Impact of the current production, supply and consumption standards on the sustainable development goals

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Abstract: Since the industry keeps on evolving, the humankind does not stop squeezing the natural resources and the production standards are set in opposition to the sustainability ideals; the condition of the planet to properly host living beings and the wellbeing of the ecosystems are jeopardized. Lack of concrete data showing the damage caused to the ecosystems prevents leaders, scientists, enterprises and the society overall from making the right decisions to break the vicious circle in which the humanity appears to be captive. Moreover, the role of the industry becomes crucial in order to respond properly and promptly to the climate emergency. This paper compiles the most reliable and current statistics that are key to evaluate and understand the degradation of the planet as well as the initiatives and targets which must be considered in order to tackle the environmental challenges. Furthermore, it aims at changing the industry towards a more sustainable production and use of resources, driven by the Sustainable Development Goals and in particular, by the decarbonization of the industrial activities.

Keywords: Greenhouse gas, Municipal solid waste, Energy, Transport, Sustainable development goals.

1. Introduction
The industry cannot continue to progress towards a complete exhaustion of the natural resources.

In a world where the scepticism feeds the society as soon as topics such as climate change, global warming or sustainability are at stake; having a scientific and critical approach to face these challenges, basing the assessments and decisions on real facts, becomes an essential task.

The aim of this paper consists in filtering, contrasting, and presenting facts and data intended to be used so that the society utterly understands the impact of the humankind on the environment, the challenges which it triggers and the revolution which reversing the current situation will cause.

The structure of the paper will be the following. Firstly, the research methodology will be explained. Secondly, there will be a compilation of different statistical analysis which will determine the impact of the global industrial exploitation of the natural resources. Afterwards, it will be emphasized the role of different sustainable development initiatives and goals in the endeavour which preserving the wellbeing of the planet means and finally, before the conclusions can be reported, it will be exhibited a comparison between what the sustainable goals dictate and what has been really achieved till now.

1.1. Recent evolution of the humankind: population growth linked to energy consumption
On the figure 1 there is an explanation of one of the defiance that the humankind needs to address.
The improvement of the welfare state during the last decades has consequently boosted a substantial rise in the global population which has reached a certain stability although a reasonably constant growth rate. As a matter of fact, if each inhabitant consumes a certain amount of global resources, increasing the population will accelerate the overall consumption of resources. Nevertheless, due to the higher efficiency that the industry intends to achieve and the variety of sustainable projects already launched in order to, for instance, decrease CO2 embedded in the manufacturing [1, 2]; it is expected to keep on decreasing the rates stated on the figure 1 instead of maintaining the current global yearly energy consumption increase. With all that said, it is clearly demonstrated that the effort assumed by the industrial activities, mainly those focused in goods and energy production, is not enough to revert the current trend (figure 1 and 2) and start producing and consuming more sustainably.

**Figure 1.** Comparison between the global demographic increase, the global energy consumption, and the global electrical consumption from 1995 till 2016 [3-5].

1.2. Disproportionate nature exploitation and its consequences: global imbalance

The features which our planet possesses provoke the necessary equilibrium which causes the chance of creating life [6]. However, this balance demands a certain care which the humankind as well as the industry have been lacking during the last century, resulting in an increase of the global atmospheric temperature (figure 2) whose impact worsens the living beings and the ecosystems wellbeing [7].

**Figure 2.** Variation of the global average temperature since 1910 till 2030* [8].

*In order to have a forecast for the current decade (2020-2030) and due to the lack of data beyond 2019, it is assumed on this paper that the temperature will keep on increasing following the average increase registered since the 1970s (76%), if no effective method modifies this tendency.

2. Methodology

The main method to accomplish the objectives of this research article consists in an exhaustive review and segregation of the latest statistics and literature which are valuable from a sustainable engineering standpoint. The selection criteria are based on the literature quality as well as on the impact which it may have on the decisions to be made in the near future within the industry. Out of a wide variety of sources, those based on scientific factors and linked to the research targets were selected and split into three different fields or categories which compose the core subject of the paper (table 1).
Table 1. Sources used to support the veracity and quality of this document.

| Key sources                      | Fields of analysis                                   |
|---------------------------------|------------------------------------------------------|
| Production and consumption      | Procedures and methods to                            |
| statistics                       | boost sustainability                                 |
| Eurostat                        | United Nations: Sustainable Development Programme     |
| Statista                        | European Commission                                 |
| Eunomia                         | Industry 4.0                                        |
| World Bank                      | Revolutionary technologies                           |
| IPCC (Intergovernmental Panel   | Circular Economy                                     |
| on Climate Change)              |                                                      |
| IEA (International Energy       | Blue and Bio-economy                                 |
| Agency)                         |                                                      |

Once the necessary information out of each source is compiled and understood, it will be contrasted and compared with the objectives that must be achieved in order to have a sustainable industrial utilization of the global resources.

3. Development

As summarized in the table 1, it will be presented data related to three technical fields: production, supply and consumption statistics; methodologies aimed to boost a sustainable usage of the earth as well as a comparison which will prove the gap between the way the world is treated by the humankind and the way it should be handled in order to be properly preserved.

The statistics provide on the one hand, an understanding of the evolution of the activities which the humankind has been conducting during the recent decades and on the other hand, the magnitude of the impact that the human behaviour has in subjects such as: animal extinction, ecosystems degradation, climate change acceleration, extreme natural phenomenon and disease spread, amongst others.

Concerning the sustainable methodologies, the aim is to demonstrate that there are robust methods, developed by remarkable scientific organizations, which are meant to provide guidance to the industry and society overall, defining not only the targets and limits for the earth exploitation but the path to be followed and the changes to be implemented in order to accomplish a sustainable development.

Finally, as for every project, it has to be defined a timeline. Having a physical and mathematical approach, the definition of velocity, represented on the equation (1), requires different sorts of information. Firstly, the initial condition of a body (x_0), being this “body” in this research case, the earth current condition; defined thanks to the statistics. Secondly, the aim (x_i) which is defined by the above sustainable guidelines and finally, the time (t), mandated either by these guidelines or the governmental leaders. Applying this reasoning, the speed to boost a change needs to be assessed by the difference amongst the initial state and the objective as well as the necessary time to reach the target.

With all that said, this third pillar of the investigation will reveal how far the current human practices are from what the sustainable methodologies and organizations expect.

\[ V = \frac{x_i - x_0}{t}, \quad for \ all \ t > 0 \]  

4. Statistical analysis

The following graphs and tables illustrate for each concerned field: the continuous increase in the consumption of natural resources, the feeding standards of the humankind, the excessive generation of agents which are harmful for the ecosystems and the living beings and finally, the massive production of residues whose processing still challenges the earth condition.
4.1. Recent primary energy consumption
The main driver for the climate change propagation has been proven to be the Greenhouse Gas (GHG) [7] whose main contributor remains in the energy production [9, 10]. Thus, to mitigate the climate change it is indispensable to reduce the GHG emissions and needless to say, the energy demand as well as replacing the non-renewable energy sources by renewable or “green” ones [9].

However, none of both reductions is being achieved according to the energy consumption evolution represented on the figure 3.

![Figure 3. Global energy consumption split into energy sources and forecast of the consumption expectations till 2040 [10].](image)

4.2. Material utilization: production and consumption
Exploiting material sources is an unavoidable process as soon as the production of a physical good is at stake. However, what makes it sustainable is: the use of renewable sources, the maintenance of the sources which need a certain time to regenerate themselves, not allowing them to become extinct; the improvement of the material extraction efficiency and the application of the reducing, reusing and recycling principles included in the Circular Economy (CE) [11].

It is important to underline that although the human being keeps on exhausting massive amounts of global resources, a promising alteration in the trendline has been identified since 2015 (table 2), reducing the material increase from a yearly 4,94% to a 2,93% increase during the most recent years which have reported data.

![Figure 4. Rise of the polymer production between 1950 and 2018 (MMT) [13].](image)

| Year | Consumption (Gt) | Annual increase (%) |
|------|------------------|---------------------|
| 1970 | 27,0             | Base                |
| 2015 | 87,0             | 4,94                |
| 2017 | 92,1             | 2,93                |

Moreover, not only the raw material consumption is a parameter which deserves the scientific community attention but also the final material or product which is created out of it.

An example of processed material whose utilization damages the environment are the polymers [14]. Polymers are very versatile materials which can last up to a thousand years till fully degrade. Due to this
outstanding durability and the increment of their consumption during the last decades, this being increased by 23.900% in less than 70 years (figure 4); the management of the plastic waste has become a burden for the science, industry and societies representing 60 to 90% of the total waste deposited in the ocean, consuming around 20% of the global oil production and contributing up to 15% to the global temperature increase.

Particularly critical is the amount of plastic which is thrown away in the oceans, accounting for 8 Mt/year, this being equivalent to a full truckload every minute [14].

4.3. Agriculture and animal breeding
Agriculture and animal breeding have boosted the development of the human communities since their existence commenced. However, the unsustainable practices related to the constant meat consumption increase have devastating consequences for the ecosystems.

Sticking to the facts, considering the data represented on the figure 5 (a) as well as the average weight of a regular pig and the population of the European Union (EU), there are 126 million pigs in a year which need to be bred so that the European society satisfies part of its feeding needs. Extrapolating it to the European inhabitants, it would be equivalent to the 24.7% of the EU population.

Without a doubt, breeding requires animal feeding and shelter. Considering that livestock need 6 billion tonnes of nourishment per year, consume 33% of the total amount of cereal generated per year as well as 56% of the total water used in agriculture [15]; the replacement of wildlands and forests by cropland (figure 5 (b)) appears unavoidable unless there is a massive change in the humankind diet.

4.4. CO₂e generation: effect of the Greenhouse Gas emissions (GHG)
Within the so called Greenhouse gases (GHG) which are the main contributors to the global warming (figure 6 (b)); there are mainly included the following sorts of gas: CO₂, N₂O, O₃ and the CH₄ [18].

In this regard, it is important to understand the reason why the focus remains in decreasing the amount of CO₂ contained in the atmosphere despite of having other gases which are indeed harmful for the ecosystems and the living beings health condition.

The parameter which represents the sum of all GHG in the atmosphere is the CO₂ equivalent (CO₂e). It acquires its name due to the fact of being able to convert every other gas measurement into CO₂. Analysing the real facts (figure 6 (a)) the total amount of CO₂e is composed up to a 72.7% by CO₂. This predominance urges to decrease the CO₂ contained in the atmosphere and thereby the total amount of GHG which triggers the climate change and provokes that any of the sustainable scenarios at stake [19] becomes insufficient to stop the current temperature increase represented on the figures 2 and 6 (b).

It is to emphasize that the distribution of the CO₂e worldwide is not balanced. Thus, the biggest global hotspots accounting for 56% of the total CO₂e production worldwide [19] are namely: China, biggest generator of the global total CO₂e (27%); the USA, biggest generator of global CO₂e per capita (16,24 t/capita); the EU-28, Brazil, South Africa and Australia; acquire a major role in the sustainable development goals achievement in order to stop the current trend and set the right changes moving towards a sustainable society, economy and industry.
5. Sustainable development initiatives, goals and trends

Since the Brundtland report [22] was created, it has been identified the imperative need of boosting the progress towards an economic development only if it respects the environmental equilibrium.

Once proven that the current economic growth, industrial activity and social practices are harming the environmental balance (section 4 – statistical analysis), it has to be identified clear targets as well as a robust leadership to boost the necessary sustainable industrial revolution.

In terms of leadership, the sustainable development is since the last decade one of the major concerns of organizations such as the European Union (EU) and the United Nations (UN). Both organizations are aware of the challenges which must be faced. Thus, a plan named “Agenda 2030” which is strongly linked to the Sustainable Development Goals (SDGs) and their indicators [23] has been drawn and is being deployed by different governments at a global level.

Within those goals, 17 in total; there is a variety of institutions and social as well as economic groups which are called to lead the new sustainable development. However, what is of major interest within this paper are the targets which may be drastically impacted by a sustainable development within the industry (table 3).

| Clean water supply | Clean and affordable energy | Sustainable industrialization |
|-------------------|-----------------------------|-----------------------------|
| Sustainable cities and societies | Sustainable production and consumption | Climate action |

It is also key to understand and assimilate the importance of the climate action (table 3) as the improvements achieved for this goal will automatically impact other targets such as water and clean energy supply, sustainable industries, cities and societies as well as a more environmentally focused production and consumption (table 3).

Moreover it is not sufficient having a plan and a certain leadership but acquiring the ideas, technologies and methodologies which can be implemented directly on the industrial fields so that the situation is starting to change in favour of the sustainable development goals.

What is also evinced is that many of these methodologies and technologies such as: Life Cycle Assessment (LCA), Digitalization, Industry 4.0, Circular Economy (CE), Bioeconomy (BE) and CO₂ mitigation systems (table 4) amongst many others; are already available and what it needs to be done is basically to spread and boost them at every industrial level and sector.
Table 4. Three phases system to decarbonize the industry [24].

| Phase | Period     | Actions                          | CO₂ Reduction |
|-------|------------|----------------------------------|---------------|
| Phase 1 | 2020-2035 | Energy efficiency improvement | 20%           |
|       |           | Electrification of industrial processes |               |
| Phase 2 | 2035-2050 | Materials replacement            | 50%           |
| Phase 3 | 2050-2070 | Implementing CO₂ capture systems |               |
|       |           | Increase of the hydrogen use    | 80-100%       |

6. Gap between the current statistics and the sustainability targets 2030

The analysis shown on the table 5 provides two outcomes: data describing the gap existing between the sustainable resources utilization and the current treatment which the humankind provides to them; as well as an understanding of the urgent actions which will be necessary to revert the current situation.

Furthermore, the improvements triggered so far have only provoked the achievement of 36% of the renewable energies (RE) utilization target, the 36% of the energy intensity’s and the 61% of the solid waste sustainable management’s (considering recycling as a key factor).

Table 5. Progress in RE utilization [25], waste management [26] and energy intensity [25] compared to the goals set by the UN Sustainable Development Programme to meet the Agenda 2030 [23].

| Field                                | Target | Latest data | Achieved |
|--------------------------------------|--------|-------------|----------|
|                                      | Conservative politics | Agenda 2030 | Global | EU | Year | (latest data vs target) |
| RE (% of total yearly electricity production) | 36     | 48          | 17.5    | 25.5| 2017 | 36%          |
| Global Energy Intensity growth (%/year) | NA    | -3.6        | -1.3    | NA  | 2018 | 36%          |
| Generation of Organic Solid Waste (%) | NA    | 12.5        | NA      | 25  | 2018 | 50%          |
| Generation of Total Solid Waste (%)  | NA    | 10          | NA      | 20  | 2018 | 50%          |
| Recycling of Municipal Solid Waste (%) | NA    | 70          | NA      | 43  | 2018 | 61.4%        |

7. Conclusions and takeaways

To achieve the sustainable vision of the future described by the UN Sustainability Targets, there is still a long way to go although limited time in order to avoid irreversible consequences.

The verification of the opposition which the current production and social standards present against the SDGs does not provide an optimistic vision of the future unless a new industrial revolution occurs, boosting technologies, politics, mindsets and habits to make feasible the Agenda 2030.

Moreover, there is a lack of comprehension within the society and industry regarding the impact of an activity on the environment and to tackle this, the available methodologies need to be improved and spread within the industry, guaranteeing their utilization. Otherwise, soon the society will not be talking about the 1.5°C or 2°C scenario but about something which might be unmanageable to be reverted.

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