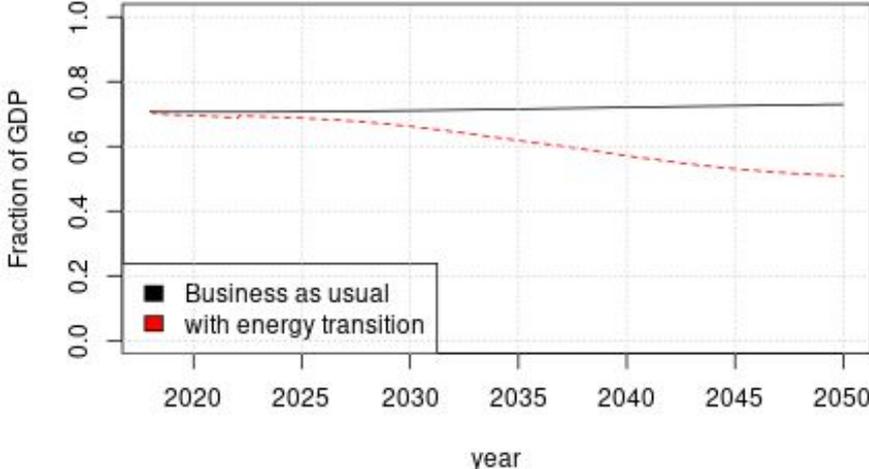


Simulation results: key takeaway

Saving rate



Wage share



Pursuing the energy transition through a green growth strategy amounts to transition to a war economy

Doing interdisciplinary research: advantages and obstacles

Obstacles:

- Difficulties to obtain funding
- I am expected to have both a master in energy engineering and economics

Advantages:

- Two promotor from two different disciplines = 2x more enriching
- Combine existing knowledge from two separate disciplines
- Easier to stand out as a researcher

Thank you !

Questions ?

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Conference on interdisciplinary and transdisciplinary research
for sustainable development

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