Circular Economy, An Overview of the trade at the Macro Level
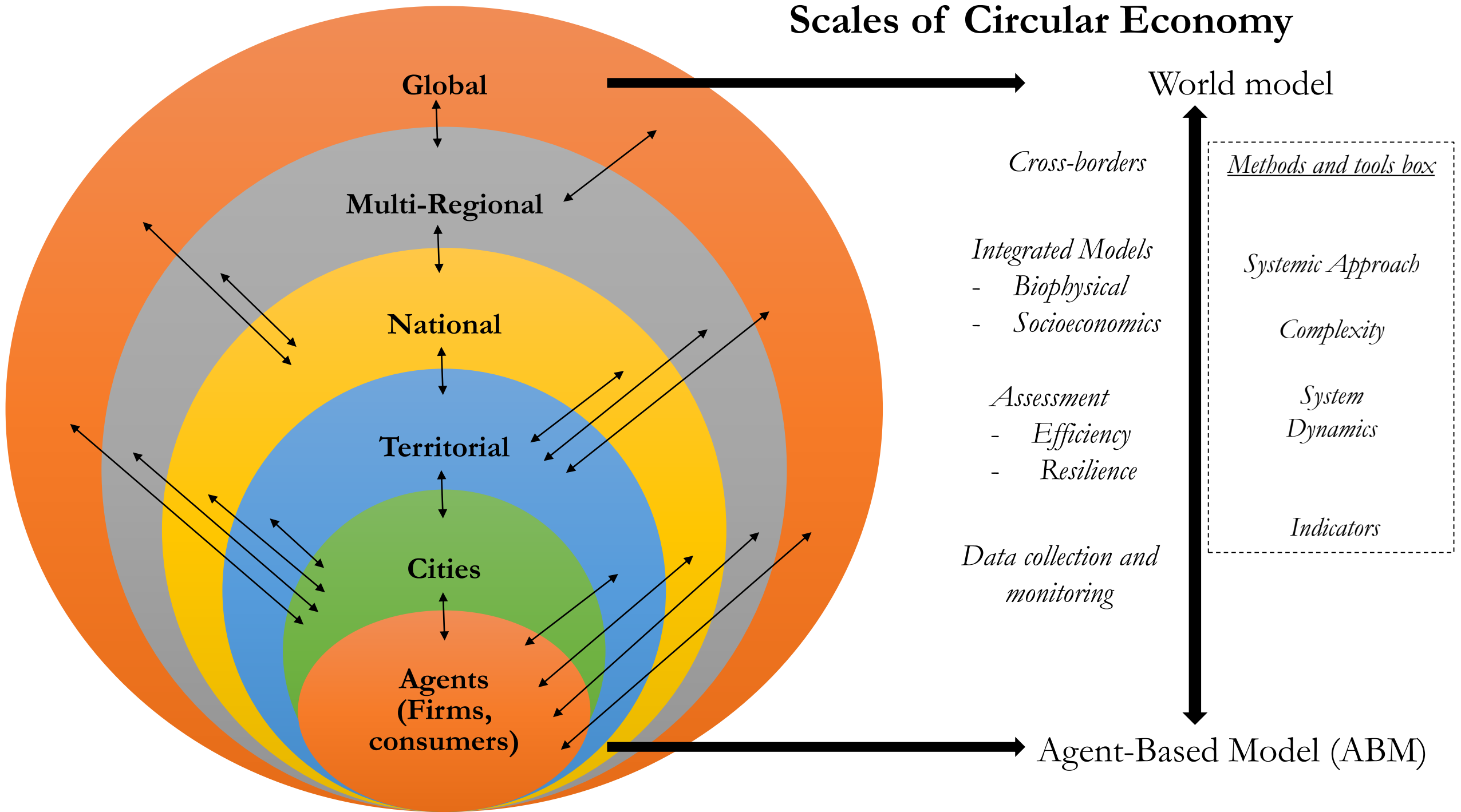
Arnaud Diemer, Cécile Batisse

WCO PICARD Conference, 9.12.2021

Scales of Circular Economy

Global

Multi-Regional

National

Territorial

Cities

Agents (Firms, consumers)

World model

Cross-borders

Integrated Models
- Biophysical
- Socioeconomics

Assessment
- Efficiency
- Resilience

Data collection and monitoring

Methods and tools box
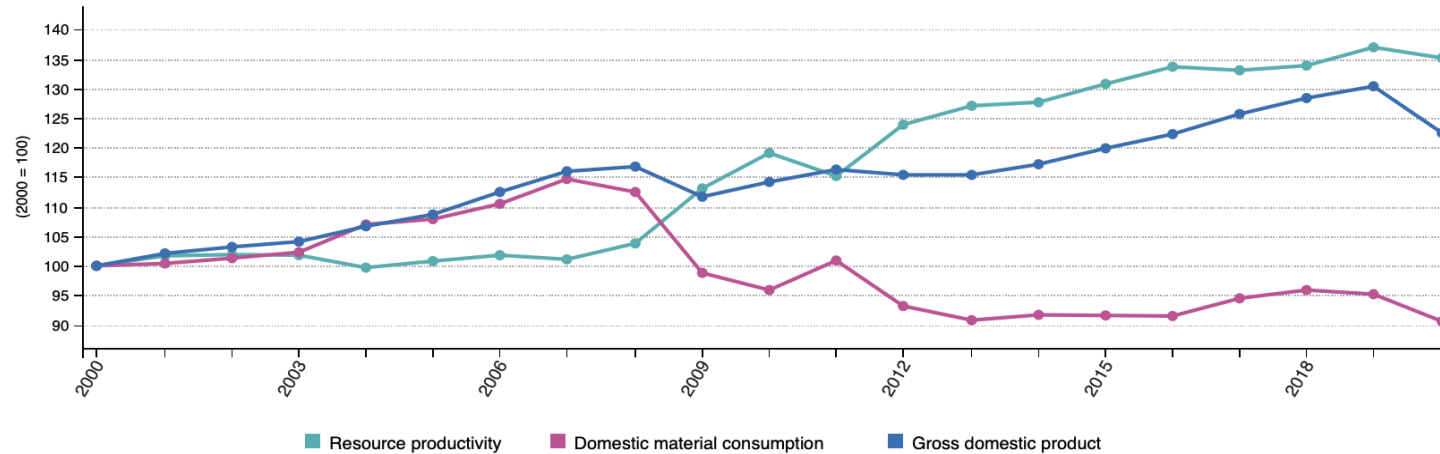
Systemic Approach

Complexity

System Dynamics

Indicators

Agent-Based Model (ABM)

Circular Economy – Macro level concept
Domestic Material Input / Domestic Export / Domestic Material Consumption/GDP

Development of resource productivity in comparison with GDP and DMC, EU, 2000-2020

Note: GDP in chain-linked volumes, reference year 2015.

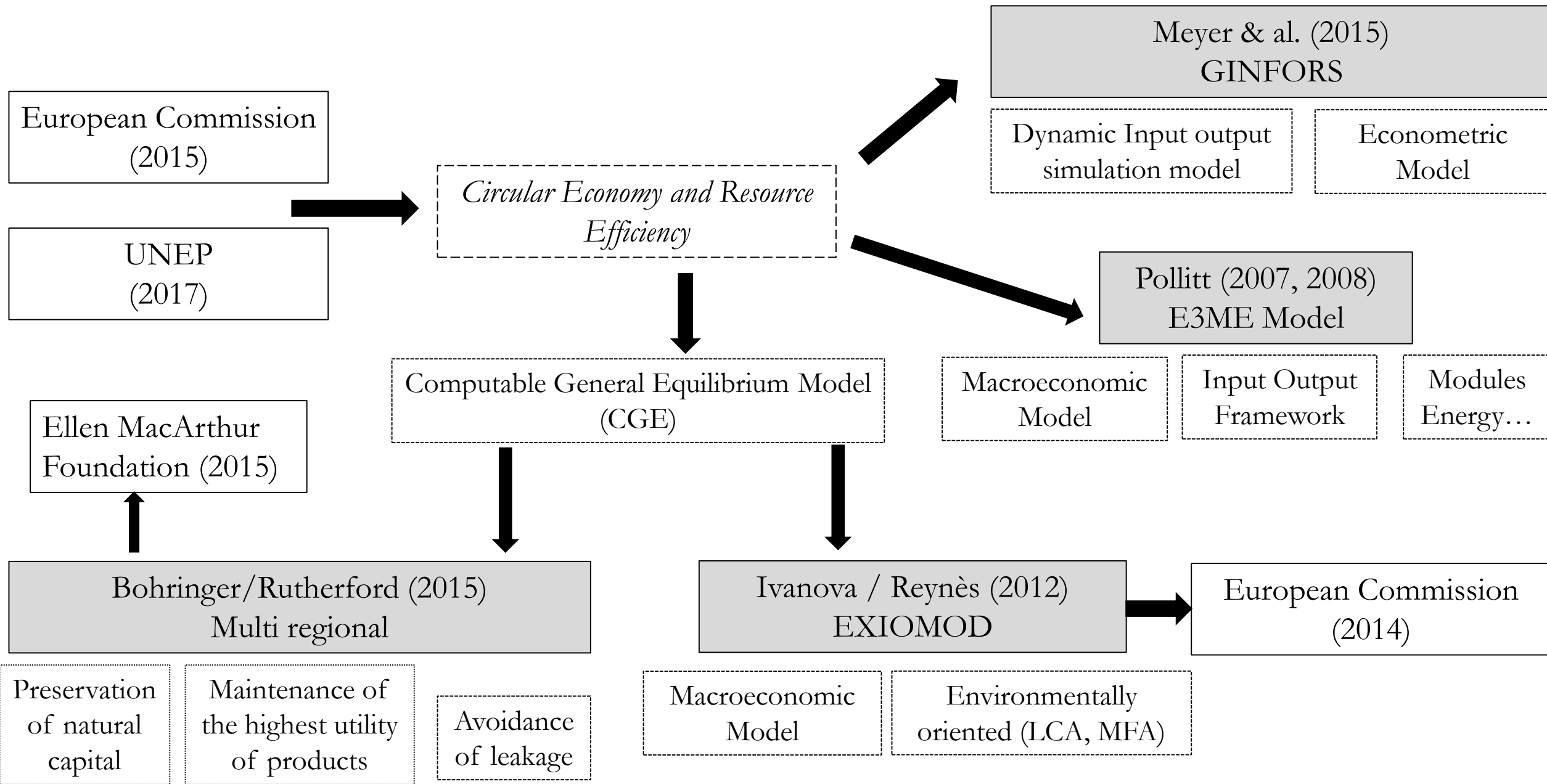*Source: Eurostat (online data code: nama_10_gdp; env_ac_mfa; env_ac_rp)*

eurostat

Direct Material Input (DMI) measures the direct and actual input of materials into a given national economy originating from the natural environment or from the rest of the world. It includes the total amount of materials (excluding bulk material flows such as water and air) which are of economic value and are available for the national economy's production system. DMI represents the total material throughput or material scale of an economy. It is an indicator derived from Economy Wide - Material Flow Accounts (EW-MFA).
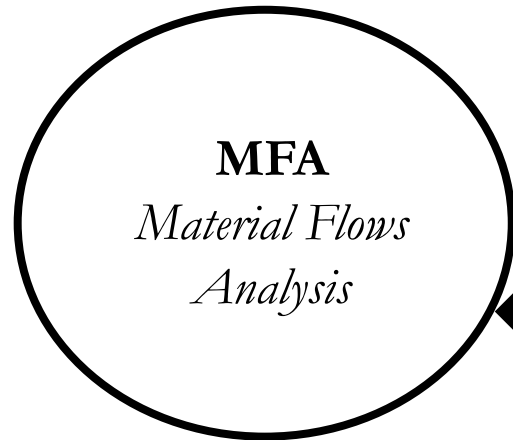
Domestic Extraction (DE) is the annual amount of raw material (except for water and air) extracted from the natural environment. DMI is calculated as the sum of Domestic Extraction plus physical imports.

Domestic Material Consumption (DMC) measures the total amount of materials directly used by an economy and is defined as the annual quantity of raw materials extracted from the domestic territory, plus all physical imports minus all physical exports. The DMC indicator provides an assessment of the absolute level of the use of resources, and allows to distinguish consumption driven by domestic demand from consumption driven by the export market.
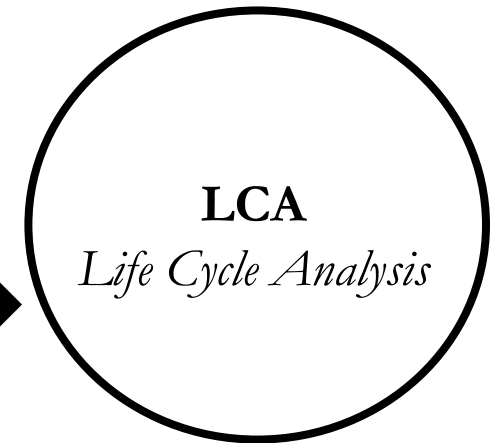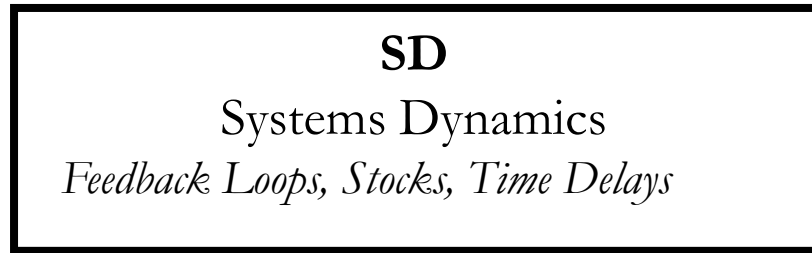
Macro level for Circular Economy – Resource Efficiency - CGE Models

European Commission (2015)

UNEP (2017)

Circular Economy and Resource Efficiency

Ellen MacArthur Foundation (2015)

Computable General Equilibrium Model (CGE)

Meyer & al. (2015) GINFORS

Dynamic Input output simulation model

Econometric Model

Pollitt (2007, 2008) E3ME Model

Macroeconomic Model

Input Output Framework

Modules Energy…

Bohringer/Rutherford (2015) Multi regional

Ivanova / Reynès (2012) EXIOMOD

European Commission (2014)

Preservation of natural capital

Maintenance of the highest utility of products

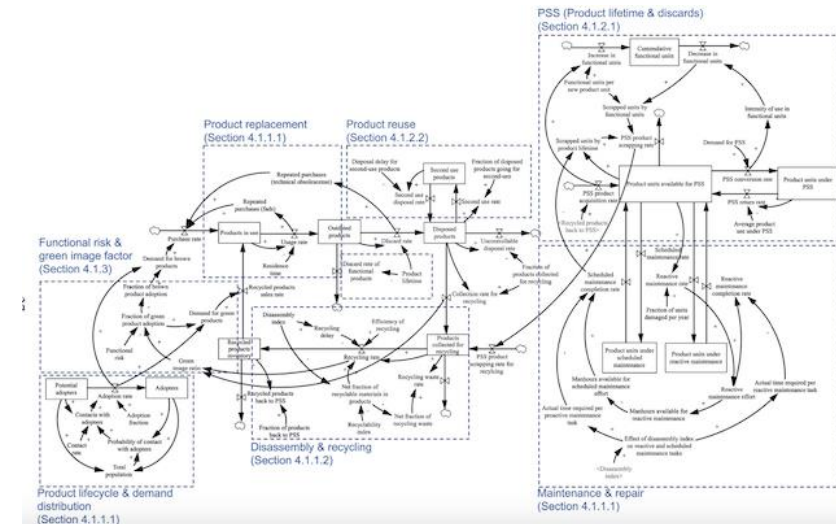Avoidance of leakage

Macroeconomic Model

Environmentally oriented (LCA, MFA)

Macro Level for Circular Economy – Closing loops – Systems Dynamics

SD
Systems Dynamics
Feedback Loops, Stocks, Time Delays

MFA
Material Flows Analysis

C. Gao & al. (2020)

LCA
Life Cycle Analysis

J.T.M Pinto & al. (2019)

Regional Circular Economy
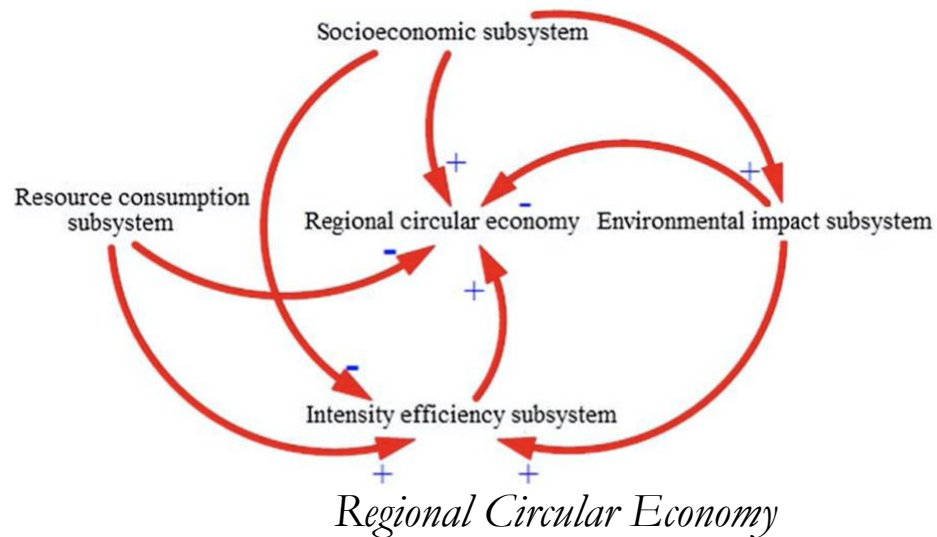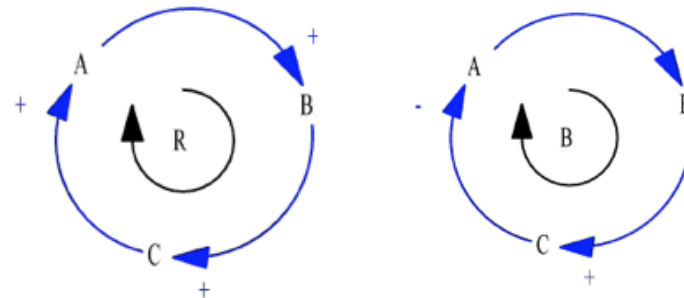
Steel Industry

EU's Monitoring Framework and indicators for Circular Economy

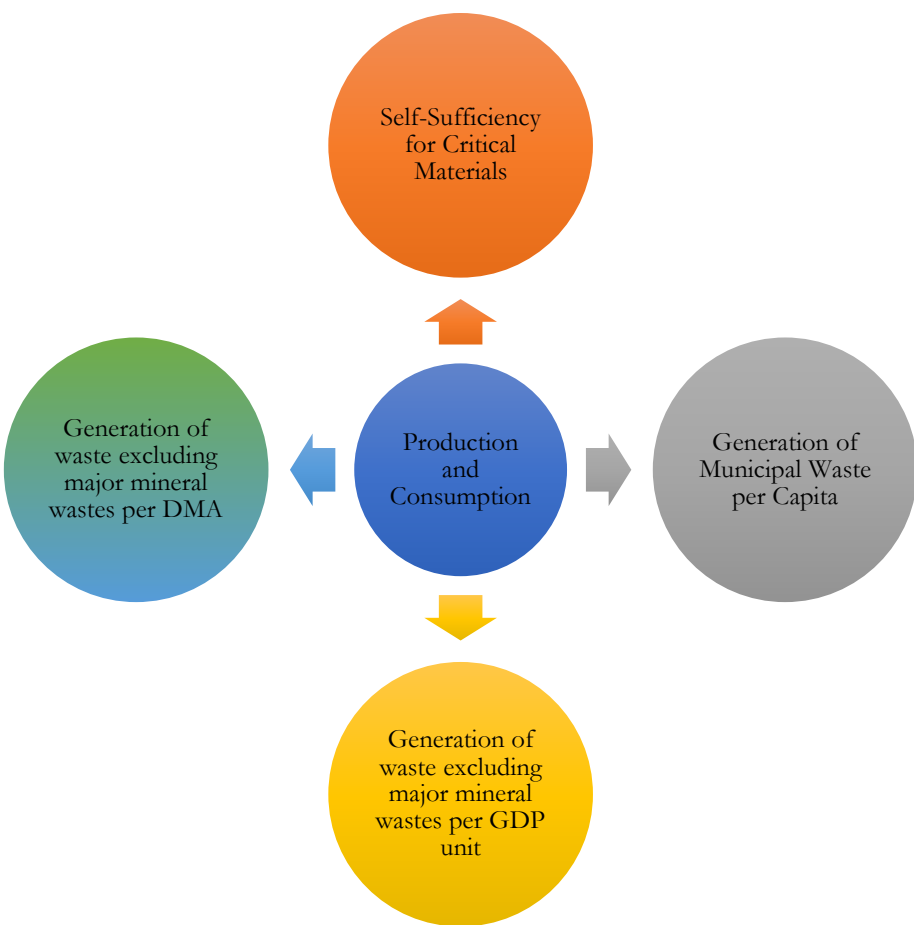## *Production and Consumption : 4 indicators*

EU Self-sufficiency for Critical Materials

Generation of Municipal Waste per Capita (Kg per capita) as indicator for consumption

↕	TIME	2016 ↑
MATERIAL ↕		
Borate		0
Dysprosium		0
Europium		0
Magnesium		0
Molybdenum		0
Neodymium		0
Phosphorus		0
Tantalum		0
Yttrium		0
Natural graphite		0.6
Platinum		2.3
Lithium		14.5
Vanadium		15.6
Copper		17.5
Iron		25.7
Fluorspar		30.3
Germanium		35.9
Silicon		36.2
Aluminium		36.4
Tungsten		56.4
Gallium		65.8
Cobalt		68.2
Limestone		97.1
Indium		115

Diagram: Production and Consumption — Self-Sufficiency for Critical Materials; Generation of Municipal Waste per Capita; Generation of waste excluding major mineral wastes per DMA; Generation of waste excluding major mineral wastes per GDP unit

Municipal waste generated, 2018 (kg per capita)

Denmark 766, Malta 640, Cyprus (¹) 637, Germany 615, Luxembourg 610, Austria 579, Ireland (¹) 576, Finland 551, France 527, Netherlands 511, Portugal 508, Greece (¹) 504, Italy 499, European Union 492, Slovenia 486, Spain 475, Lithuania 464, Sweden 434, Croatia 432, Bulgaria 423, Slovakia 414, Belgium 411, Latvia 407, Estonia 405, Hungary 381, Czechia 351, Poland 329, Romania 272, United Kingdom 463, Norway 739, Switzerland 703, Iceland (¹) 656

Waste Management : 6 indicators

Overview **recycling rates** of different waste streams (EU, 2018)

Waste stream	Rate
All waste excluding major mineral waste*	56% Recycled
Municipal waste	47% Recycled
Overall packaging	66% Recycled
Plastic packaging	42% Recycled
E-waste	35% Recycled
Construction and Demolition Waste	88% Recovered

*2016

Waste Management comprises two groups of indicators:

- Recycling rates (the share of waste which is recycled);
- Specific waste streams (packaging waste, biowaste, e-waste, etc.).

Less

Increasing recycling is part of the transition to a circular economy. This area focuses on the share of waste which is recycled and actually returned into the economic cycle to continue creating value.

Central diagram — Waste Management:
- Recycling Rate of Municipal Waste
- Recycling Rate of All Waste
- Recovery Rate of Construction and Demolition Waste
- Recycling of Biowaste
- Recycling Rate of e-waste
- Recycling Rate of Packaging

European Union's imports and exports of waste
(million tonnes)

Imports from countries outside the EU
Exports to countries outside the EU

Exports of waste from the EU of 27 has increased by two thirds since 2004 (31 million tonnes). In contrast, imports of waste have fallen (16.7 million tonnes).

Main destinations for waste from the European Union, 2019
(million tonnes)

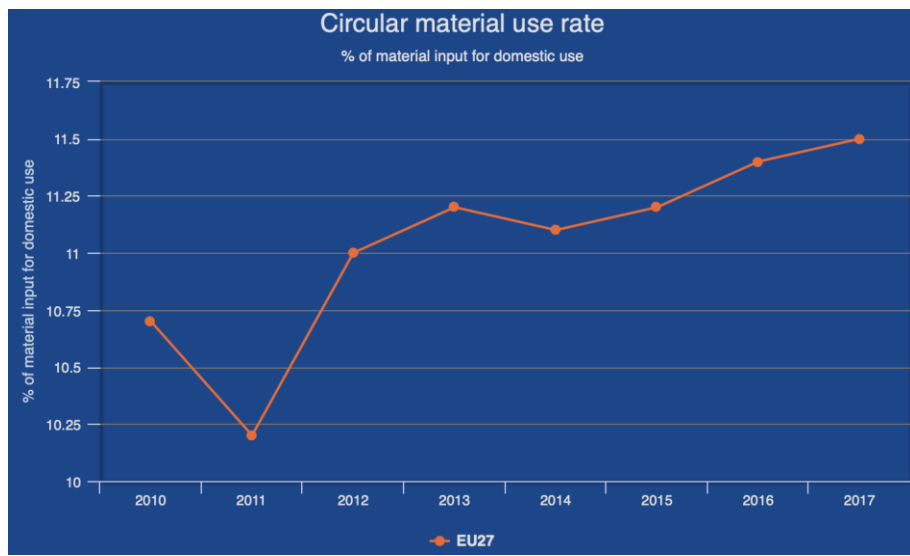| Country	Value
Turkey	11.4
India	2.9
United Kingdom	1.9
Switzerland	1.6
Norway	1.5
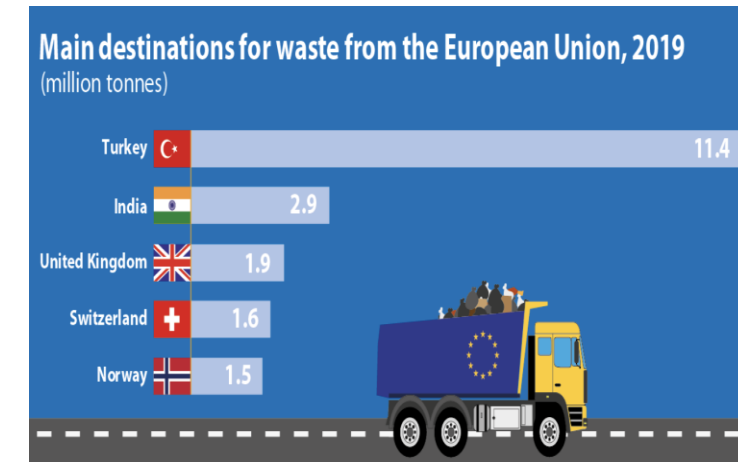
Turkey is the largest destination for waste exported from the EU (11.4 tonnes in 2019) : Three times as much as in 2004. EU Export from China have fallen from 10.1 million tonnes in 2009 to 1.2 million tonnes in 2019.

Raw Materials : 3 indicators
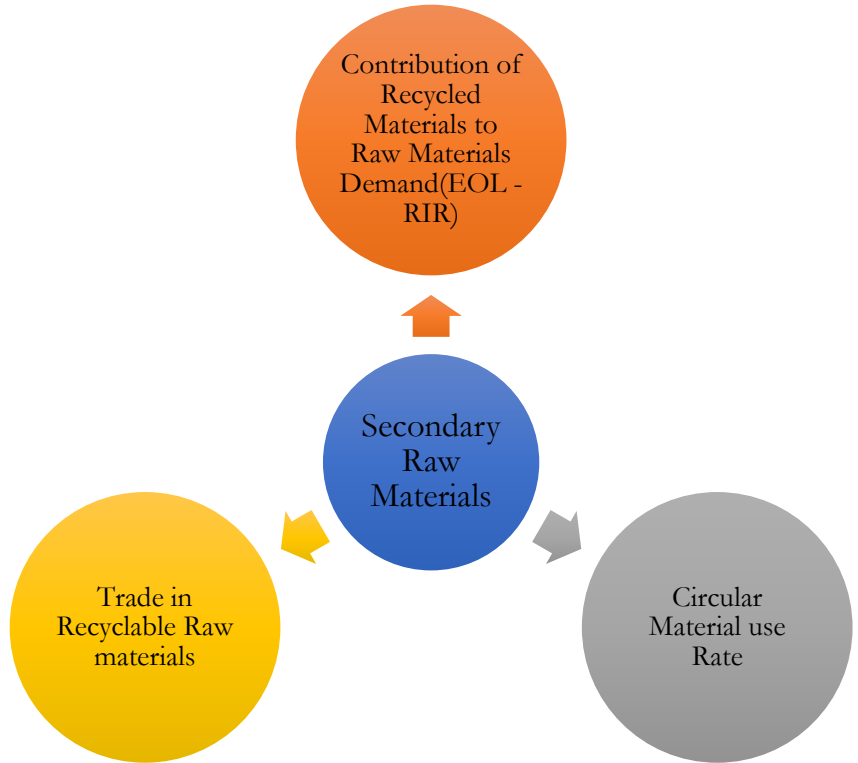
Circular Material Use Rate

To close the loop, material and products need to be re-introduced into the economy, in form of new materials or products. Recycled materials replace newly extracted natural resources, reduce the environmental footprint of production and consumption and increase the security of the future supply of raw materials.
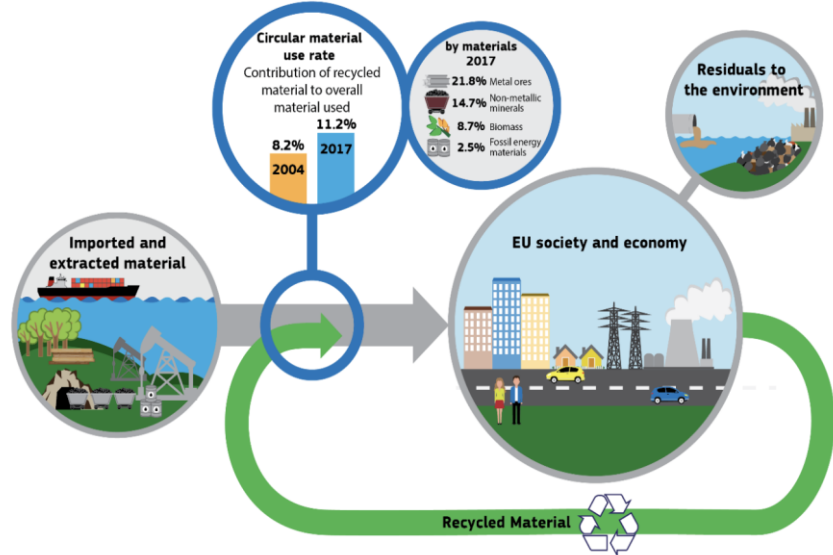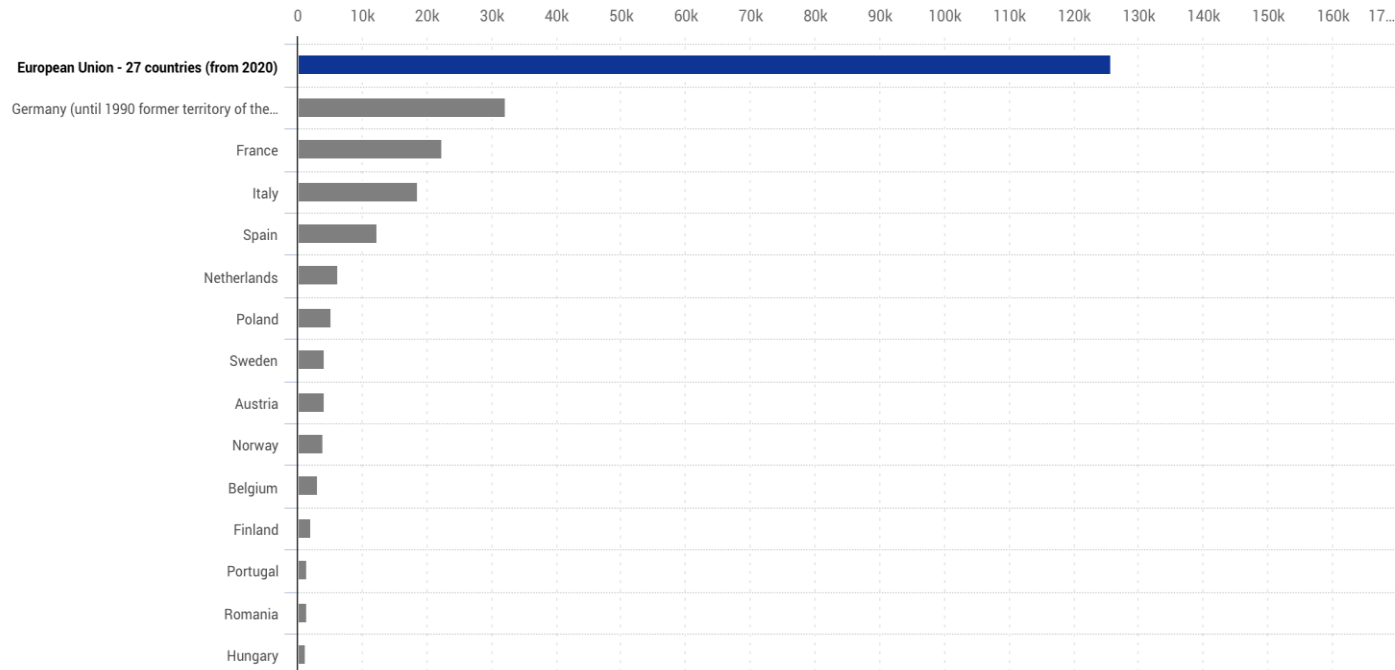
Competitiveness and Innovation : 3 indicators

The circular economy contributes to the creation of jobs and growth. The development of innovative technologies (Patents) is dominated by Asian Countries (China, Hong Kong and Indonesia)

**Private investments, Jobs and Gross Added Related to Circular Economy**

The indicator includes "Gross investment in tangible goods", "Number of persons employed" and "Value added at factor costs" in the following three sectors: the recycling sector, repair and reuse sector and rental and leasing sector.

Patents related to recycling and secondary raw materials
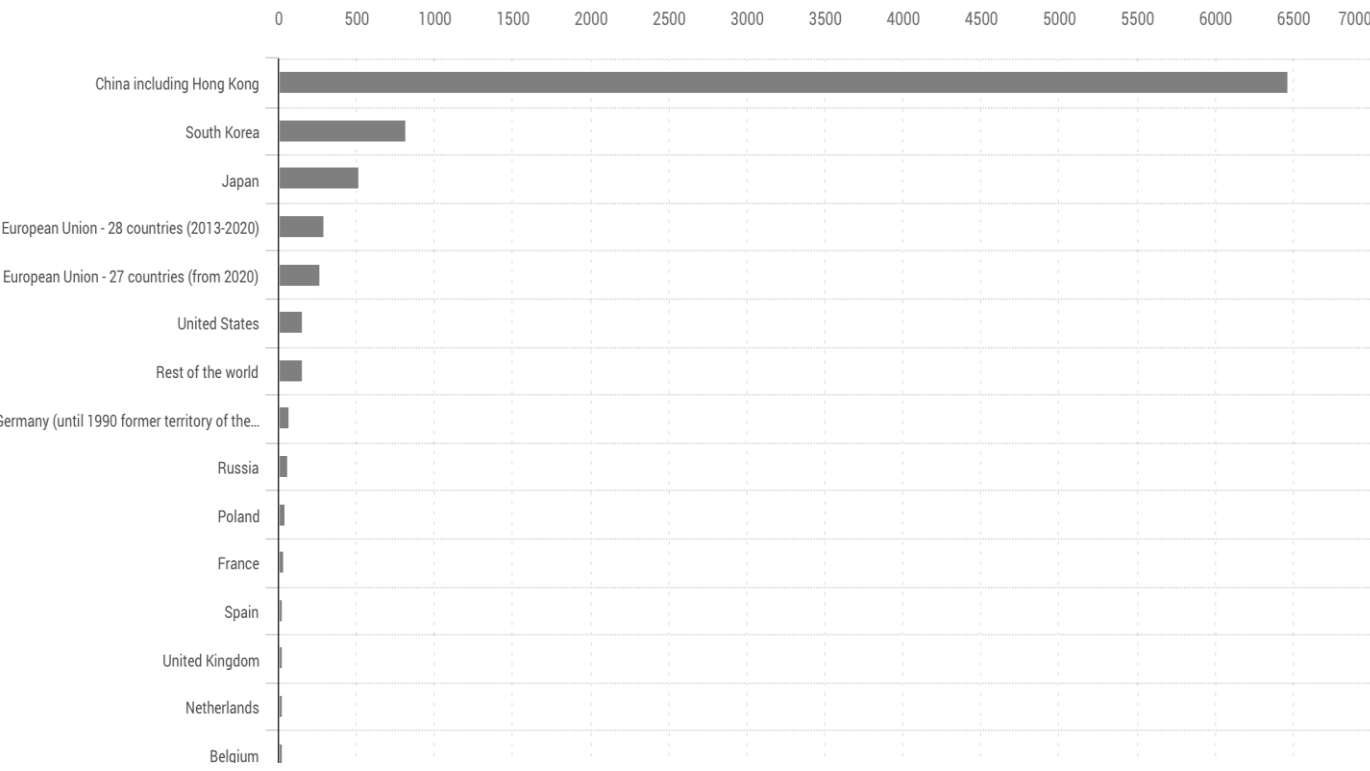
Patent Box Regimes in Europe

Effective Corporate Income Tax Rates on Qualifying IP Income under a Patent Box Regime, as of July 2021
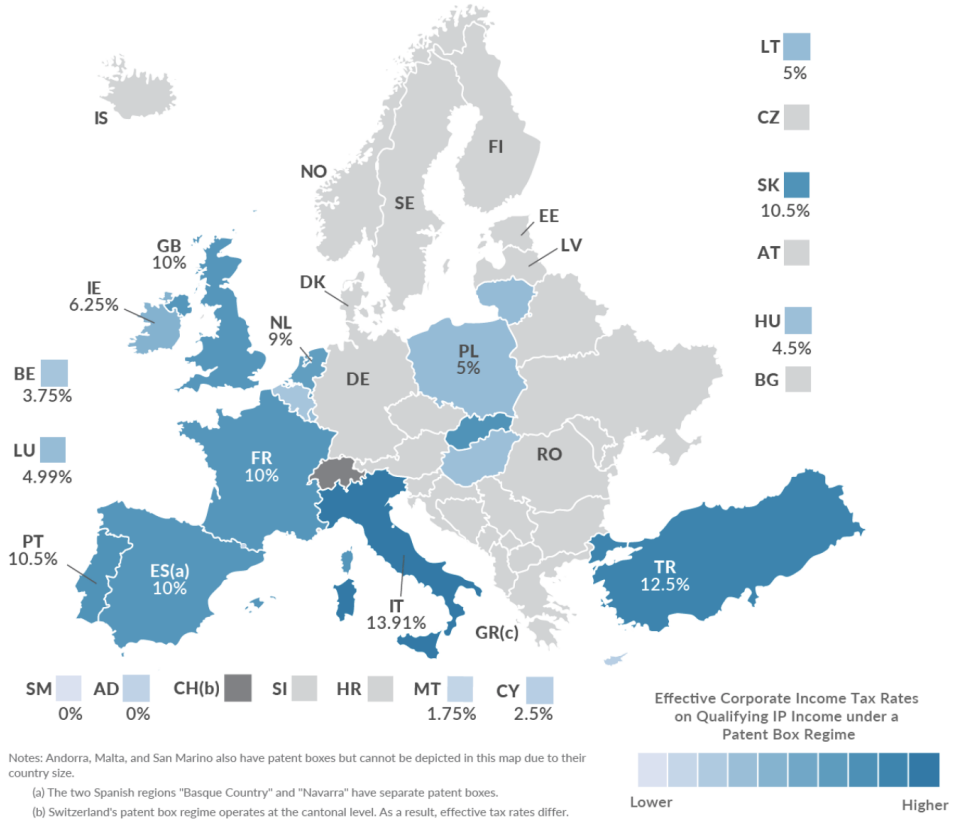
Notes: Andorra, Malta, and San Marino also have patent boxes but cannot be depicted in this map due to their country size.

(a) The two Spanish regions "Basque Country" and "Navarra" have separate patent boxes.

(b) Switzerland's patent box regime operates at the cantonal level. As a result, effective tax rates differ.

(c) Greece has a three-year exemption for profits from the sale of self-manufactured goods based on an internationally recognized patent.

Source: Sources: OECD, "Corporate Tax Statistics: Intellectual Property Regimes;" Bloomberg Tax, "Country Guide;" PwC, "Worldwide Tax Summaries;" and EY, "Worldwide R&D Incentives Reference Guide 2021."

Conclusion for Erasme Projects

IAM LOOP : Integrated Assessment Models for Living On One Planet - using iSDG model (System Dynamics) to challenge national and territorial scales : France, Burkina Faso

IATB LOOP (Integrated Assessment Tools Box for Living On One planet) : 2021 – 2023 (AUF)

CE LOOP : Circular Economy for Living On One Planet – developing a circular economy model at the city level → International Network of Michelin Cities (40 cities) and Jacques Cartier Meetings (october 2020, october 2021)

European Chair on Circular Economy and Industrial Ecology (Jean Monnet Grant, november 2021)