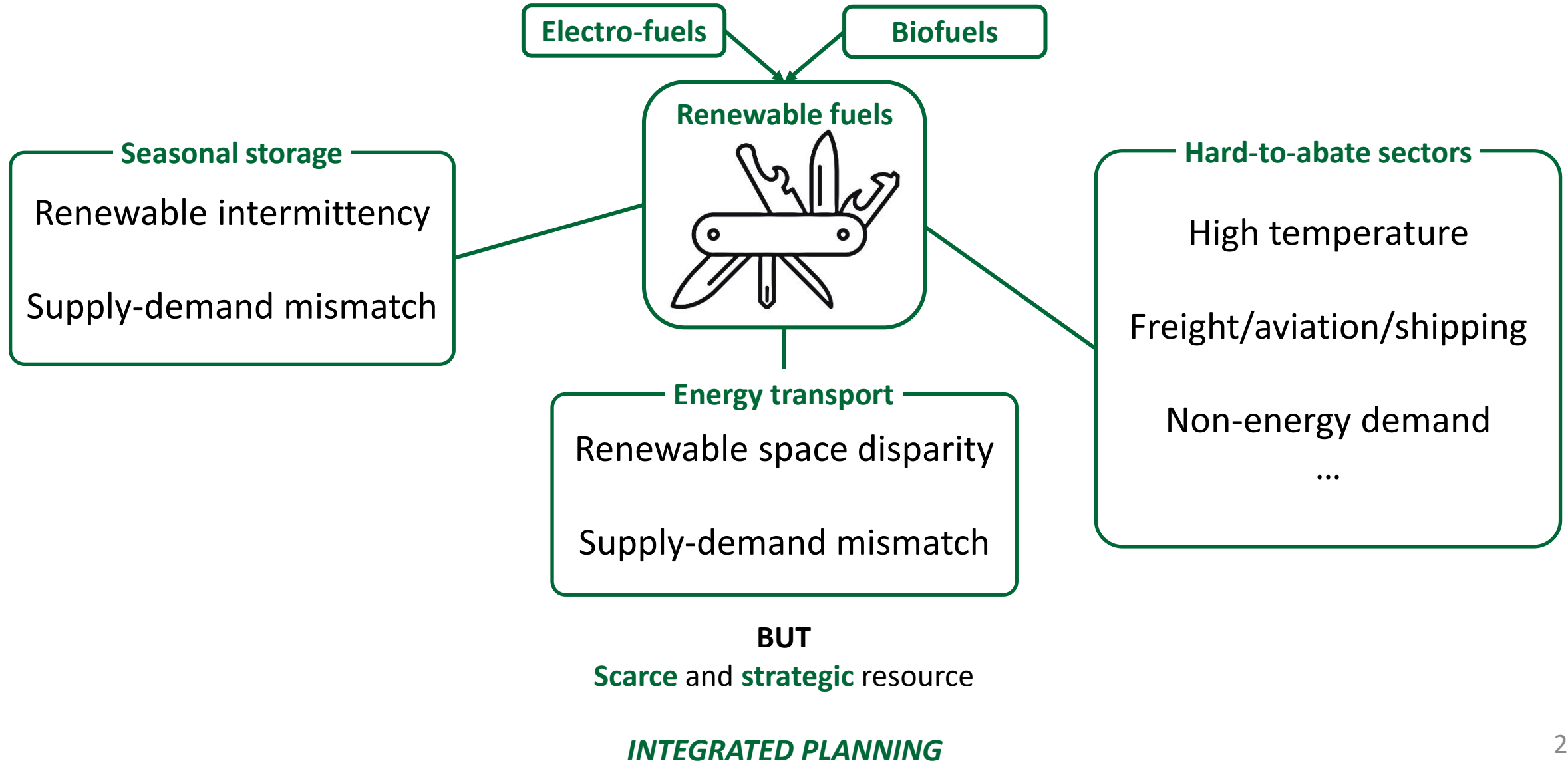


The role of **renewable fuels** in **a fossil-free** European whole-energy system

Author: Paolo Thiran

Supervisors : Pr. Hervé Jeanmart and Pr. Francesco Contino

Renewable fuels: the Swiss Army Knives of the energy transition



Main outcomes

- A **fossil free** and **energy independent** Europe is feasible
- Renewable fuels cover **37% of the final energy consumption**
- Renewable fuels are **produced** both from **biomass** and **e-hydrogen**
 - Used directly or upgraded
- Renewable fuels are **used** in
 - **Industry** (non-energy demand and high temperature)
 - **Heavy transport** (trucks, boats and buses)
 - **Flexibility** (thermal plants and seasonal storage)
 - **Energy exchanges**

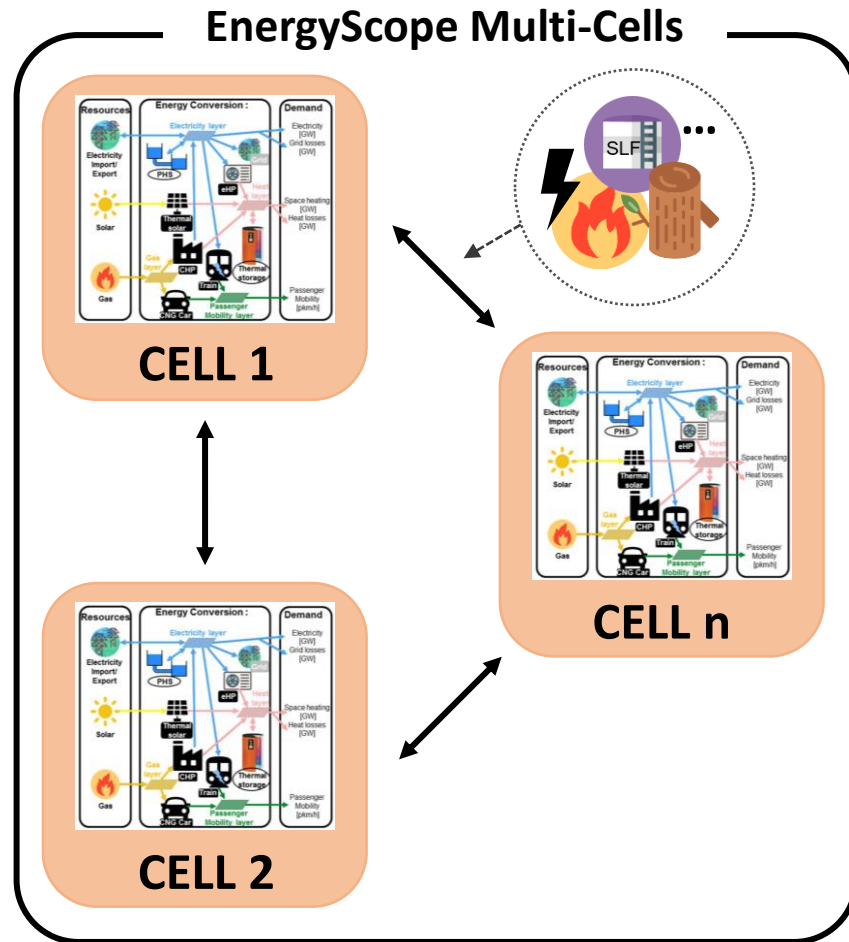
Contents

- Methods: the **EnergyScope Multi-Cells** model
- Case study: a **fossil-free** Europe in 2050
- Results : **strategic** production and use of **renewable fuels**
- Main **outcomes**

Methods and case study

EnergyScope Multi-Cells applied to a fossil free Europe in 2050

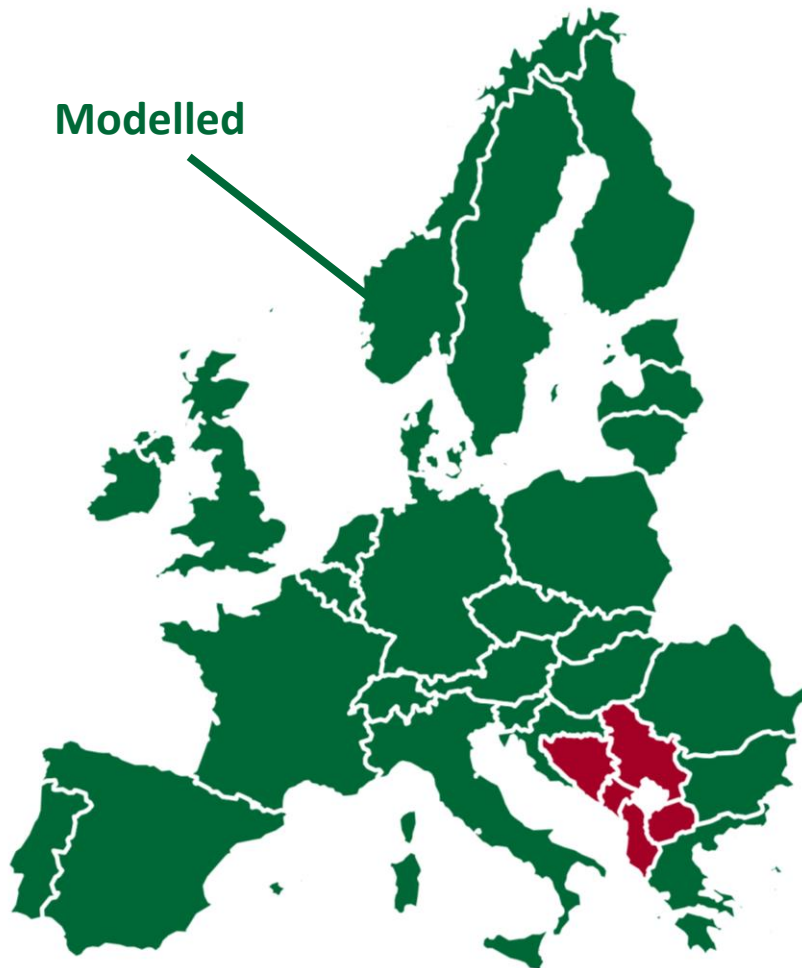
Methods: **EnergyScope Multi-Cells** is suited to model
the **competing interests for renewable fuels**



Characteristics

- ✓ **Optimisation** of design & operation
- ✓ **Multi-regional**
- ✓ **Hourly** resolution over a **year**
- ✓ **Whole-energy system** model:
 - ✓ All energy uses (9)
 - ✓ All energy vectors (32)
- ✓ **Open-source** and documented

Case study: a **fossil free** Europe in 2050



28 European countries (EU28) interconnected through

Networks:

- Electricity
- Gas
- Hydrogen

constrained by

- Actual network
- Extension/retrofitting
- Cost of network
- Losses

Freight:

- Wood
- Methanol
- Ammonia
- CO₂

constrained by

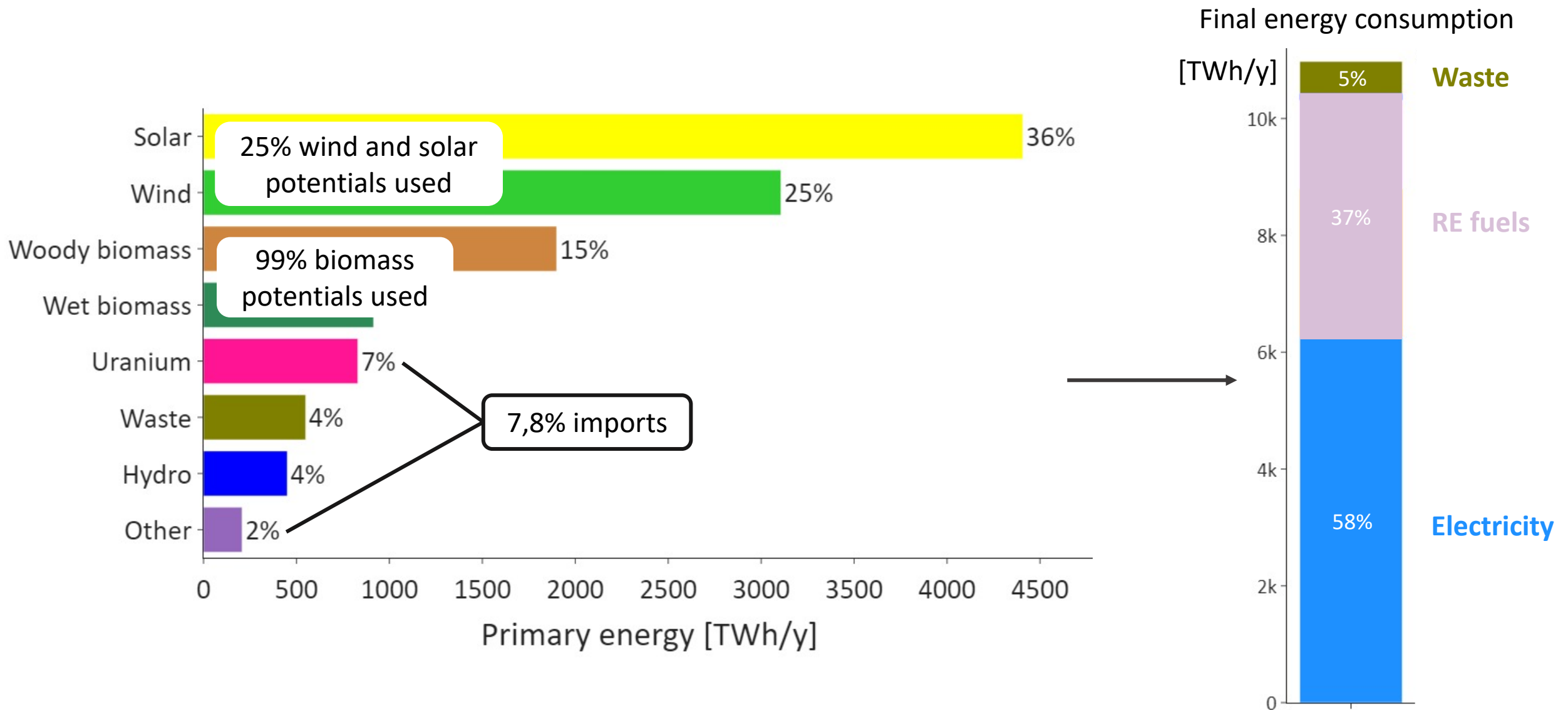
- Additional freight demand

+ all countries can **import renewable fuels from the exterior** at a certain cost

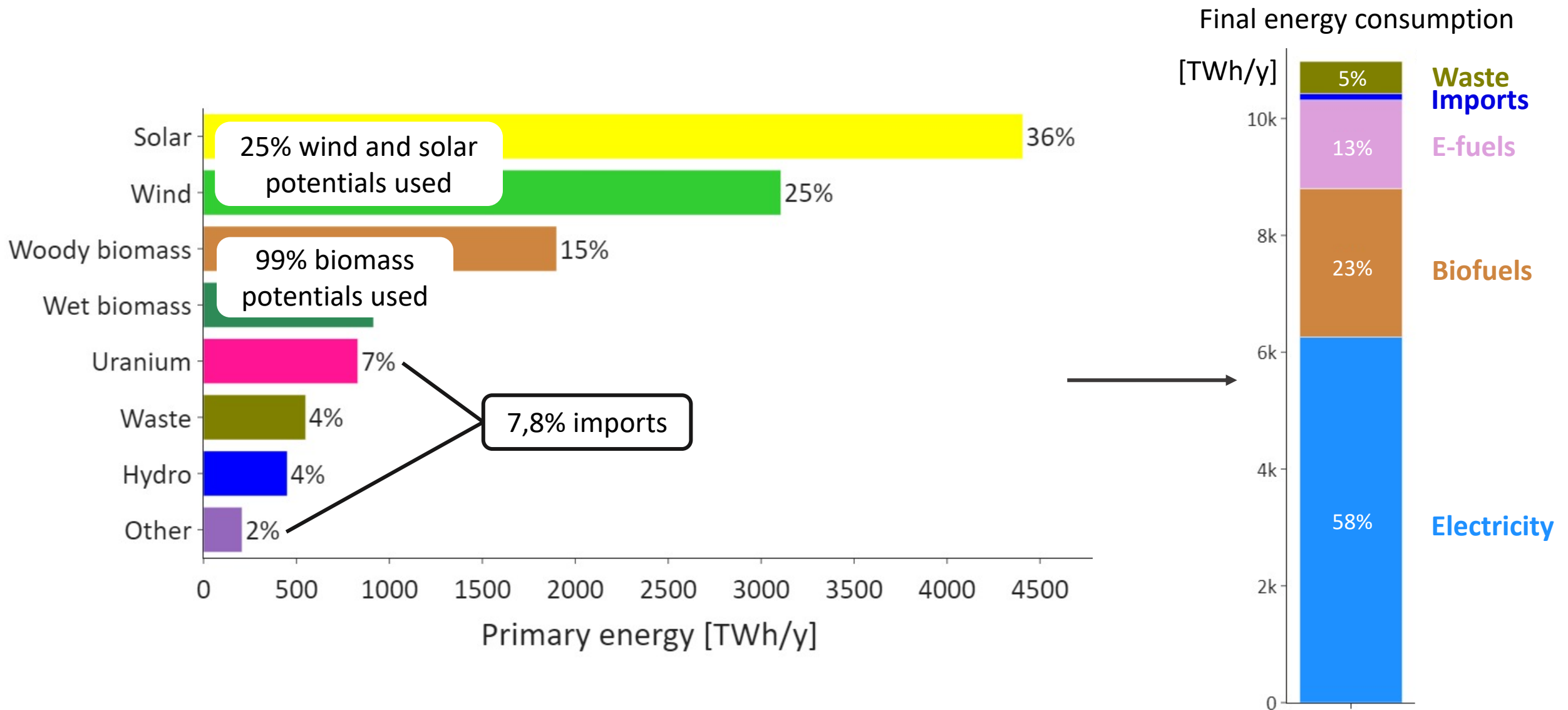
Results

The role of RE fuels in a fossil free Europe in 2050

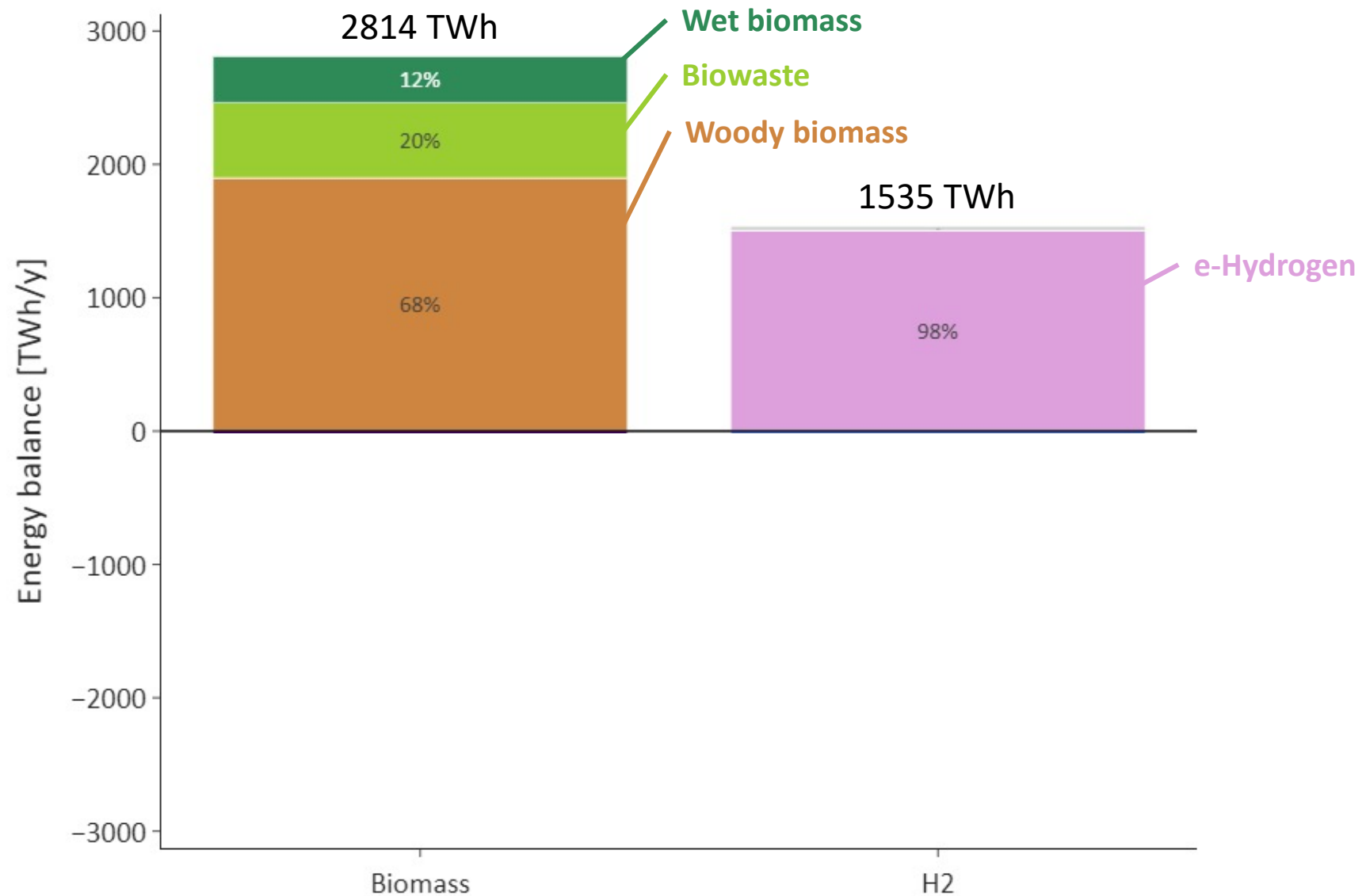
Fossil free and energy independent Europe is feasible



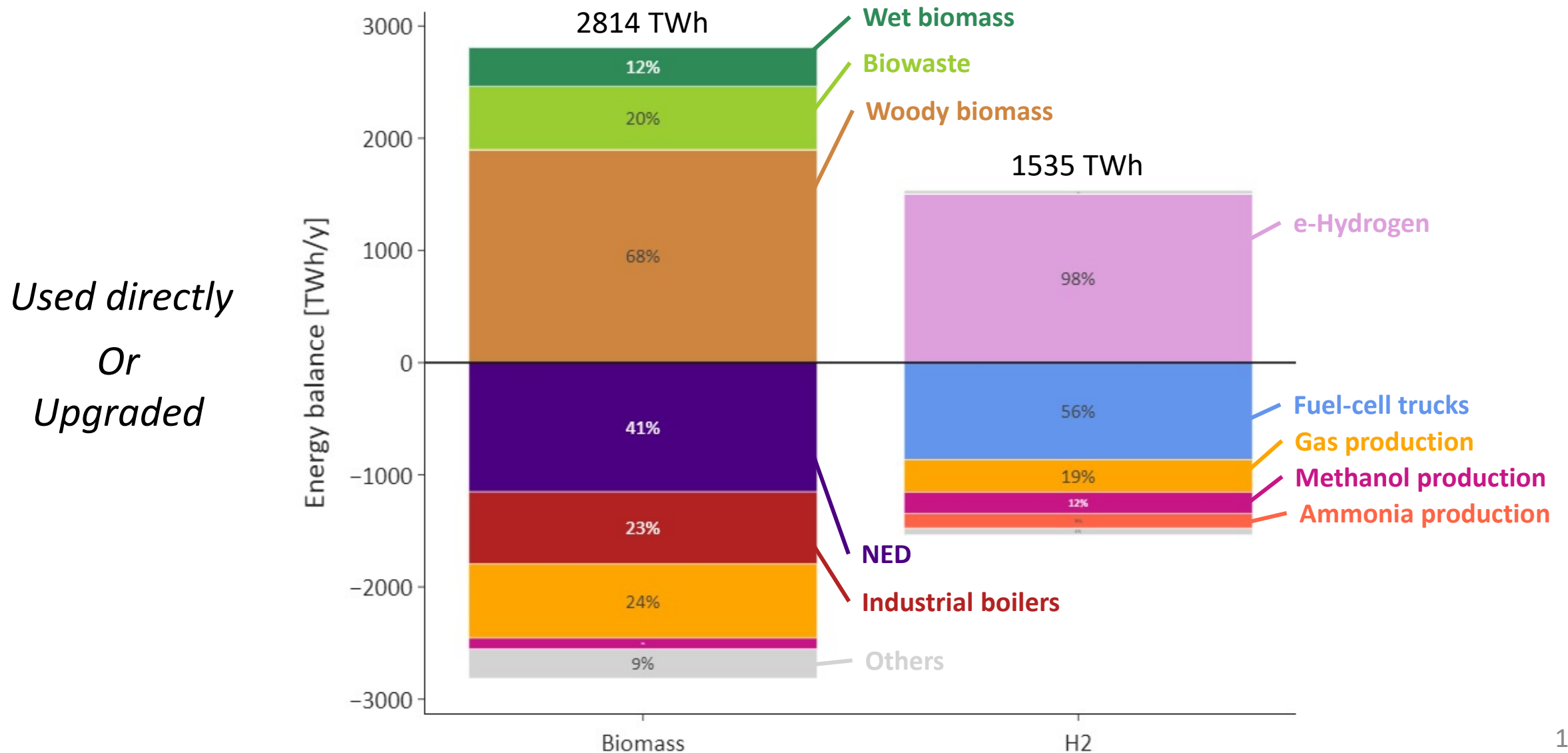
Fossil free and energy independent Europe is feasible



Biomass and e-Hydrogen are the 2 sources of RE fuels

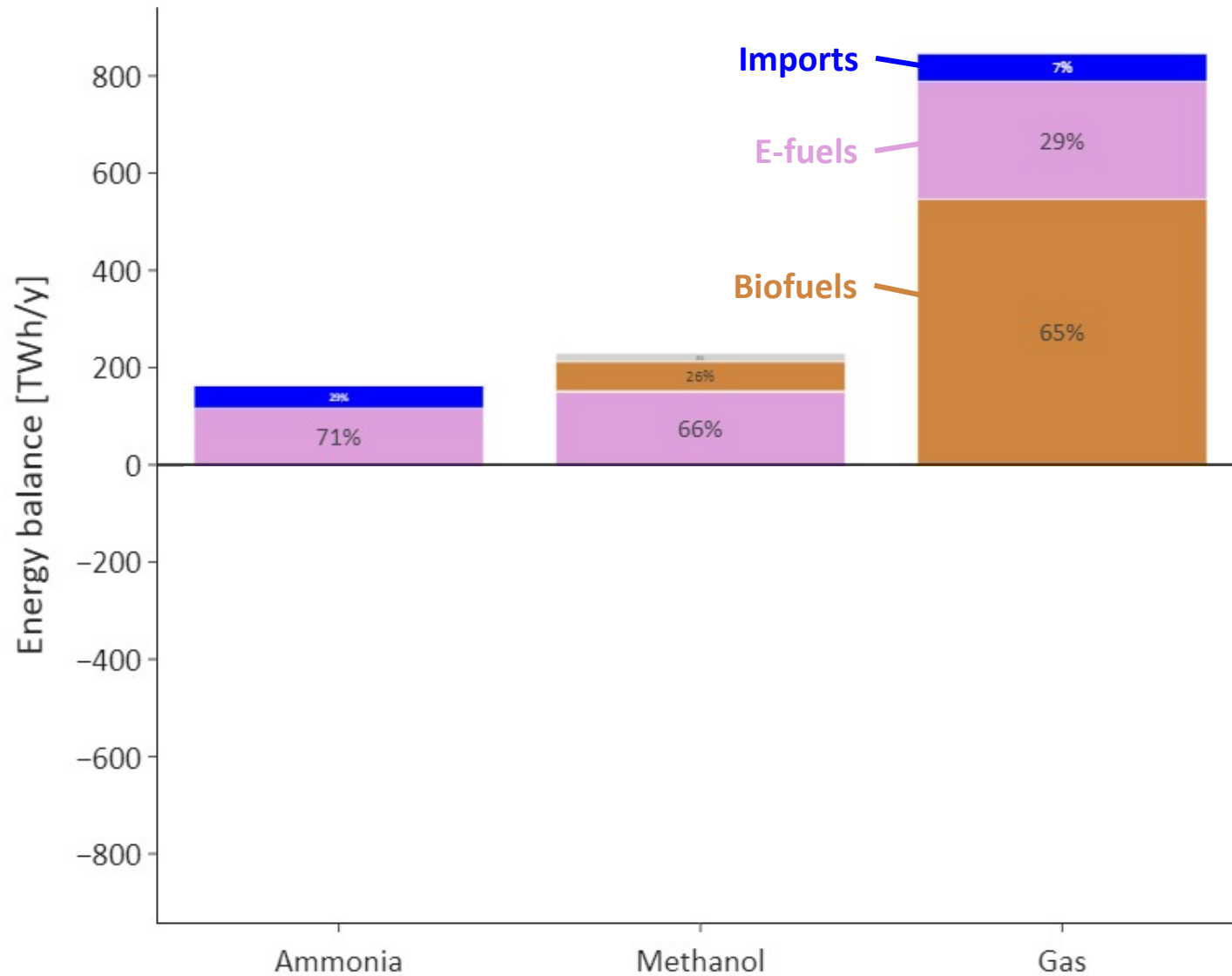


Biomass and e-Hydrogen are the 2 sources of RE fuels



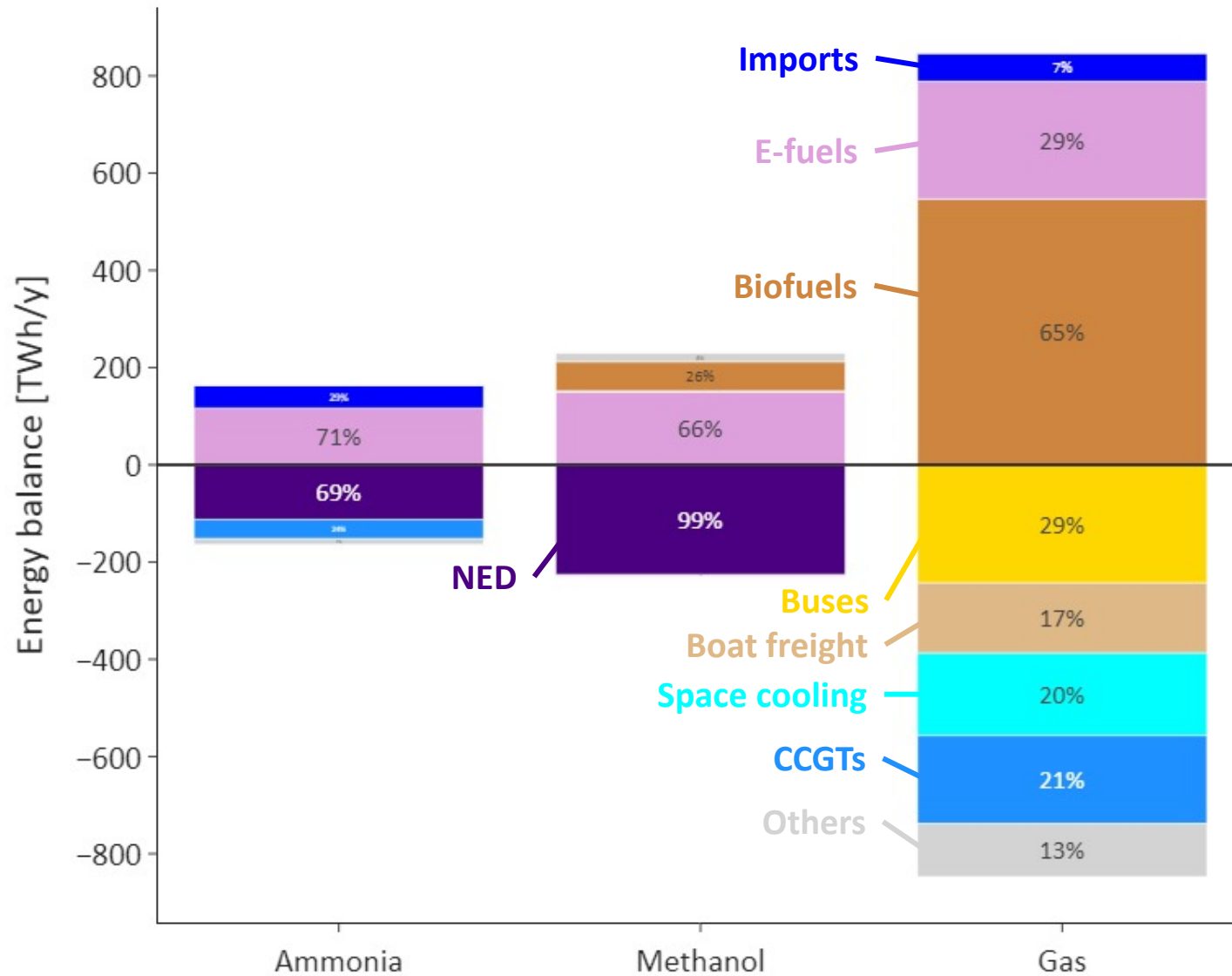
Key in hard-to-abate sectors: industry, heavy transport, flexibility

Yearly energy balance

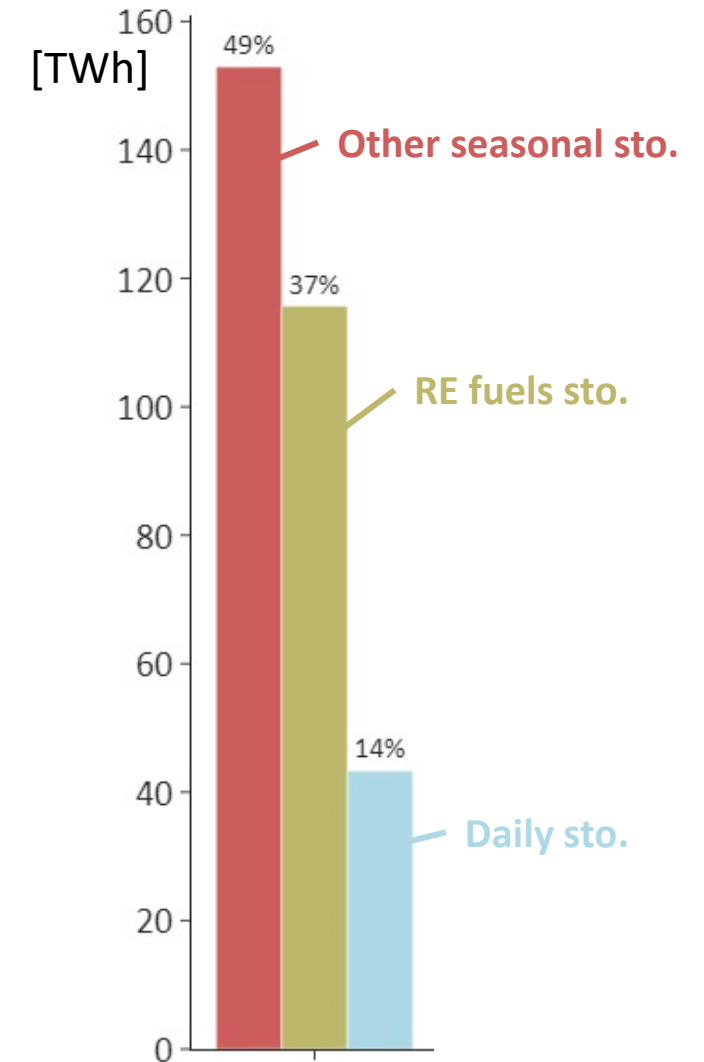


Key in hard-to-abate sectors: industry, heavy transport, flexibility

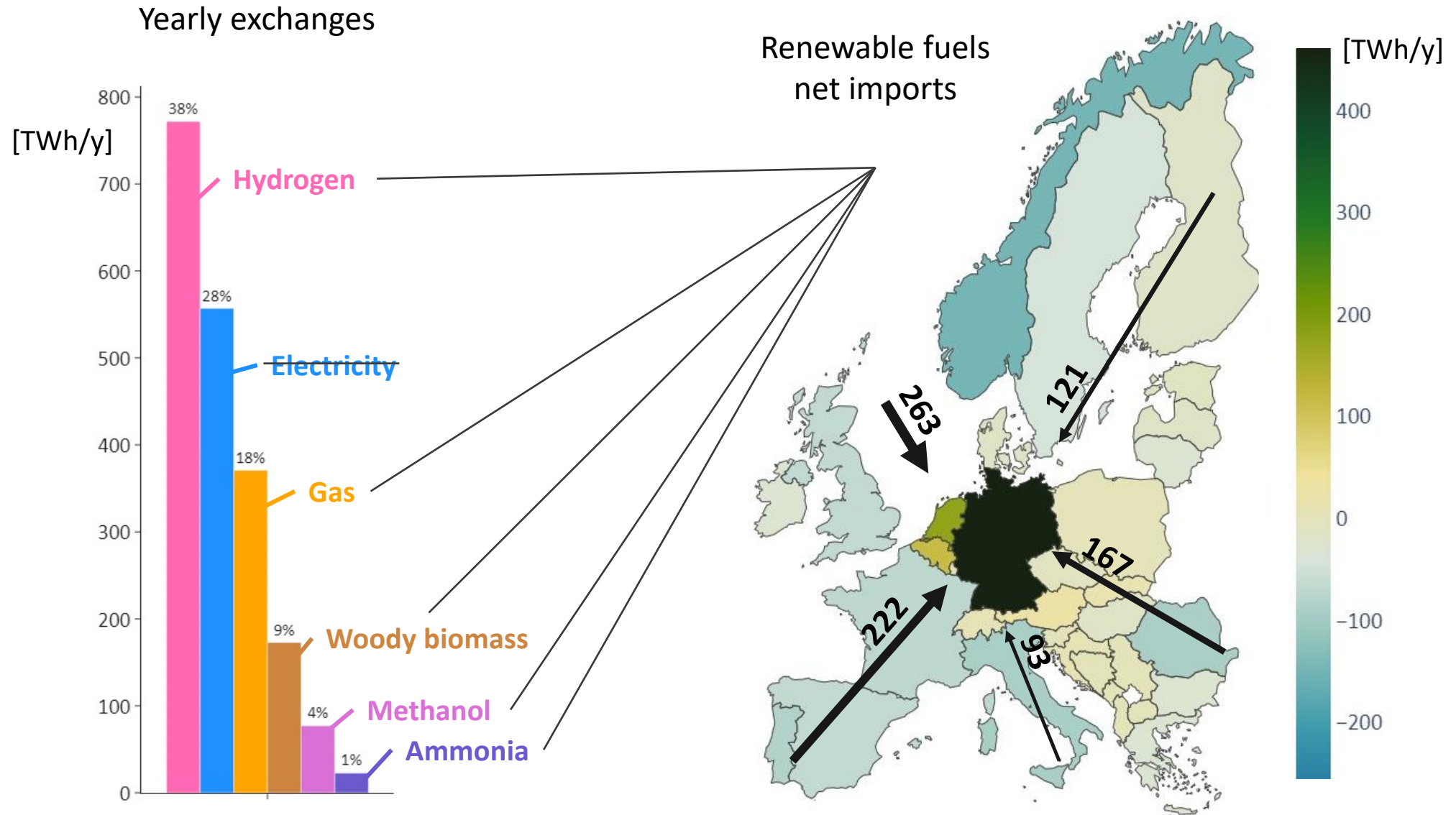
Yearly energy balance



Storage capacity



RE fuels transport the bulk energy to high consumption places



Main outcomes

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