CIRCULAR ECONOMY: KEY CONCEPTS AND PROBLEMS.

William V. Longhi

GOAL NO. 12 OF THE 2030 AGENDA: ITS TARGETS

Among different objectives of 2030 Agenda, the one most centered on the concept of circularity is doubtless **goal no. 12: "Ensure sustainable consumption and production patterns"**.

- ✓ **12.1** Implement the **10-year framework of programmes** on sustainable consumption and production, all countries taking action, with developed countries taking the lead, taking into account the development and capabilities of developing countries
- ✓ **12.2** By 2030, achieve the sustainable management and **efficient use of natural resources**
- ✓ **12.3** By 2030, halve per capita global **food waste** at the retail and consumer levels and **reduce food losses** along production and supply chains, including post-harvest losses
- ✓ **12.4** By 2020, achieve the environmentally sound management of **chemicals** and all wastes throughout their life cycle, in accordance with agreed international frameworks, and significantly **reduce their release to air, water and soil** in order to minimize their adverse impacts on human health and the environment

GOAL NO. 12 OF THE 2030 AGENDA: ITS TARGETS

- ✓ **12.5** By 2030, substantially reduce waste generation through **prevention, reduction, recycling and reuse**

- ✓ **12.6** Encourage companies, especially large and transnational companies, to adopt sustainable practices and to integrate **sustainability information into their reporting cycle**

- ✓ **12.7** Promote **public procurement practices** that are sustainable, in accordance with national policies and priorities

- ✓ **12.8** By 2030, ensure that people everywhere have the relevant information and **awareness for sustainable development** and lifestyles in harmony with nature

GOAL NO. 12 OF THE 2030 AGENDA: ITS TARGETS

12.A Support developing countries to strengthen their scientific and technological capacity to move towards more sustainable patterns of consumption and production

12.B Develop and implement tools to monitor sustainable development impacts for **sustainable tourism** that creates jobs and promotes local culture and products

12.C Rationalize **inefficient fossil-fuel subsidies** that encourage wasteful consumption by removing market distortions, in accordance with national circumstances, including by restructuring taxation and phasing out those harmful subsidies, where they exist, to reflect their environmental impacts, taking fully into account the specific needs and conditions of developing countries and minimizing the possible adverse impacts on their development in a manner that protects the poor and the affected communities

GOAL NO. 12 OF THE 2030 AGENDA: ITS TARGETS

For each target there are **indicators** to measure the performance:

Target

12.5

By 2030, substantially reduce waste generation through prevention, reduction, recycling and reuse

Indicators ▲

12.5.1

National recycling rate, tons of material recycled

Target

12.6

Encourage companies, especially large and transnational companies, to adopt sustainable practices and to integrate sustainability information into their reporting cycle

Indicators ▲

12.6.1

Number of companies publishing sustainability reports

CHARACTERISTICS OF THE CIRCULAR ECONOMY

The circular economy is an economy conceived, organized and structured in order to be able to

self-regenerate.

The idea of the circular economy was born as a reaction to three related, but different problems:

1. the **limited availability of natural resources** that can be used in production cycles, in relation to the growing needs of the capitalist model, in constant extension also in emerging countries (China, India, Indonesia, Vietnam…) and in developing countries (Nigeria, Ethiopia…);
2. the **impact on the environment** that derives from increases in the consumption of goods, resources and energy, determined by the spread of well-being;
3. the **social impact of the capitalist model**, in terms of inequalities within single nation and among different States (territorial inequalities, delocalizations, exploitations).

TWO MODELS COMPARED

LINEAR ECONOMIC MODEL

The current economic model is considered a linear model;

it is also defined as '**take-make-dispose**' since it starts from a certain availability of natural and energy resources for the creation of products with which the entire process ends. The outcome is characterized by:

- increasing consumption of **limited and non-reproducible resources** (fossil fuels);
- release on the planet and into the atmosphere of **large amounts of waste** deriving from production and consumption.

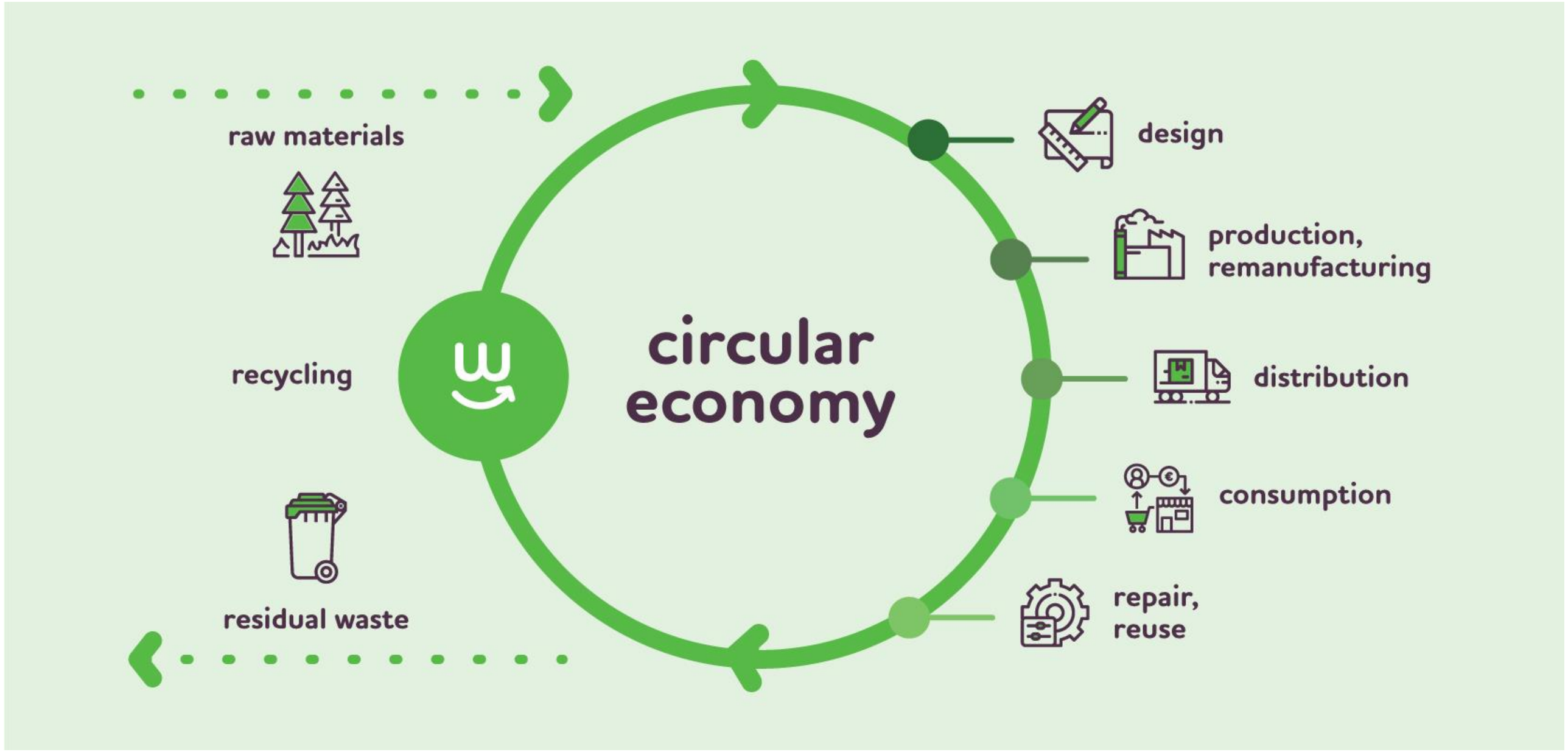
CIRCULAR ECONOMIC MODEL

The alternative economic system is the circular model. In this case, all phases of the product life cycle - design, production, commercial distribution, consumption - can represent an opportunity to:

- limit the contribution of **raw material and energy** as production inputs;
- limit the **production of waste** materials;
- limit the impact of **negative externalities**: environmental (pollution) and social (exploitation) as well;
- realize **new economic value**, altogether with new **social value** (not only profit, but also well-being).

All this could be summed up in this way:

more quality and **less quantity** in production and consumption models.


raw materials
recycling
residual waste
circular economy
design
production, remanufacturing
distribution
consumption
repair, reuse

THE MAIN TOOLS OF THE CIRCULAR ECONOMY

Recycling: at the end of the product's life cycle, the reduction of potential waste can be obtained thanks to the collection, disassembly and recovery of the materials that constitute it, to be regenerated and reused in new production cycles; it is a phase whose responsibility lies with businesses.

Reuse: it is a process that allows to extend the life of the products on the market, preferring the repair rather than the replacement of a product, or the purchase of second-hand or regenerated goods to the purchase of new products.

Reduction: move towards a consumption that allows you to eliminate waste, improving the efficiency of consumer spending, avoiding the purchase of unused goods, or only partially used or destined to quickly become waste. The reduction may aim to reduce the importance of owning an asset in favor of its use (car-sharing or book exchange opportunities).

ELLEN MACARTHUR FOUNDATION: 5 PRINCIPLES FOR THE CIRCULAR ECONOMY

To understand how a circular economy model can be feasible, based on recycling, reuse and reduction, one can also be inspired by the five key principles indicated (some years ago…) by the **Ellen MacArthur Foundation**:

- eco-design;
- versatility;
- renewable energies;
- holistic approach;
- recovery of materials.

5 PRINCIPLES

ECO-DESIGN

The possibilities of recovering waste materials and the product at the end of its life cycle must be made concrete right from the **design stage**.

MATERIALS RECOVERY

Promote the industrial use of **secondary raw materials** instead of raw materials.

VERSATILITY

Designing products characterized by a wide flexibility and modularity in use, so that their reuse can be promoted even in situations other than those for which it was initially conceived.

RENEWABLE ENERGIES

Encourage the progressive abandonment of the use of fossil fuels by favoring **renewable energy** with low environmental impact.

HOLISTIC APPROACH

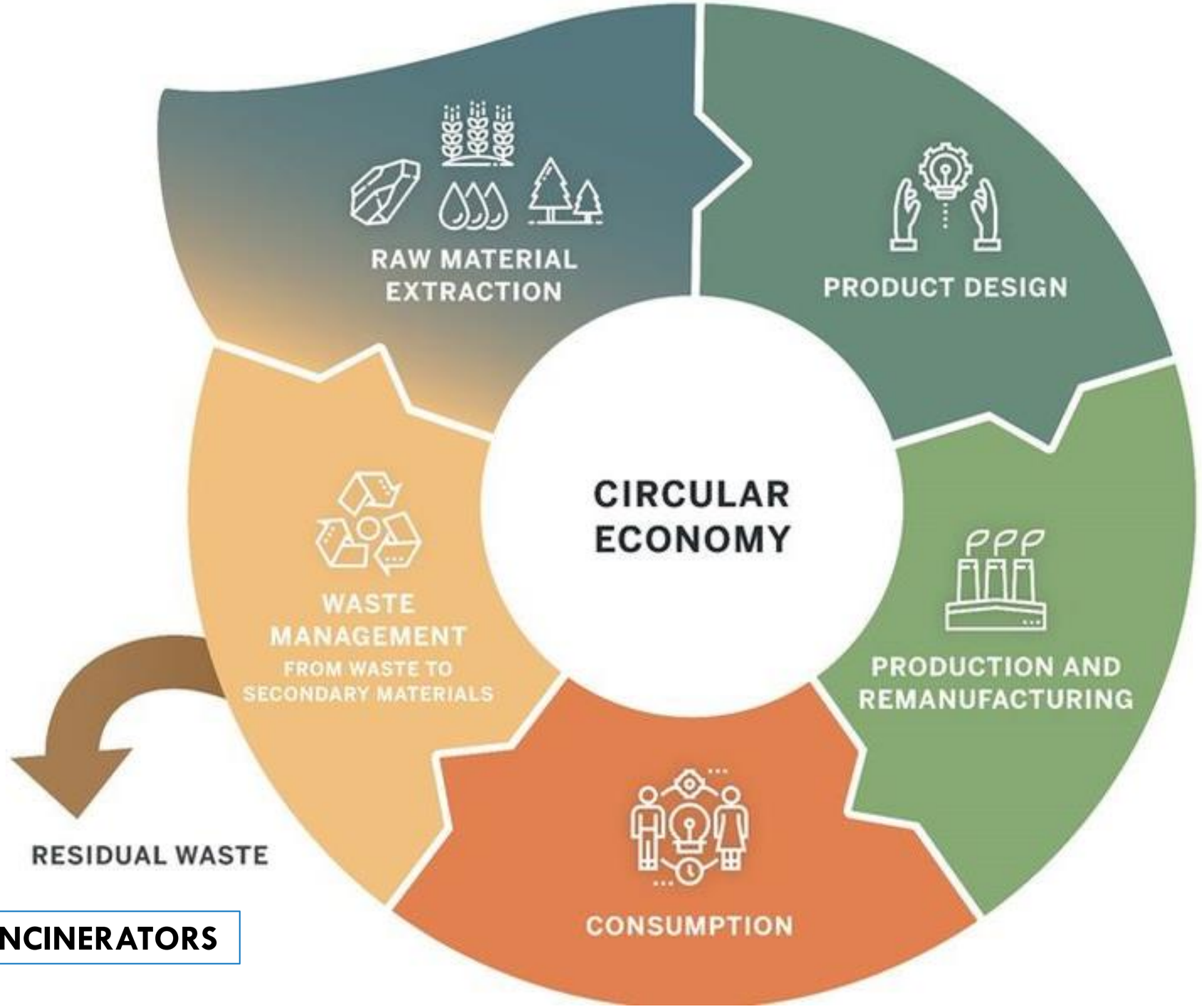
In corporate and national economic planning, adopt a **systemic orientation**, which allows to always consider the interdependencies between the different elements of an ecosystem.

ABANDONMENT IN THE ENVIRONMENT

LANDFILLS – RUBBISH DUMP

WASTE TO ENERGY PLANTS

INCINERATORS



SOME CLARIFICATIONS...

INCINERATORS AND WASTE-TO-ENERGY PLANTS

Incinerators and **waste-to-energy plants** are plants that burn waste: in Italy, for example, there are 56 industries of this type, and for the most part they are waste-to-energy plants located in the North, of which 13 in Lombardy.

- **Incinerators** are simple plants intended for the incineration of waste to reduce their volume, without any form of energy recovery; they are almost all located in the Center and South of Italy;

- **Waste-to-energy plants,** on the other hand, are industries that converts municipal and industrial solid waste into electricity and/or heat for industrial processing and for district heating systems – an ecologically sound of energy recovery. The energy plant works by burning waste at high temperatures and using the heat to make steam; the steam then drives a turbine that creates electricity.

open issues (debate?...):

- recovery and disposal of the post-combustion residue;
- reduction of emissions.

SECONDARY RAW MATERIALS

Secondary raw materials derive from:

- ❑ waste from the **production process** recovered through recycling activities;
- ❑ **urban separate waste collection** in the downstream phase of the product life cycle.

This type of materials are fed back into another production cycle as raw (secondary) materials.

Examples of secondary raw materials are glass, wood, aluminum, paper, organic.

COMMON USE OBJECTS FROM RECYCLING

GLASS...

Glass is, with steel and aluminum, a **permanent material** or, in recycling, it does not change its chemical and physical characteristics.

When a kilogram of glass is sent for recycling, it does not suffer a loss of mass or property.

If you take a dark container, such as that of a beer, it will most likely have been made thanks to the separate collection and recycling of glass bottles and jars.

Warning! transparent containers can be made (in the case of recycling) only from transparent scrap.

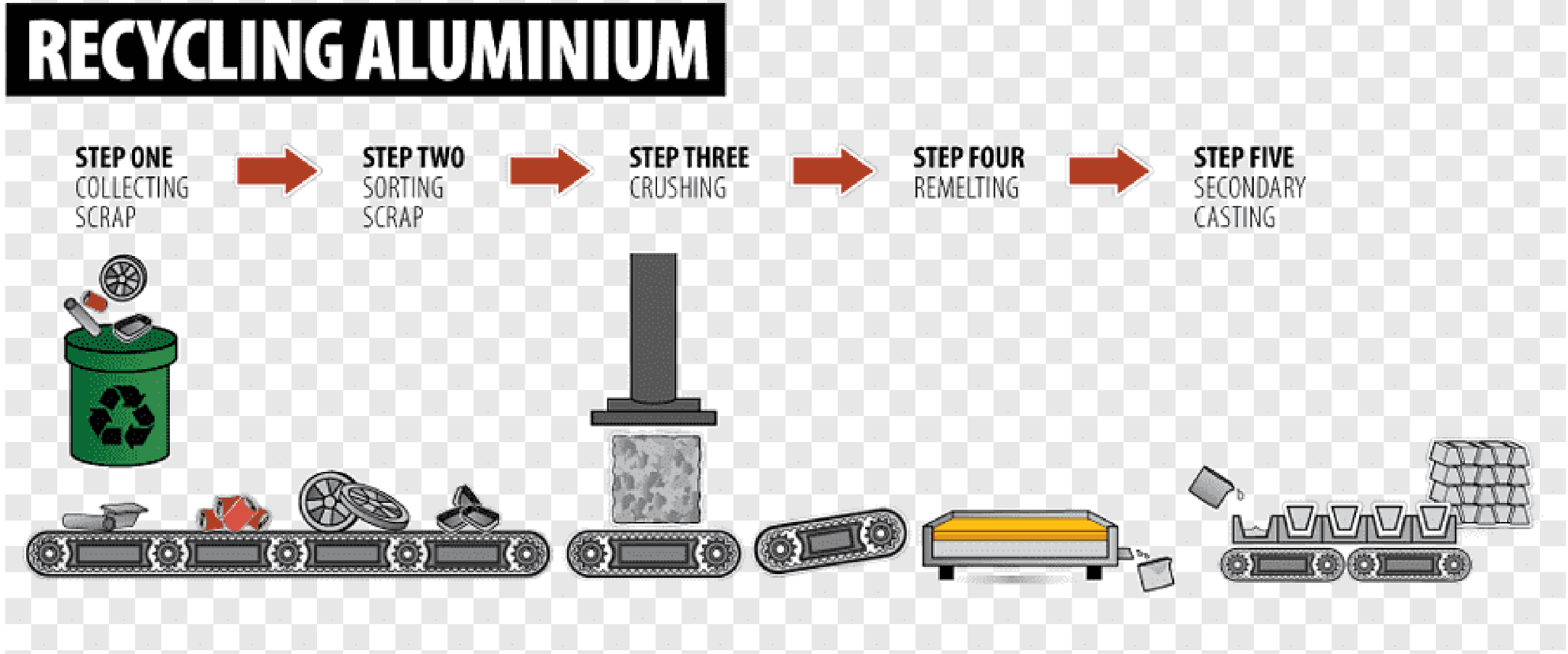
In some places (for example in Germany) the collection by colors has also started!

ALUMINUM

Aluminum is also a permanent material and by its nature it is, therefore, theoretically recyclable indefinitely.

With 37 cans you can, for example, make a mocha coffee maker, while with 800… a bicycle!

And then desk lamps or mighty high-speed train carriages



PLASTIC… AND PAPER

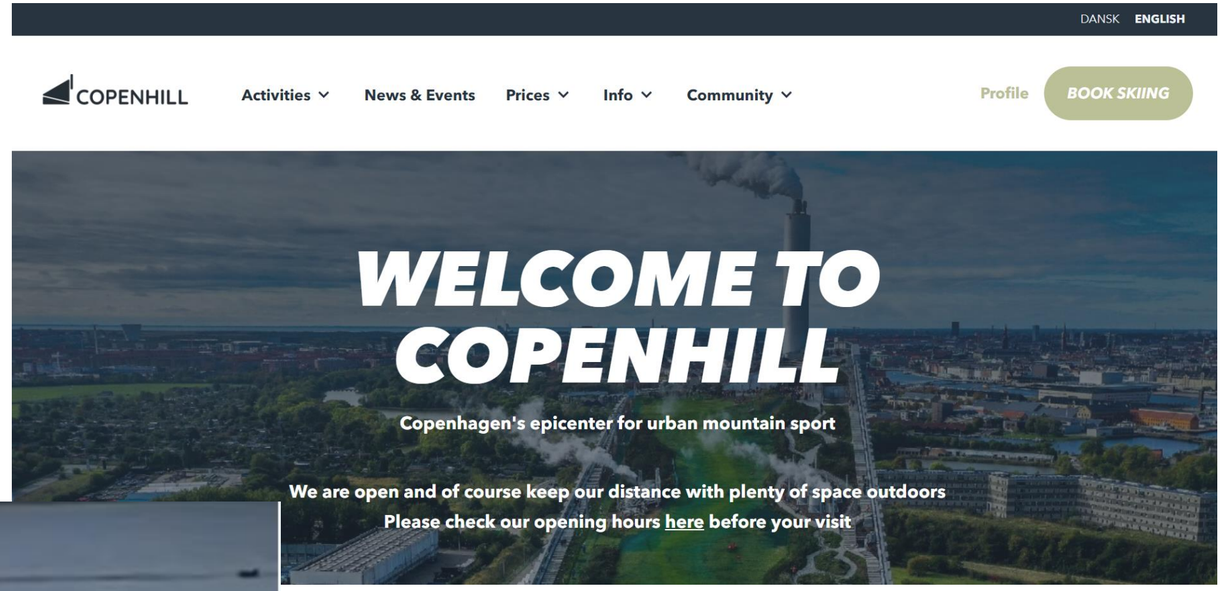
With about 18-30 plastic bottles you can make a warm sweatshirt, with 20 a soft blanket.

The textile sector could not satisfy the demand with natural fibers alone.

Paper: since they are not permanent materials, a little virgin raw material must be added, coming from wood, but thanks to recycling, the amount needed will be much less and, above all, waste will be avoided.

A COUPLE OF CONCRETE EXAMPLES OF CIRCULAR ECONOMY IN EUROPE

In Copenhagen and Stockholm, state-of-the-art waste-to-energy plants are used, highly efficient and with the utmost respect for the environment.



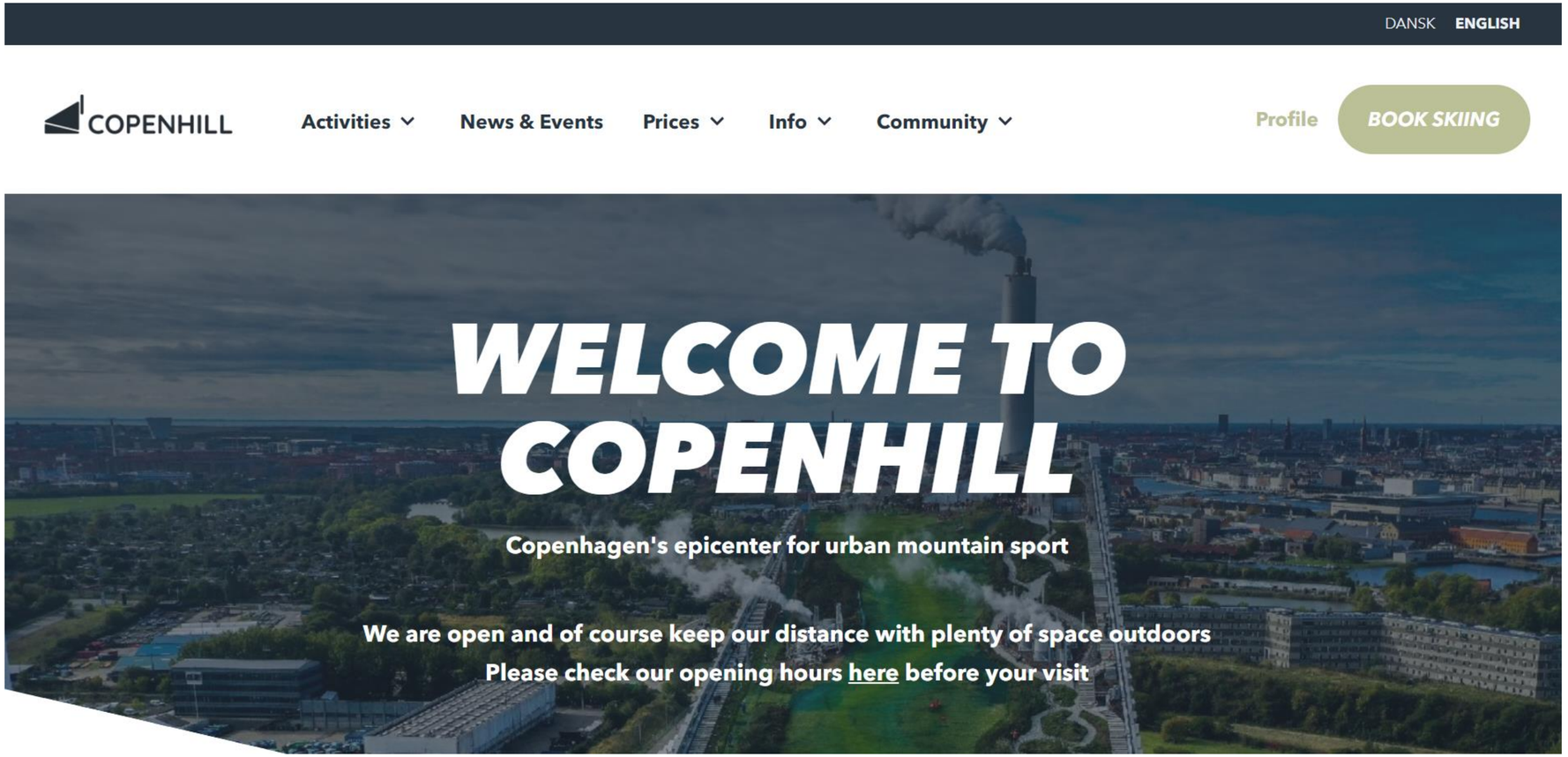
COPENHILL

In Denmark, **the waste-to-energy project** cost about $ 660 million and is located just 5 km from the city center. It's called Amager Bakke, but they renamed it Copenhill, "Green Hill", and it was launched in September 2017.

The plant is at the forefront, getting rid of about 70 tons of waste per hour (about 400 thousand per year), and with a sophisticated filtering system it manages to do so by reducing emissions by 99.5%.

Copenhill is also an artificial ski resort: three slopes that connect the highest point of the incinerator, about 90 meters high, to the base. And then again hiking trails, walls to climb and large green spaces all around. While under their feet the "mountain" swallows garbage, transforming it into electricity and heat for almost 200 thousand users.

COPENHILL VIDEO



HAMMARBY SJÖSTAD

About 50% of the electricity used in Swedish homes comes from renewable energy and less than 1% of their waste ends up in landfills, the government having focused on massive campaigns for the reuse of all kinds of materials.

In Stockholm, in the 90s, the Hammarby Sjöstad district was created, a former industrial area transformed into a sort of highly futuristic open-air scientific experiment for waste management.

There are no bins on the street, but the waste is separated, collected and distributed through a complex system of pipes that suck it up and send it directly to recycling.

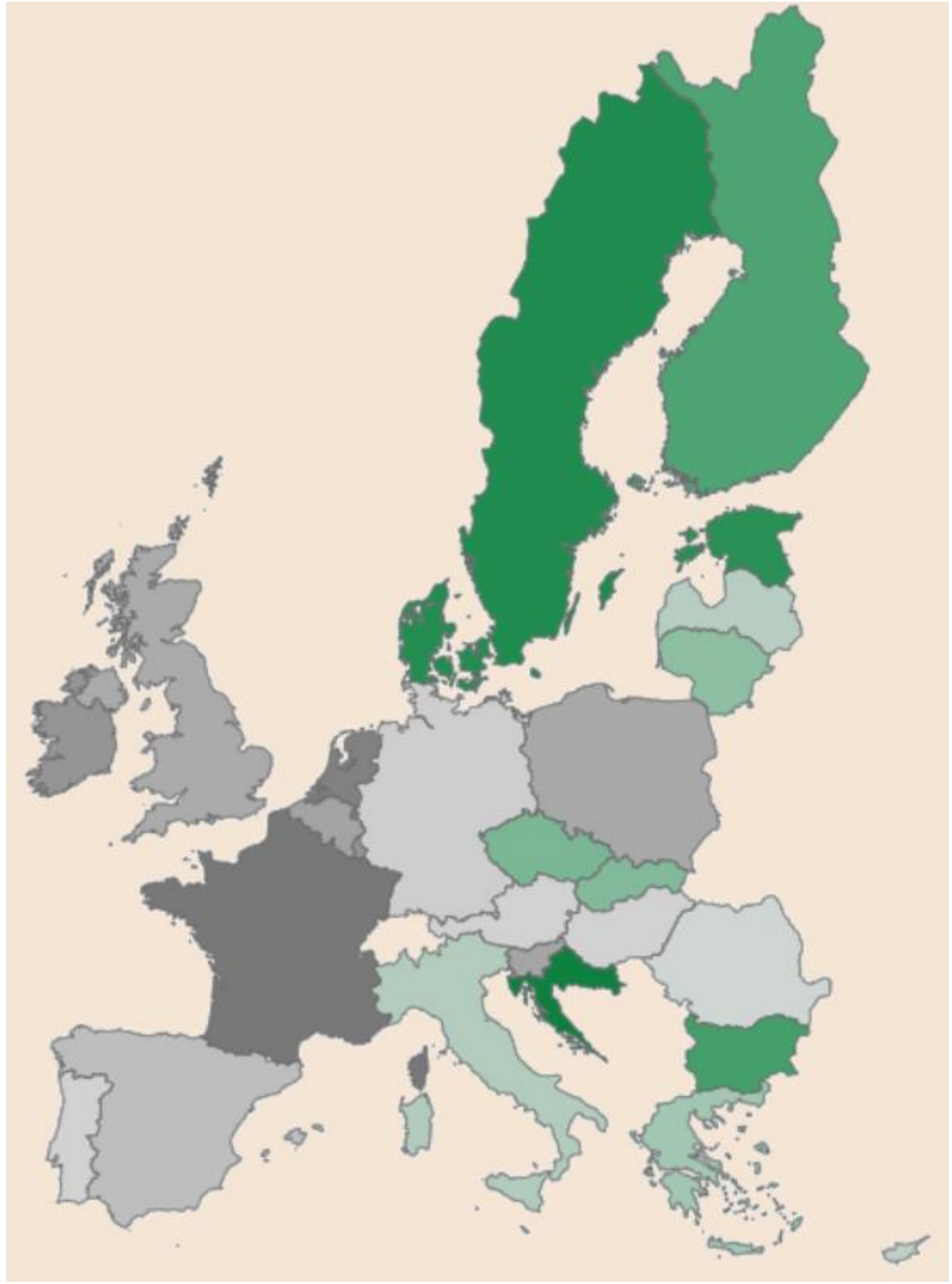
Thanks to this mechanism, almost 50% of the neighborhood's energy comes from its own waste.

On the contrary, the problem for the country is becoming the availability of garbage, which imports mainly from the United Kingdom (and the difficulties in this sense imposed by Brexit are considerable) and by Italians, who pay the Scandinavians about 40 euros per ton. to take charge of their waste and transform it into **energy**, therefore also into **money**.

WHAT ARE THE INDICATORS THAT THE GREEN GENERATION MUST KEEP UNDER CONTROL?

RENEWABLE ENERGIES - SECONDARY RAW MATERIALS

SOME NUMBERS...

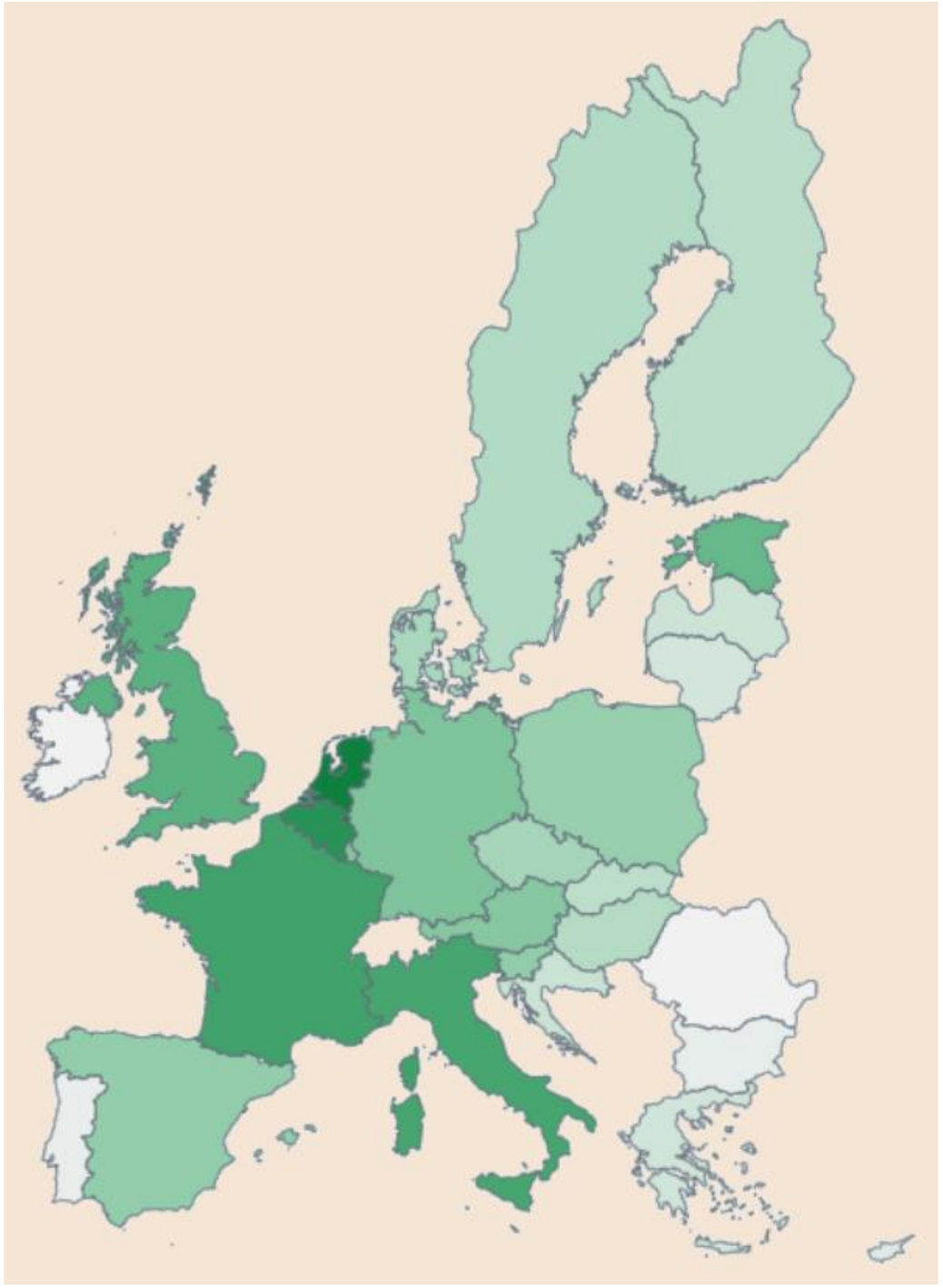


The first indicator concerns the production of energy from **renewable sources.**

In the map we can see values as a percentage of the total energy produced: in green the countries that have exceeded the 2020 targets, in gray those that have failed.

Among the worst are the Netherlands and France, while Croatia, Sweden and Denmark are among the best.

Data as of 2019 - Source: Eurostat



This map shows the percentage of waste that is transformed into **secondary raw materials.**

The highest percentage is reached in the Netherlands, where the share of waste that becomes secondary raw materials reaches 28.5%. But the Belgian, Italian, French and British contributions are also important: 24%, 19.3%, 20,1% and 16,6% of materials, respectively, are reintroduced into the economy.

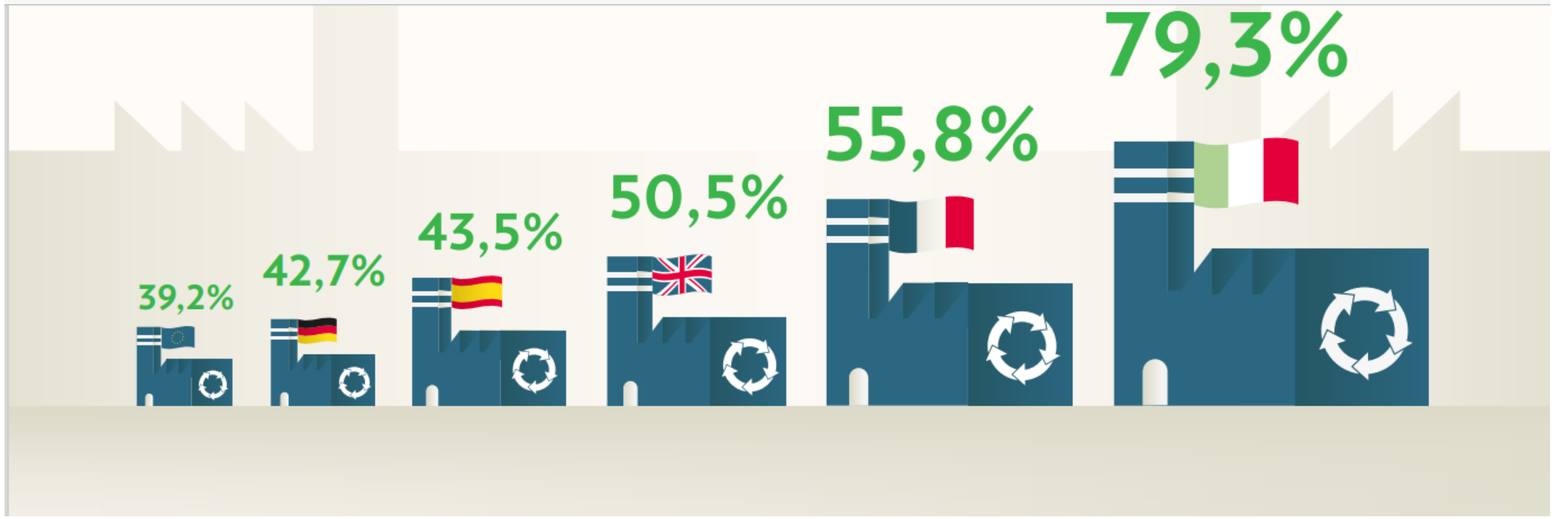
Data as of 2019 - Source: Eurostat

Another Report updates the analysis on the state of **circular economy in UE**, assessing the results achieved in the areas of production, consumption, circular waste management, as well as investments and employment in **recycling**, **repairing** and **reuse**.

For each of these areas a set of indicators was identified, resulting in a mark, and it was thus developed a comparison among the main economies in the European Union: Germany, France, Italy, Spain, and Poland, the latter being the fifth European economy after the UK left the EU.

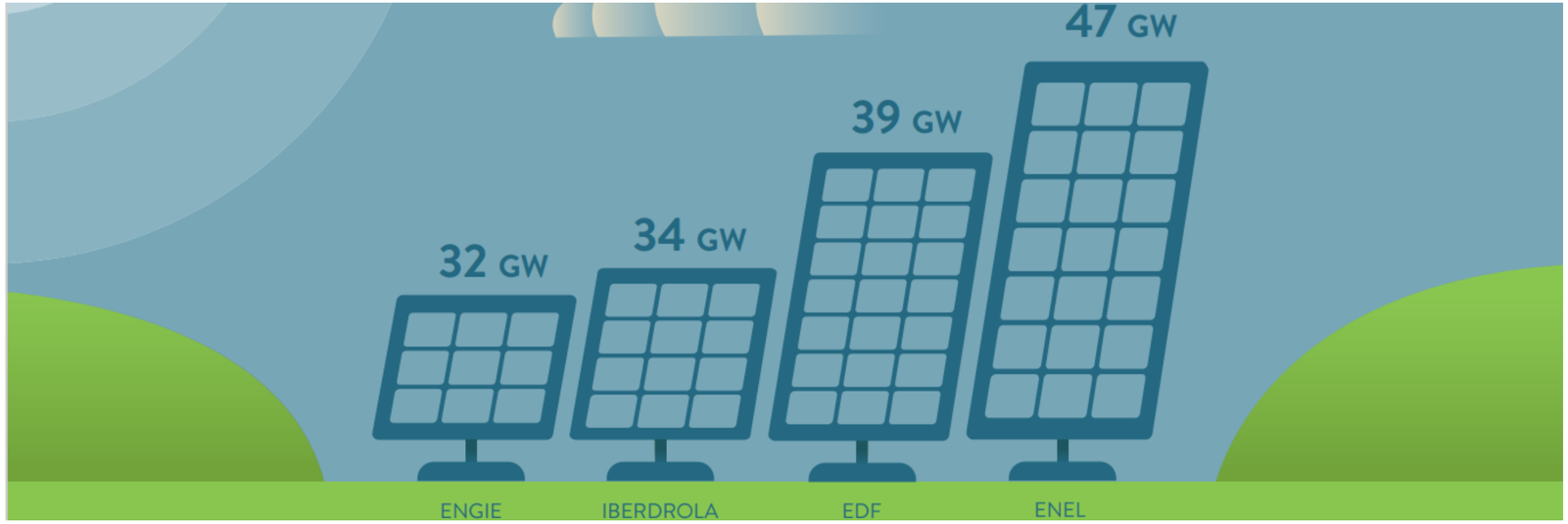
The sum of scores in each sector determines the "circular economy performance index", which confirms Italy in the first place, as in 2020:

		2021	Variation from 2020
1st	Italy	79	⟷
2nd	France	68	⟷
3rd	Germany	65	⟷
3rd	Spain	65	⟷
4th	Poland	54	⟷



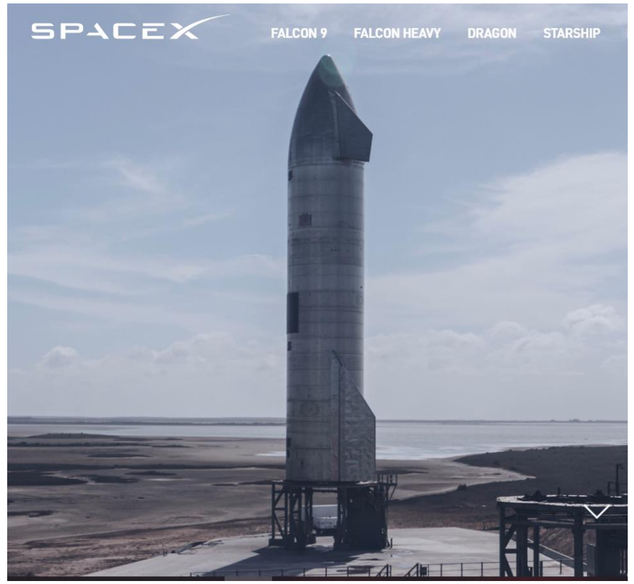
EUROPEAN **CHAMPIONS** IN THE **CIRCULAR ECONOMY**

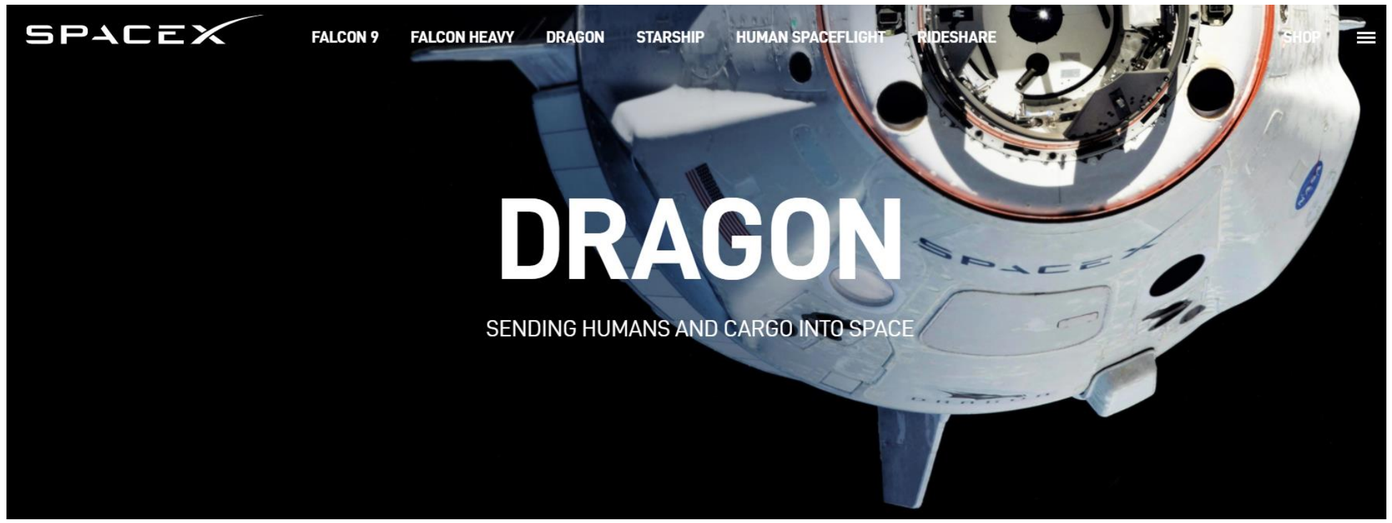
Italy is the European country with the highest recycling rate in total waste. At 79.3 % of waste sent for recycling, it accounts for almost twice the EU average (39.2%) and stands higher than the other major European countries: France (55.8%), the United Kingdom (50.5%), Spain (43.5%) and Germany (42.7%). The replacement of secondary raw material in the Italian economy results in an annual saving of 23 million tons of oil equivalent and 63 million tons of CO_2. We also rank first among the major EU countries for waste reduction: 43.2 tonnes per million euros produced, while Spain has 48.7, Great Britain 60.8, Germany 59.5, France 74.7 (EU average 78.8).



THE LARGEST RENEWABLE ENERGY OPERATOR IS ITALIAN

Enel, with its subsidiary Green Power, is the world's largest private operator in the renewables sector with 47 GW of managed capacity as of the third quarter of 2020 (49 GW estimated at the end of 2020) from wind, solar, geothermal and hydroelectric plants located in Europe, the Americas, Africa, Asia and Oceania.





CIRCULAR ECONOMY IN SPACE…

SpaceX has turned it into routine…

Reusability is the real feature that distinguishes Elon Musk's technologies from any other space actor.

The **Falcon 9**, the **Crew Dragon**, and ultimately the **StarShip** are reusable.

SHORT-TERM IMPACTS OF COVID-19 ON THE N.12 SD GOAL

SDG 12

Responsible consumption and production

Impact still unclear

- Short-term reduction in natural resource use due to reduced economic activity and consumption
- Pressure to loosen up regulations on circular economy and postpone the adoption of new measures
- Increased plastic pollution (e.g., used to produce personal protective equipment)

IS CIRCULAR ECONOMY REALLY A GOOD SOLUTION FOR SUSTAINABLE MODELS OF PRODUCTION AND CONSUMPTION?

SOME PROBLEMS WITH RENEWABLE ENERGIES...

ISSUES AND PROBLEMS... RENEWABLE ENERGIES

We know that **renewable energies** are key tools for circular economy.

And we know renewable energies are fundamental for the **ecological transition**, but…

…how sustainable is this kind of ecological transition?

Renewable energies and (related) **electric mobility**, in fact, also have a cost in environmental terms.

In order to produce solar panels, wind turbines and batteries we will need lots of extra materials.

We're going to have to mine them underground, just like fossil fuels.

TYPES OF RENEWABLE ENERGY SOURCES

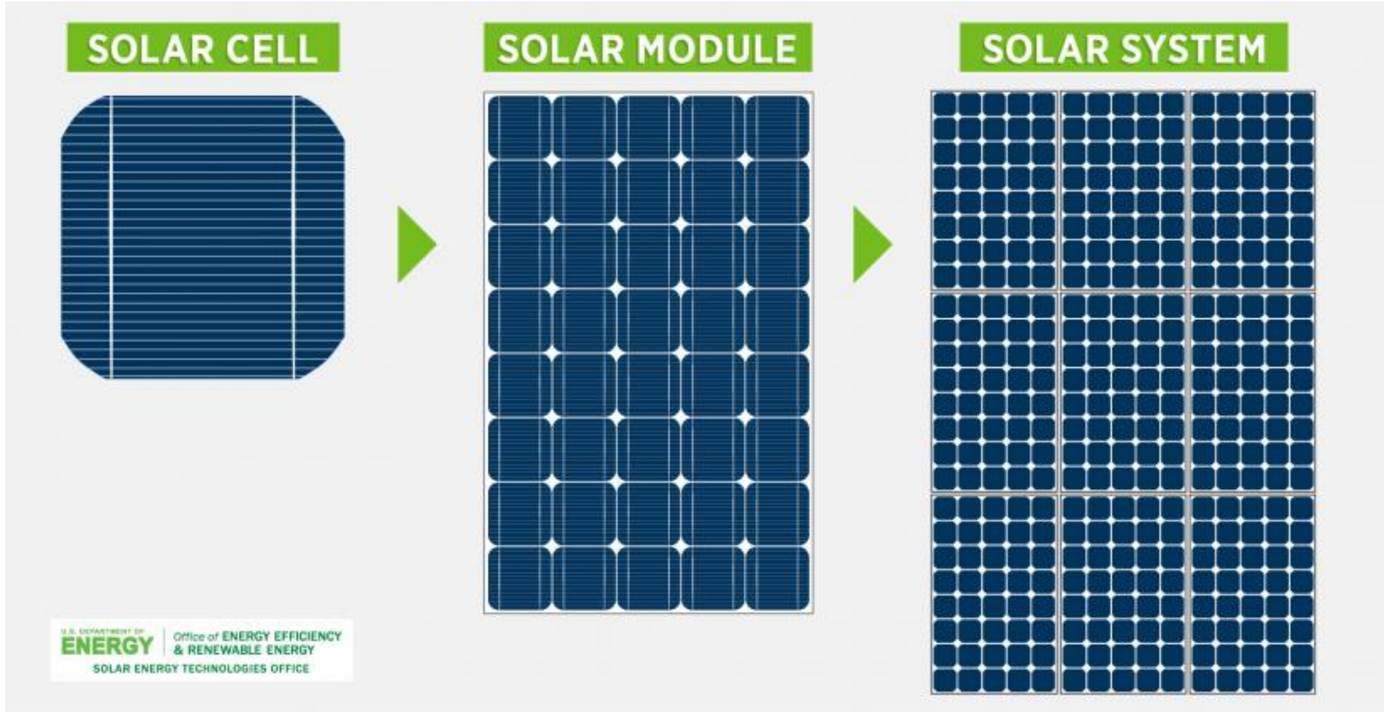
Solar Energy:

Solar farms can generate electricity for thousands of homes, using mirrors to concentrate sunlight across acres of solar cells.

Solar, or photovoltaic (PV), cells are made from silicon or other materials that transform sunlight directly into electricity for single homes or businesses, either through rooftop panels that power entire neighborhoods.

Most solar panels have few environmental impacts…

…beyond the manufacturing process.



TYPES OF RENEWABLE ENERGY SOURCES

Wind energy :

Wind energy turns a turbine’s blades, which feeds an electric generator and produces electricity.

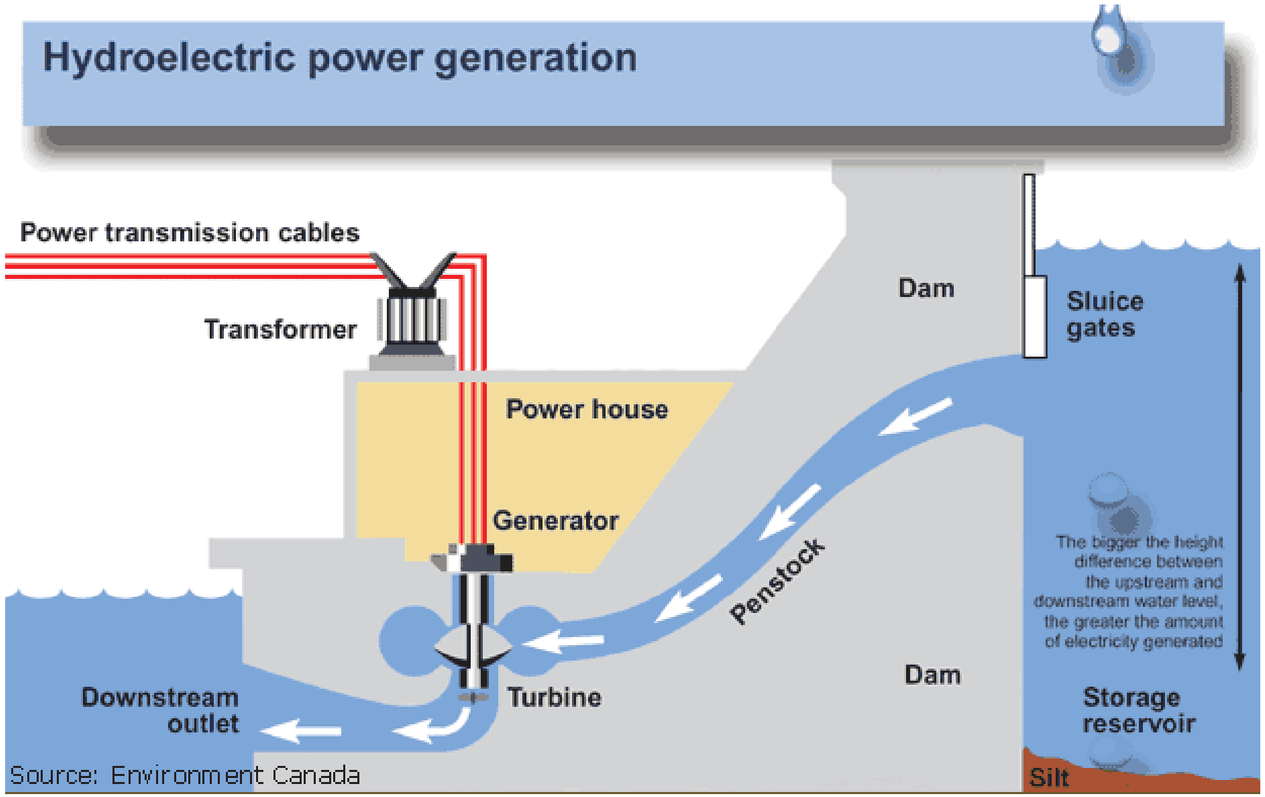
Turbines can be placed anywhere with high wind speeds, such as hilltops and open plains, or even offshore in open water.

TYPES OF RENEWABLE ENERGY SOURCES

Hydropower:

Hydropower relies on water, typically fast-moving water in a large river or rapidly descending water from a high point.

Hydroelectric plants converts the force of water into electricity by spinning a generator's turbine blades.

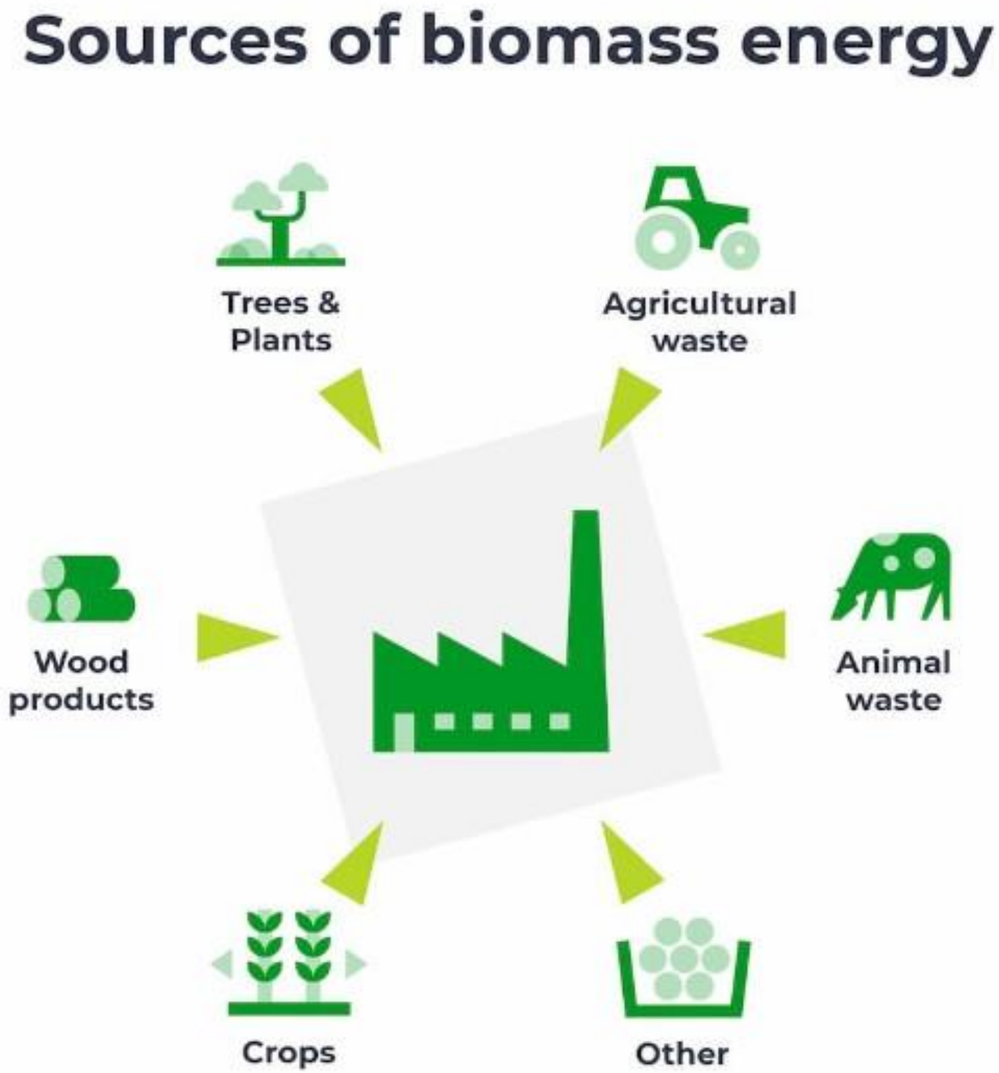


TYPES OF RENEWABLE ENERGY SOURCES

Biomass Energy

Biomass is organic material that comes from trees, plants, agricultural waste, animal waste, and includes crops and waste wood.

When biomass is burned, the chemical energy is released as heat and can generate electricity with a steam turbine.



TYPES OF RENEWABLE ENERGY SOURCES

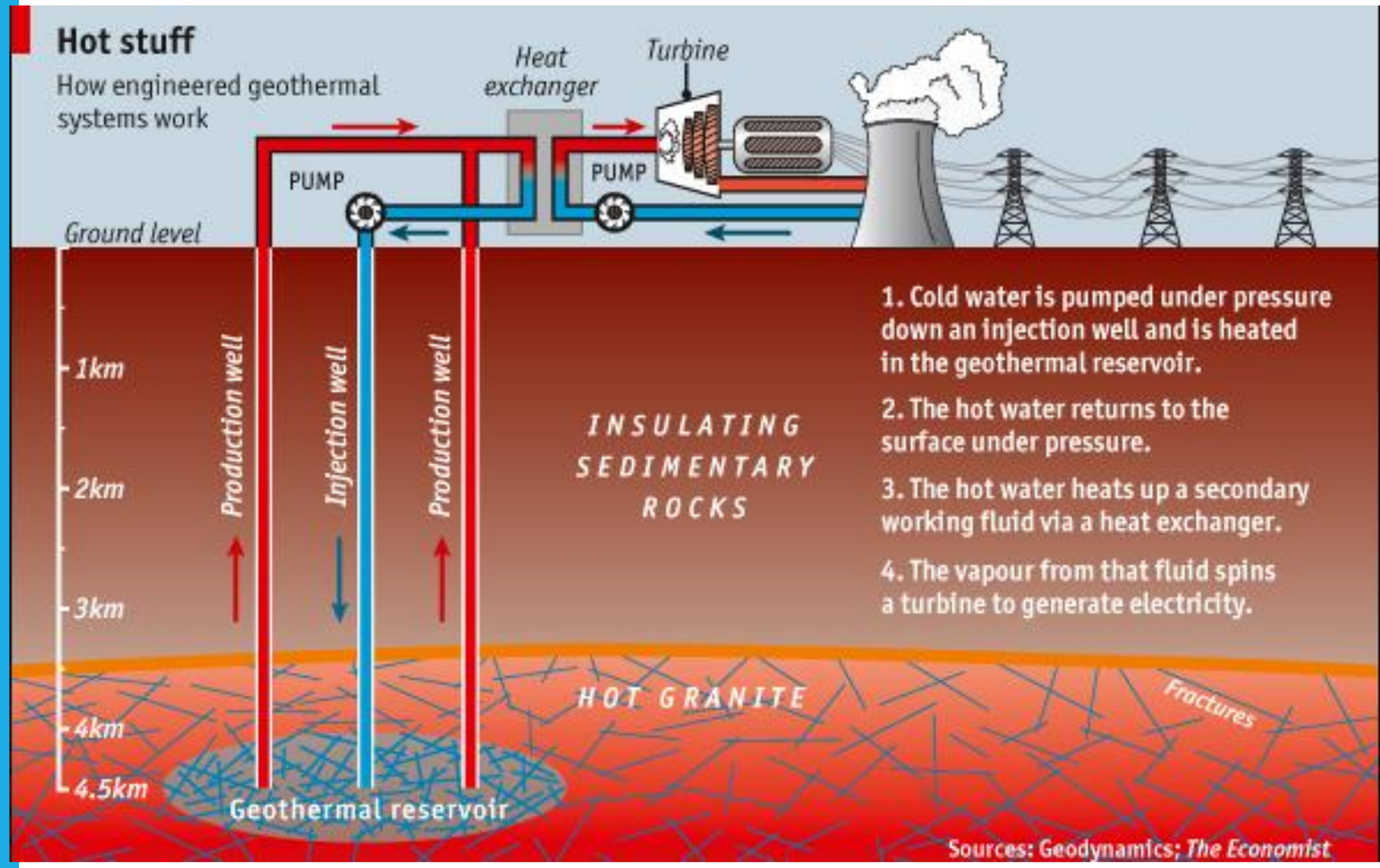
Geothermal energy

The earth's core is about as hot as the sun's surface, due to the slow decay of radioactive particles in rocks at the center of the planet.

Drilling deep wells brings very hot underground water to the surface as a hydrothermal resource, which is then pumped through a turbine to create electricity.

Geothermal plants typically have low emissions if they pump the steam and water they use back into the reservoir.

There are ways to create geothermal plants where there are not underground reservoirs.



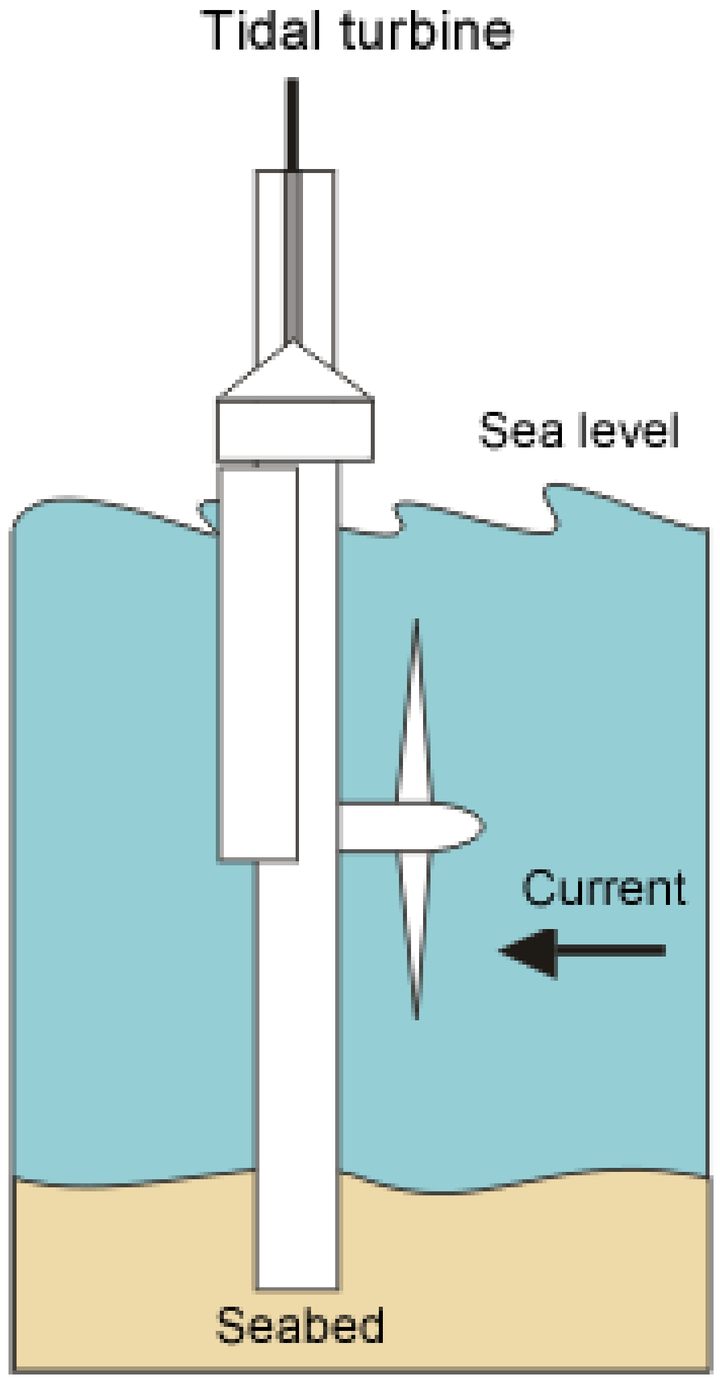
TYPES OF RENEWABLE ENERGY SOURCES

Tidal energy

The gravitational pull of the moon and sun along with the rotation of the earth create tides in the oceans.

In some places, tides cause water levels near the shore to rise and fall up to 40 feet.

Today, there are tidal energy systems that generate electricity. Producing tidal energy economically requires a tidal range of at least 10 feet. Tidal turbines are similar to wind turbines in that they have blades that turn a rotor to power a generator. They can be placed on the sea floor where there is strong tidal flow.



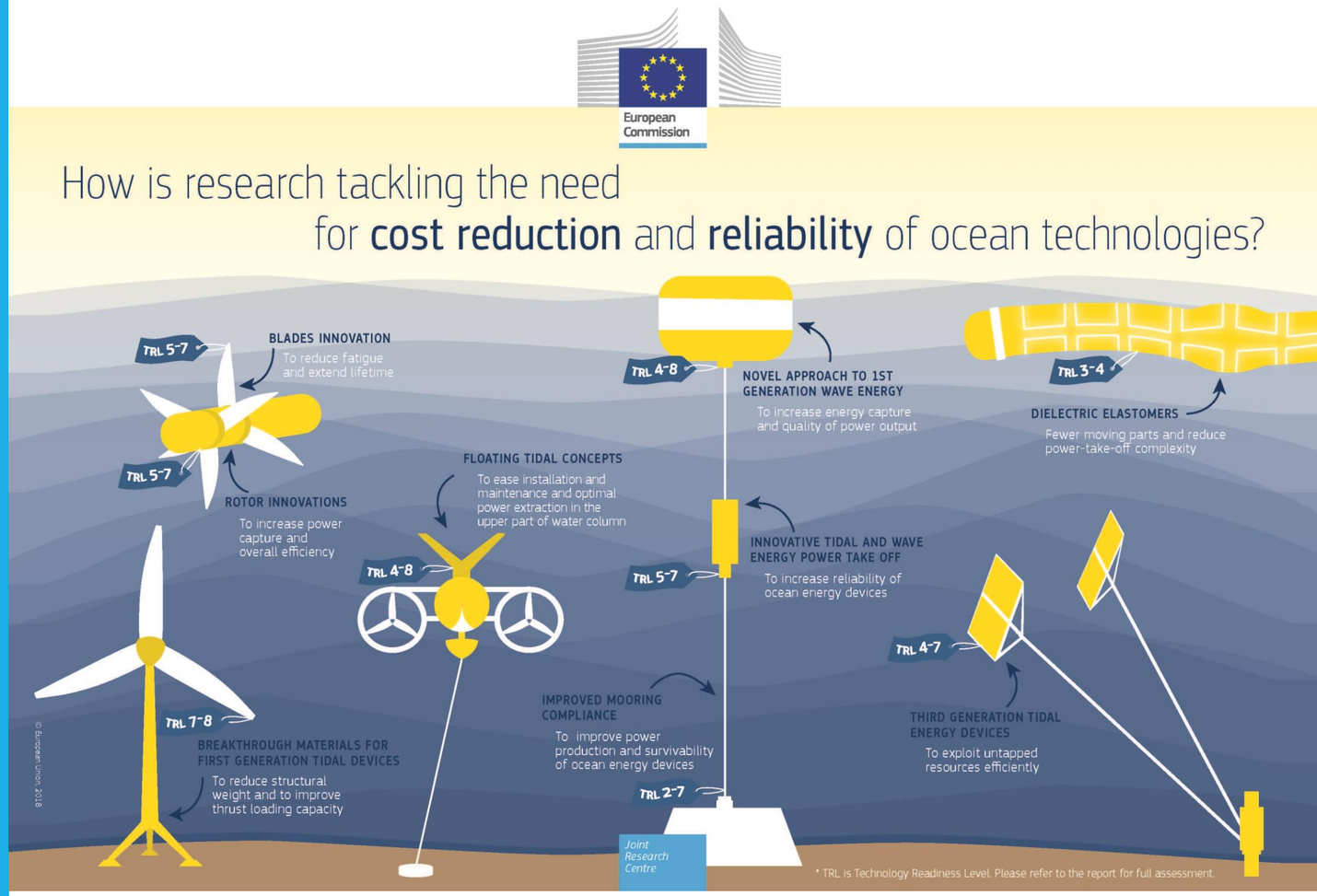
TYPES OF RENEWABLE ENERGY SOURCES

Wave energy

Waves form as wind blows over the surface of open water in oceans and lakes. Ocean waves contain tremendous energy.

The west coasts of the United States and Europe, and the coasts of Japan and New Zealand, have potential sites for harnessing wave energy.

Many different methods and technologies for capturing and converting wave energy to electricity are… under development, including placing devices on or just below the surface of the water and anchoring devices to the ocean floor.



ISSUES AND PROBLEMS… RENEWABLE ENERGIES

An energy system powered by **clean energy technologies** differs profoundly from one fuelled by traditional **hydrocarbon resources.**

While **solar PV plants** and **wind farms** do not require fuels to operate, they generally require more materials than fossil fuel-based counterparts for construction.

Solar panels, wind turbines, batteries and electric cars are technological devices made of plastic, steel, titanium, copper, silver, cobalt, lithium and dozens of other minerals.

Minerals are a case in point.

A typical electric car requires six times the mineral inputs of a conventional car and an onshore wind plant requires nine times more mineral resources than a gas-fired plant of the same capacity.

ISSUES AND PROBLEMS… RENEWABLE ENERGIES

In the next twenty years the production of **cobalt** will have to increase by 21 times, that of **graphite** by 25, that of **lithium** even 42 times. We are talking about extracting hundreds of millions of tons of extra metals every year.

And each ton of metal carries 150, 200, 400 or even thousands of tons of waste materials, which are very often contaminated with chemicals during extraction.

Therefore…

…we are talking about an unprecedented increase in the withdrawal of natural resources.

Source: www.iea.org

MINING AND ACCIDENTS

At these rates of exploitation, as the World Bank had already pointed out a few years ago, there is a risk that the entire planet will not have enough lithium to meet the needs of the battery industry.

And the same goes for another ten or so materials at the basis of the ecological transition.

In addition, the estimates on the environmental impact of mineral extraction are calculated on the basis of the current yields of the deposits. But…

…if the production of nickel or lithium is to increase by 20 or 40 times, clearly, we will be forced to exploit deposits that are less and less rich in raw materials.

And the environmental impact will increase.

MINING AND ACCIDENTS

The UN estimates that, in the last ten years alone, the mining sector has been involved in at least 40 serious environmental accidents, four per year.

each of these incidents has poured into rivers, lakes or seas a quantity of contaminated water between 20 and 40 times the amount of contaminated water that will be released in Fukushima.

Multiplying the withdrawal of natural resources means multiplying accidents of this kind…

According to the International Energy Agency, recycling will contribute a negligible percentage to the need for materials for the energy transition, just 8%...

ISSUES AND PROBLEMS... ELECTRIC MOBILITY

Even on the climate front, the IEA report confirms the doubts of those who wonder if this massive flow of “green” investments will really help to secure the next generations.

Let's take the case of electric mobility: even in a 100% renewable scenario, the electric car will never be carbon neutral.

Including in the calculations the emissions related to the construction of the vehicle and the battery, plus those related to the production of electricity to recharge it…

…it turns out that for the moment an electric car emits the same amount of carbon dioxide as a Citroen C3 diesel (Life Cycle Assessment).

GEOPOLITICAL PROBLEMS

There is another type of problem with the green transition towards a circular economy.

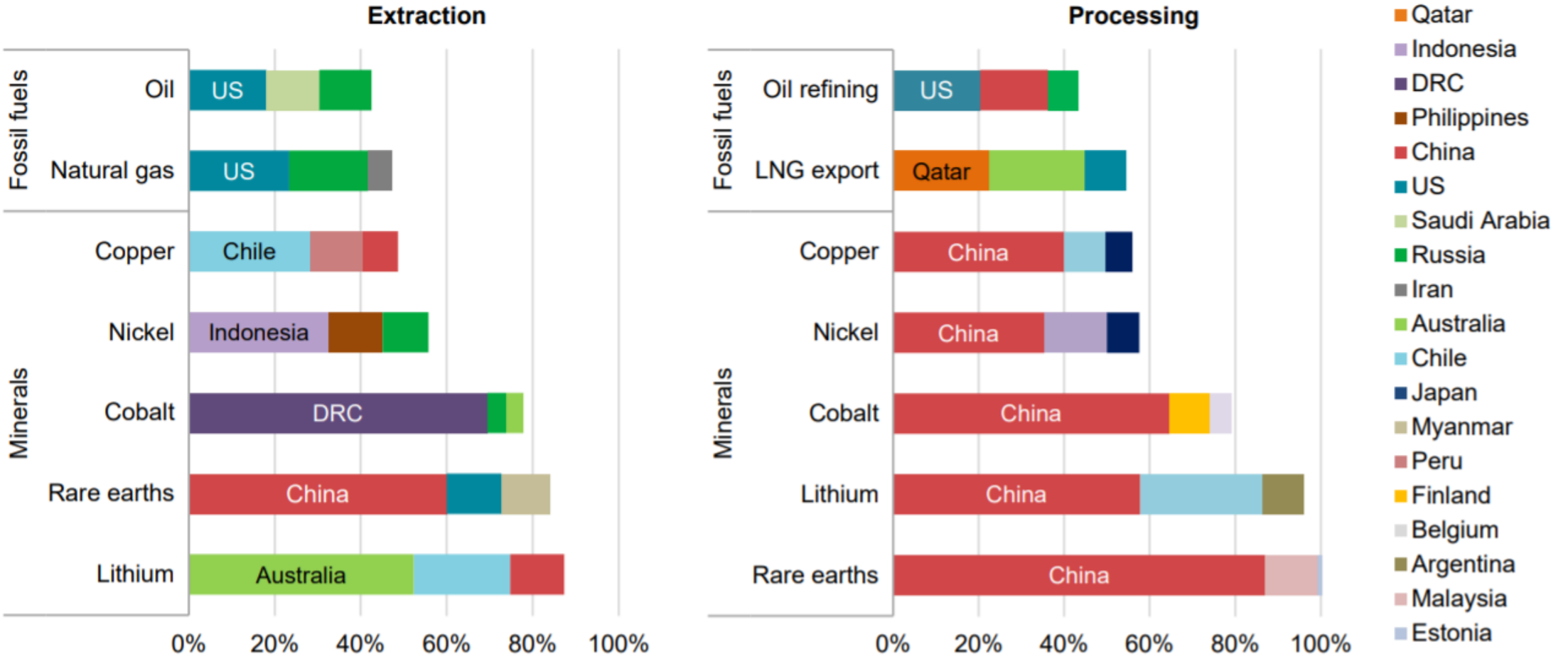
While the **fossil fuel sector is diversified**, in the sense that no producer controls more than 15/20% of global production capacity…

…the renewable energy and electric mobility sector is all in the hands of **China**.

Most of the hundreds of billions mobilized by the **European Green New Deal** will end up in the pockets of industrial giants controlled directly by the Chinese government, that is by an authoritarian regime.

Production of many energy transition minerals today is more geographically concentrated than that of oil or natural gas

Share of top three producing countries in production of selected minerals and fossil fuels, 2019



Notes: LNG = liquefied natural gas; US = United States. The values for copper processing are for refining operations.
Sources: IEA (2020a); USGS (2021), World Bureau of Metal Statistics (2020); Adamas Intelligence (2020).

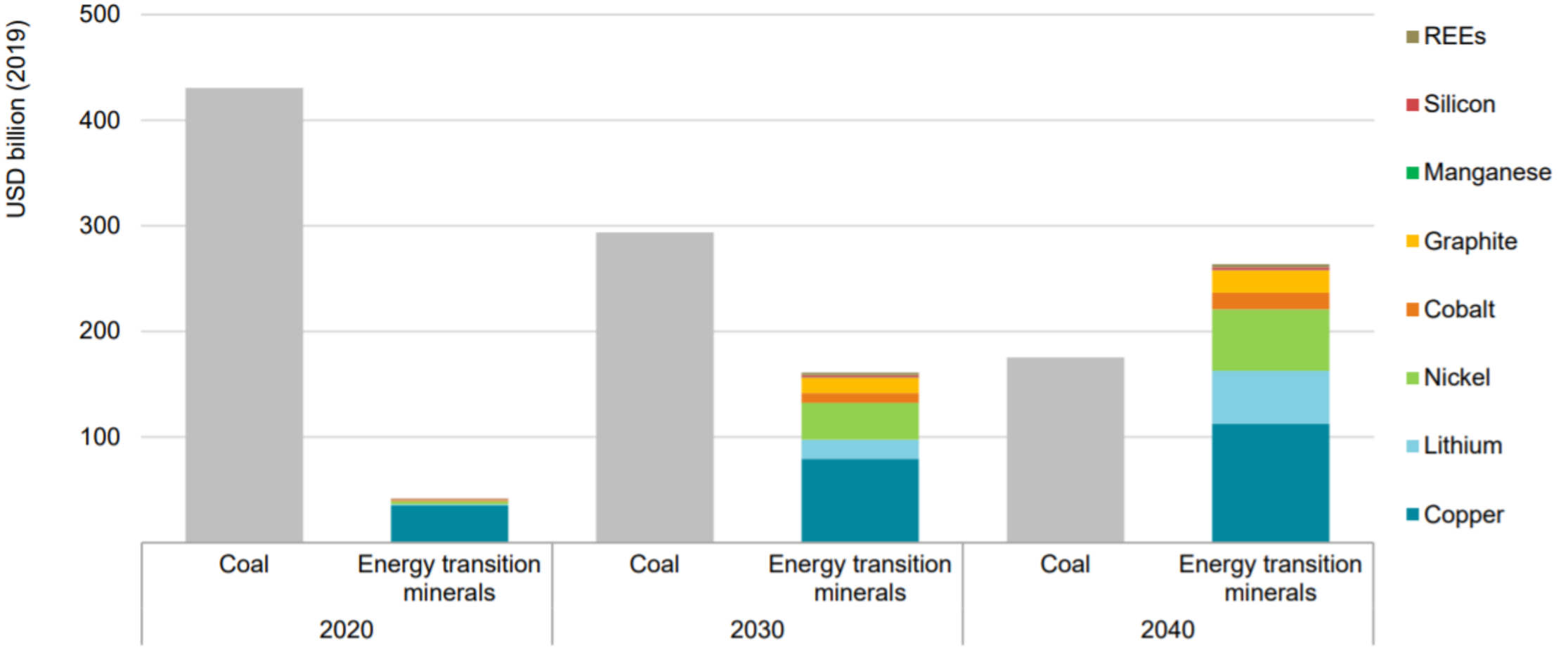
HUMANITARIAN PROBLEMS

There is also a consideration of a humanitarian nature.

The International Energy Agency estimates that at the peak of the ecological transition (2040) the turnover of **green raw materials** will be worth two thirds of that of **coal** today, which in turn is worth tens of times less than the **oil** market.

If we consider that the market for green raw materials, in addition to being poorer than that of fossils, will be concentrated in the hands of three or four (industrialized) countries, the ecological transition risks turning into a humanitarian catastrophe.

Revenue from production of coal and selected energy transition minerals in the SDS



Notes: Revenue for energy transition minerals includes only the volume consumed in clean energy technologies, not total demand. Future prices for coal are projected equilibrium prices in *WEO 2020* SDS. Prices for energy transition minerals are based on conservative assumptions about future price trends (moderate growth of around 10-20% from today's levels).

HUMANITARIAN PROBLEMS

Today countries like Nigeria, Chad, Angola, Uganda live on **oil**.

Oil pays for schools, hospitals, courts. In dozens of countries around the world, the state pays the citizens a dividend, a sort of citizenship income, guaranteed by oil revenues.

For example, 75% of Nigeria's public spending is paid for by oil.

And we are talking about countries where, otherwise, the population would die of hunger, certainly not Canada, Italy or US.

Those who are clamoring to ban fossil fuels are not suggesting any alternative…

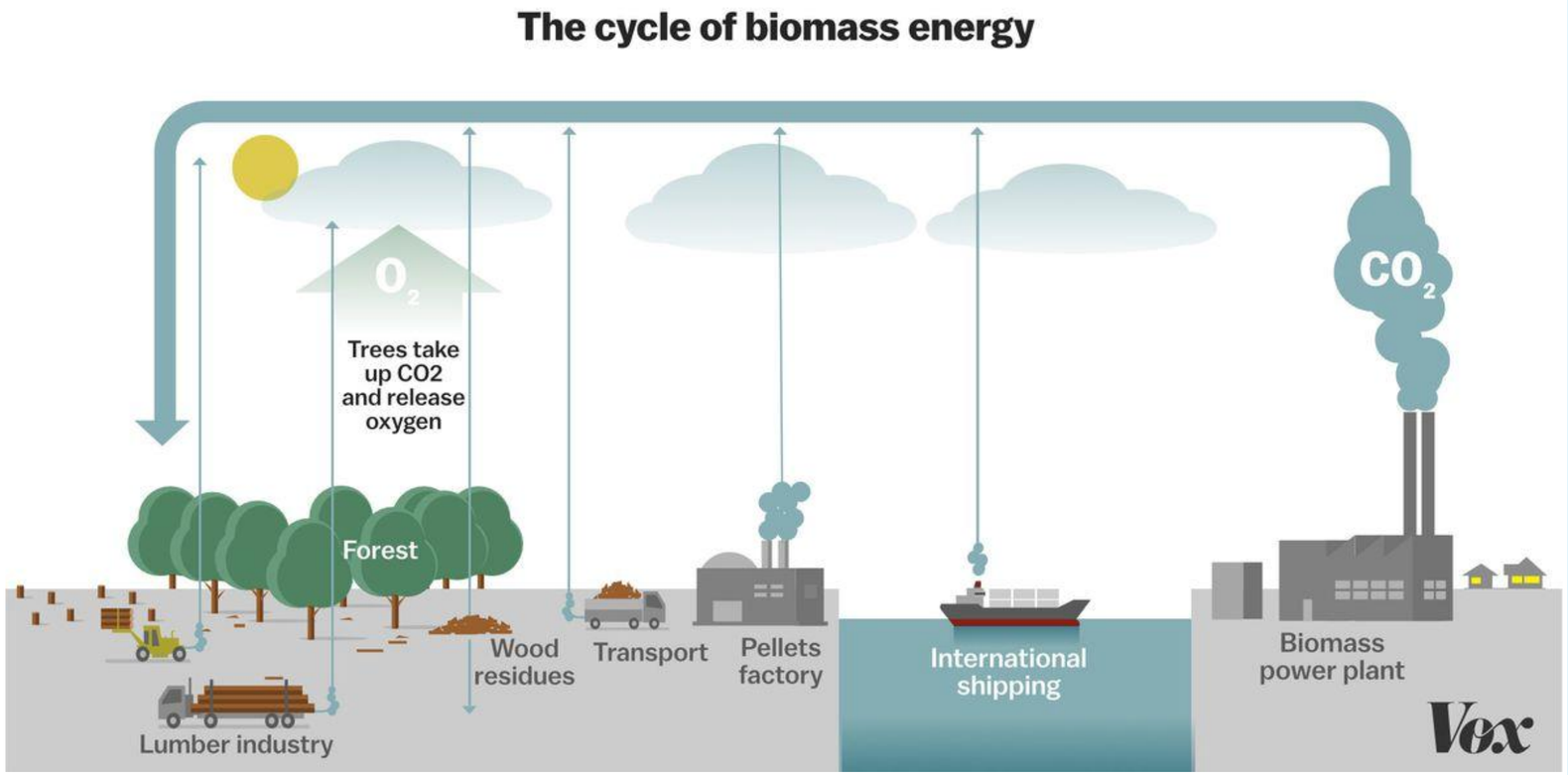
ARE HYDROELECTRIC PLANTS REALLY RENEWABLE?

Large hydroelectric plants are often considered to be non-renewable energy. So called Mega-dams in fact, divert and reduce natural flows, restricting access for animal and human populations that rely on rivers.

Small hydroelectric plants (an installed capacity below about 40 megawatts), carefully managed, do not tend to cause as much environmental damage, as they divert only a fraction of flow.

Therefore, it depends on installed capacity…

IS BIOMASS REALLY RENEWABLE?



Biomass is often described as a clean, renewable fuel and a greener alternative to coal and other fossil fuels for producing electricity.

However, recent science shows that many forms of biomass, especially from forests, produce higher carbon emissions than fossil fuels.

There are also negative consequences for biodiversity.

SITOGRAPHY

www.ellenmacarthurfoundation.org

Goal n. 12: targets and indicators

UN Sustainable Development

Indicators for green generation (italian)

International Energy Agency

Europe’s renewable energy policy is built on burning American trees

REVE