

Comments Regarding the Book *How To Avoid A Climate Disaster*

VIRGINIA CÂMPEANU
European Studies Centre
Institute for World Economy, Romanian Academy
Bucharest
ROMANIA
virginiacampean@gmail.com http://www.iem.ro

Abstract: Climate change and the growing and more frequent global disasters caused by them over the last 30 years have led to the initiation and deployment of global and European climate change strategies based on large-scale research. The COVID- 19 pandemic has not stopped concerns in this field, moreover, those have intensified, with many countries setting the target of achieving climate neutrality by 2050. The European Union, through the European Green Deal, is not only a promoter, but also a leader of the global climate change movement. In this context, our article presents some comments regarding a book that was recently published (February 2021), "How to Avoid a Climate Disaster" written by Bill Gates, based on research made by a large group of multi-disciplinary experts, brought together by the Bill & Melinda Gates Foundation and with the financial support of internationally renowned investors. Of the 12 chapters of the book, the author presents synthetically a) the premises from which the research began; b) the solutions to achieve the planet's climate neutrality, and c) the recommendations of the author of the book to reduce the costs involved in combating climate change and achieving zero net carbon in 2050. The recommendations are concrete, as a Medium-Term (2030) and Long-Term (2050) Action Plan and are addressed to governments, parliaments and people around the world.

Key-Words: Global Warming, Environment and Development, Technological Innovation, Government Policy
JEL Classification: Q54, O44, O33, Q58

1. Planet health- the biggest challenge of the 21st century

Climate change threatens both humankind and the environment. A lot of international research studies concluded that human activities based on fossil fuels consumption contribute to climate change by eliminating greenhouse gas emissions (GHGs) in the atmosphere and rising temperatures globally. Natural disasters caused by climate change have become more frequent and increasingly intense since the 1980s, causing more and more loss of lives, as well as economic damages around the world. Under these circumstances, environmental sustainability is no longer optional, but has become a global imperative, even in the time of the COVID - 19 pandemic (during the 2020-2021).

The importance of reducing pollution and to adopt responsible measures for fighting climate change was emphasized in various studies in the field (Downar et al., 2019; Sovacool & Brown, 2009)). Environmental concerns and sustainable development are not new. In the last 30 years, the definition of sustainable development and climate change strategies has marked continuous progress at global (Table 1) and European level. For the first time in history, the Paris Agreement brought all nations — including the top emitters of greenhouse gases — together in 2015 to fight the climate crisis. The Paris Agreement (2015) concluded that combating the climate change and achieving a transition to a clean and fair energy are the biggest global challenges of the 21st century.

Table 1: The key moments in defining global strategies for climate change, 1992-2021

Year	Global level
1992	Global Summit, Rio de Janeiro
1992	UN Framework Convention on Climate Change (186 signatory countries, incl.EU)
1997	Kyoto Protocol: GHG reduction by 1% / year until 2020/1990 (incl.EU)
2000	Millennium Development Goals (UN)
2015	The Paris Agreement (incl.EU)
2021	Investing in Climate Action - The Make-or-Break Decade (UN Development Programme, UN on Climate Ambition and Solutions, USA, EC, WIB, ECB).

Source: Representation of the article/s author based on the international documentation, 2021

These are also the main priorities of the European Green Deal (European Commission, 2019), a new strategy for green and sustainable growth by 2050 with the aim of 55% greenhouse gas (GHG) emissions cut by 2030 and achieving climate neutrality by 2050 (Table 2).

Table 2: EU strategies to combat climate change, 1992-2021

Year	EU level
2001; 2006	Sustainable development strategies
2008	The energy-climate change package 2020: Objectives 20/20/20
2015	Strategy for a resilient Energy Union (includes de-carbonizing the economy)
2019	Climate target plan 2030 - GHG reduction by at least 55% by 2030/1990
2019	European Green Deal
2020	Towards a clean and just energy transition - Combating climate change. Climate neutrality by 2050.
2020	EU strategy on energy system integration
2020	EU Hydrogen strategy
2020	EU Methane gas strategy
2020	EU Annual Sustainable Growth Strategy 2021 (Green Transition, Digital Transition and Productivity, Equity, Macroeconomic Stability)

Source: Representation of the article/s author based on the international documentation, 2021

After a break of several years, international cooperation in combating climate change is recovering in 2021. The new US administration has returned to the Paris Agreement, preparing its own strategy and financial plan related to the Agreement (Earth Justice, 2021). The Europeans have begun to unite on the basis of a common climate agenda. On both sides of the Atlantic, some studies are now recognizing that the action to combat climate change is not only an environmental issue, but also a geopolitical one (Manzo, 2010; Beringer, 2019). The climate challenge requires determined action and significant investment in each country, far exceeding current levels.

The steps taken from now to 2030 will determine whether we can avoid the most devastating effects of climate change in the future. Moreover, it is considered that now we need a concrete, step-by-step plan that turns all this momentum into a practical achievement of saving the Planet.

2. How to avoid a climate disaster – a book with a very comprehensive approach

The goal of our article is to present a structured synthesis of a book written by a well-known but also controversial author in the world, whose background is in the software, not climate science, but who united around him scientists, entrepreneurs, environmentalists and experts from around the world to draw the most practical ways to achieve zero net emissions.

The author is Bill Gates and his book “*How to avoid a climate disaster: The solutions we have and the breakthroughs we need*” was first published in USA, February 16, 2021. The book attracts attention especially because it presents a plan, a path to follow, a series of steps to provide the best chance of avoiding a climate disaster. In his opinion, Gates states that “we have a number of solutions that we need to implement on a large scale now and we also need a lot of innovation to be developed and spread around the world over the next few decades”.

In the early 2000s, Bill Gates¹ founded the Bill & Melinda Gates Foundation, donated large sums of money and refocused on global health, development, and U. S. education and finally on a problem that affects the entire planet - energy and climate change. In this last field, he has been joined not only by experts but by global big-name investors (such as Amazon, Bloomberg, LinkedIn, Bill & Melinda Gates Foundation, Virgin Group, Alibaba Group, African Rainbow Minerals, HRH Prince Alwaleed bin Talal-Alwaleed Philanthropies, Tiger Management, Soft Bank Group Corp., SOHO China and the list is much larger).

Within next few years, Gates became convinced of three things: 1) To avoid a climate disaster, we have to get to zero greenhouse gas emissions; 2) We need to deploy faster and smarter the tools we already have, like solar and wind energy sources, and 3) We need to create and roll out breakthrough technologies that can take some decades (Gates, 2021).

¹ In 1975, Bill Gates with Paul Allen founded Microsoft and led the company to become the worldwide leader in business and personal software and services. In 2008, Bill transitioned to focus full-time on his foundation’s work.

2.1 Research premises: why zero

The author of the book started his research considering the following premises:

- *Greenhouse gases were making the Planet's temperature rise*, and as long as humans kept emitting any amount of greenhouse gases, temperatures would keep going up. Gates explains why we need to get to zero emissions, including what we know about how rising temperatures will affect people around the world.
- *Annual GHG emissions and global population growth*: 51 billion tons of GHGs are added every year to the atmosphere; global population will increase to 10 billion inhabitants to the end of this century (about 7.7 billion today); as the global standard of living improves, energy demand will increase by 50% by 2050 and, if nothing changes, GHG emissions will follow the same trend. To avoid a climate disaster, we need to go from 51 billion tons of GHGs to zero in just 30 years, providing at the same time more food, more vehicles and more housing to accommodate the entire population (Gates, 2021).
- *The global top sources of GHGs*: the 5 main sources of the most current global GHG emissions are: industrial production (31%), electricity (27%), agriculture (19%), transport (16%) and buildings (7%).

Our comparative data analysis of some countries highlights (in Bold) the sources of GHG emissions that exceed the world average (Table 3), which means that the countries should focus in a first stage, especially on the sources that exceed the world average. Then, to reach zero net emissions, each country has to address all these five major challenges.

Table 3: Main sources of GHGs globally and in some countries (%)

GHGs sources	Global	Developed countries			Emergent country	Central and Est European (UE-27 MSs)		
		USA	Germany	France		China	Poland	Hungary
Industry	31	24	20	18	45	20	24	30
Electricity	27	28	34	10	34	37	19	23
Agriculture	19	11	8	22	10	14	18	22
Transport	16	29	22	32	7	16	21	16
Buildings	7	8	16	18	4	13	19	9

Source: Representation of the article/s author, 2021 based on the data found on: <https://www.breakthroughenergy.org/our-challenge/the-grand-challenges>

2.2 The solutions to achieve neutrality

Gates (2021) believes that there is *no single solution* for any of the 5 economic sectors - sources of GHGs, but the cycle of innovation and attracting strong, resilient and risk-tolerant capital must be accelerated. This means more investments in research and development, creating market demand for clean technologies and design public policies to encourage consumers and businesses to make green choices in all five major sectors.

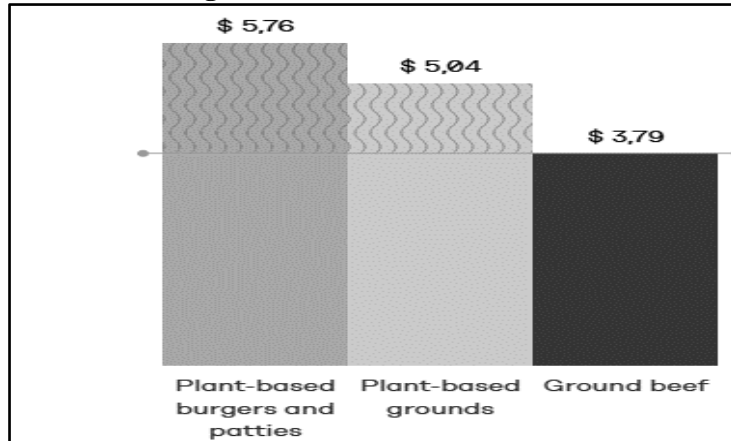
✓ Establishing an Action Plan based on Green Premium

Clean solutions are more expensive now than high-emission ones, in part because the prices do not take into account the real economic and environmental costs of existing energy options, such as fossil fuels.

This cost difference between current practices and clean, green practices that will lead to zero net carbon is called Green Premium by Bill Gates.

To better understand what is the Green Premium we will see the case of ground beef (with high GHGs emissions) versus plant - based ground and burger, where Green Premium with low GHG content is 52% more expensive than ground beef as in Figure 1 (\$ 5.76- \$ 3.79 = \$ 1.97 or + 52%).

Fig. 1: Green Premium for beef



Source: Gates, 2021

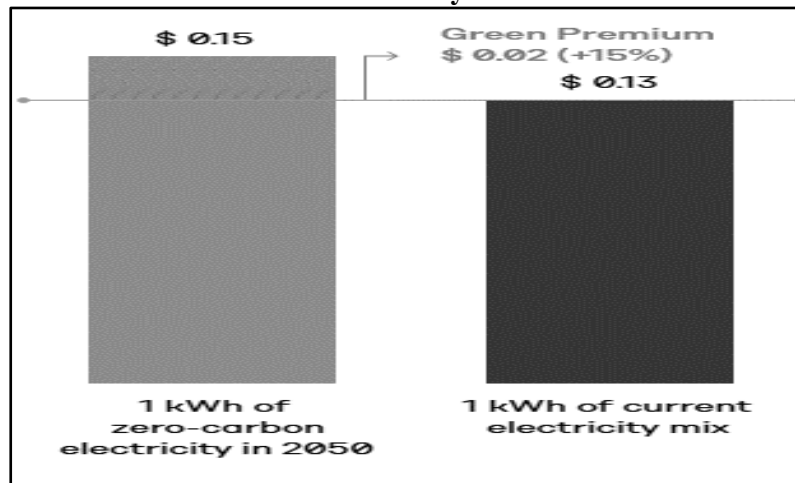
✓ **Green Premium as a decarbonization roadmap tool**

In setting the roadmap for decarbonising the planet, there are several solutions that need to be widely implemented now, and other solutions based on innovation and extensive investment are also needed to be developed and spread around the world over the next few decades (Gates, 2021).

a) Priority now: Small Green Premium Technologies

In the US, priority should be given to zero-carbon electricity, mainly due to lower renewable energy costs. The costs of onshore wind and solar energy have decreased by 44% and 87%, respectively, from 2005 to the present time, due to technological advances and political incentives.

Fig.2: Green Premium for zero- carbon electricity in 2050 versus the current electricity mix



Source: Gates, 2021

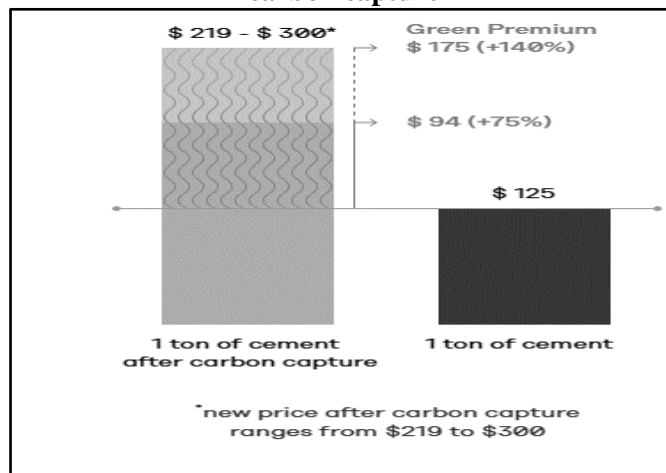
According to Gates's assumptions, Green Premium of zero-carbon electricity would be only \$0.02 (Fig.2). So, clean electricity would increase costs for most US household consumers by only 15% or \$ 18 each month. Such a low premium - Green Premium - shows that renewable energy sources can play a substantial role in bringing the US to zero net- carbon and should take place quickly wherever it is economical.

b) Long-term innovations and investments: High Green Premium technologies

Among the technologies with high Green Premium, which could become clean, green only with innovations and large cost and investments in the coming decades, Gates takes into consideration as example some products such as cement, steel and liquid fuels.

- **Cement:** each ton of cement creates one ton of carbon dioxide. The USA produces over 96 million tons of cement / year, almost 300 kg / person. Nowadays, the only way to completely eliminate CO₂ from the production process is to use carbon capture technology, which adds a cost estimated at 75-140% per ton of cement (very high Green Premium, Fig.3) (prices in the USA).

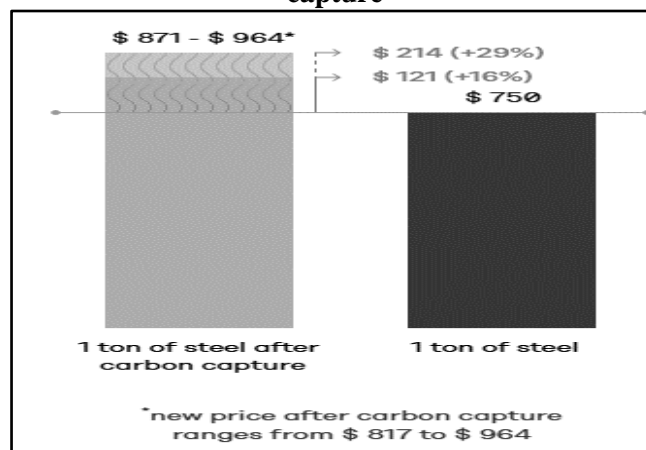
Fig. 3: Green Premium for cement. The cost of a normal ton of cement compared to a new price after carbon capture



Source: Gates, 2021

- *Steel*: each ton of steel creates 1.8 tons of carbon dioxide. Green Premium for 1 ton of clean steel after carbon capture would be \$121-\$214 (Fig.4).

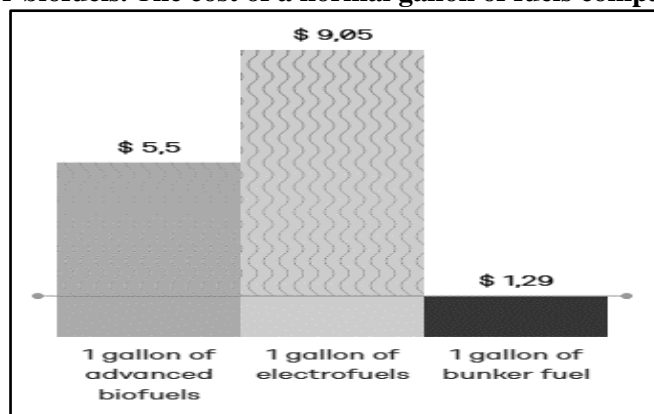
Fig.4: Green Premium for steel. The cost of a normal ton of steel compared to a new price after carbon capture



Source: Gates, 2021

- *Biofuels*: one of the highest Green Premium is computed for the biofuels. The new technologies for advanced biofuels and electrofuels are very expensive, requiring large innovations and investments on a long term (Fig.5).

Fig. 5: Green Premium for biofuels. The cost of a normal gallon of fuels compared to new clean products



Source: Gates, 2021

3. Recommendations for reducing Green Premium and moving to zero net carbon

3.1 General recommendations

Bill Gates (2021) has some general recommendations for:

- Governments: to apply economic policies either to make the carbon version more expensive or to make the clean version cheaper - or, ideally, both.
- Companies and investors: buy cleaner alternatives, invest in R&D, support clean energy startups and advocate for useful government policies.
- Population: to hold the elected responsible.
- World leaders: [We need to reward people who have the courage to take difficult steps.](#)

3.2 Recommendations for federal, state and international lawmakers

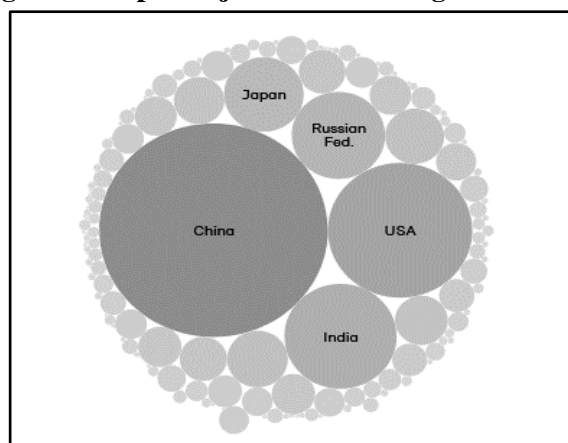
The policy recommendations cover the five major sources of GHGs and are designed to reduce Green Premium of clean technologies, to expand R&D infrastructure, to support the demonstration and early adoption of innovations and to encourage market signals, consumer choices and positive feedback loops that accelerate the decarbonisation of the entire global economy.

It should be noted that the set of smart, practical and ready-to-implement solutions, as each part of the global economy decarbonizes, was made by Gates with the support of experts from Breakthrough Energy (US).

We further briefly present the 5 major sources of GHGs - electricity, transport, industry, agriculture and buildings. For each source are identified the main GHGs emitting countries worldwide and Bill Gates' policy recommendations that should be addressed by governments and parliaments (Gates, 2021).

3.2.1 Electricity - source of GHG

Fig.6: The top 5 major GHG emitting countries in the world



Source: Gates, 2021.

Although solar and wind energy is used more than ever (7% of global consumption), they are not always available, so we still rely heavily on fossil fuels and other technologies that emit greenhouse gases.

New ways need to be found to generate, store and use low-carbon electricity around the world, while expanding existing technologies such as wind and solar, advanced nuclear power, geothermal energy and carbon capture generation.

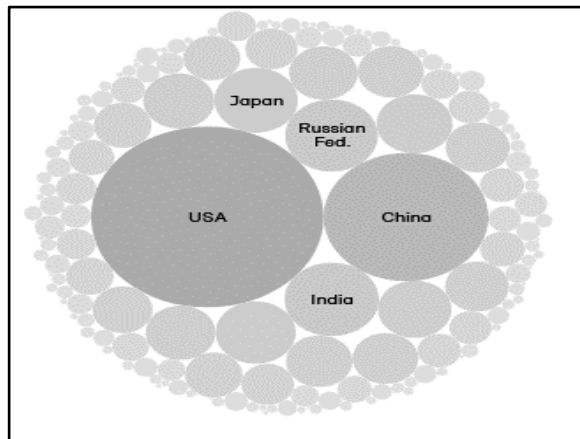
Recommendations on areas of interest for reducing GHG emissions focused on electricity policies:

- Carbon purification of energy, by types of resources.
- High voltage transmission infrastructure to efficiently move electricity from where it is generated to where it is used.
- Renewable energy: Continuing trends in reducing the costs of onshore wind and solar energy (PV) through innovation in design, production, location and operation.
- Storage of wind and solar energy for long periods of time.

There are already a range of options, including different types of batteries, underground pumped hydroelectricity and storage in molten salt. The implementation of these technologies, on a large scale, requires political innovations and reforms of market rules.

3.2.2 Transport -source of GHG

Fig.7: The top 5 major GHG emitting countries in the world



Source: Gates, 2021.

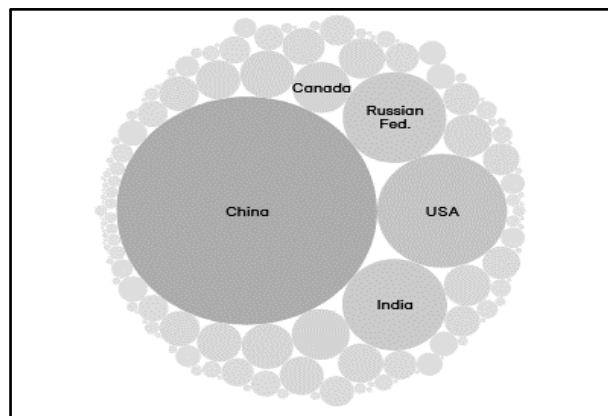
While GHG emissions from transportation account for only about one-sixth of the total global, burning fossil fuels in cars, trucks, trains, planes and ships is the main source of emissions in the United States. And, as transport infrastructure continues to improve in developing countries, transport emissions will increase by 50% by 2040. From electric vehicles to low-carbon fuels, zero-GHG transport will require a complete transformation of the way goods and people move from one place to another.

Recommendations on areas of interest for reducing GHG emissions focused on transport policies:

- Electrification: Electric vehicles need to be further supported by technological innovations (longer range batteries), market reforms and smart public policies and investments (eg. in battery charging infrastructure).
- Efficient mobility: Policies and technologies that increase fuel economy and reduce vehicle weight and distance traveled.
- Low carbon fuels: In the long - distance transport sectors (aviation, naval) low carbon liquid fuels are needed (advanced biofuels and Electro-fuels). While advanced biofuels cost about twice as much as gasoline (with 106% Green Premium), electric fuels have 237% Green Premium. However, these two innovations require more attention and funding to reduce costs.

3.2.3 Industry- source of GHG

Fig.8: The top 5 major GHG emitting countries in the world



Source: Gates, 2021.

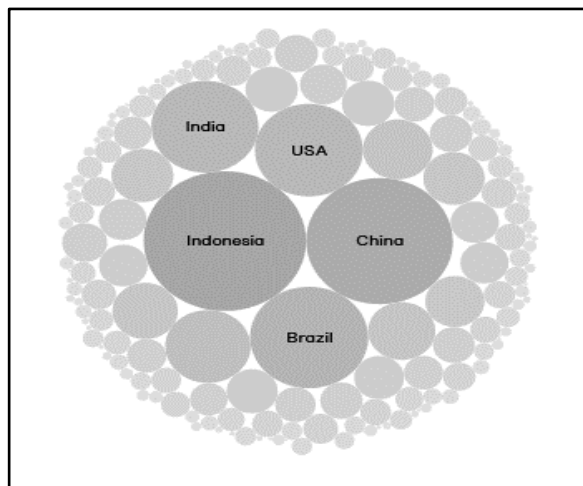
Industrial goods and materials account for almost a third of global greenhouse gas emissions. To bring this sector to zero GHG emissions, clean electricity and production processes are needed whenever possible. If we do not have them, the technology that captures and stores carbon must be expanded so that it does not enter into the atmosphere.

Recommendations on areas of interest for reducing GHG emissions focused on industrial policies:

- Electrification: New heat pumps, boilers and ovens powered by clean electricity can offer a low or zero emission alternative.
- Energy and material efficiency: Strategies to increase production efficiency include the use of intelligent energy management systems to shut down equipment when not in use.
- Low carbon fuels: biofuels, hydrogen and electro-fuels have the potential to replace conventional fossil fuels. Policies to stimulate investment and reduce the cost of low GHG fuels.
- Carbon capture: can be stored underground or used for other products. Sustainable public policies must encourage companies to invest and implement the necessary equipment on a large scale.

3.2.4 Agriculture- source of GHG

Fig.9: The top 5 major GHG emitting countries in the world



Source: Gates, 2021.

Some emissions from agriculture are generated by nitrogen oxides from the soil (49%). Other sources (44%) that emit methane gas come from animals (cattle, sheep) that are raised for meat and dairy products. Bringing these emissions to zero while meeting growing global demand for food will require significant changes in the way agriculture is practiced and in the way people are feeding. This means reducing the use of chemical fertilizers, improving soil management, reducing methane emissions from animals and minimizing the consumption and waste of high-carbon foods, by expanding new technologies, such as meat and vegetarian dairy products, based on plants.

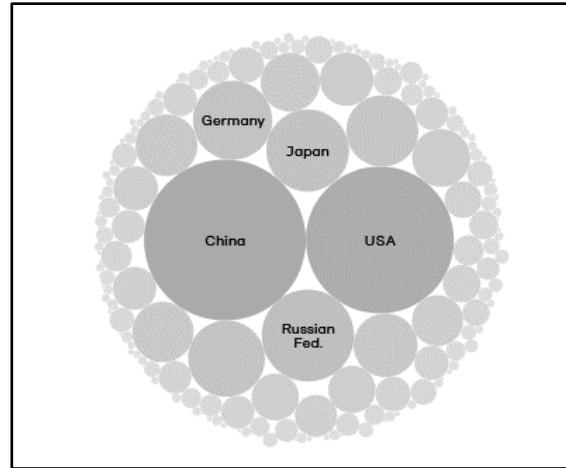
Recommendations on areas of interest for reducing GHG emissions focused on agricultural policies:

- Soil and nutrient management: better soil health management systems can help sequester carbon and reduce GHGs.
- Alternative proteins: meat and dairy products will remain the foods with the highest GHG emissions per plate; plant pork and chicken could reduce emissions by 30-36%, and plant vegetarian burgers could reduce emissions by 80-90% compared to beef. Cell-based meat or laboratory-grown meat can drastically reduce GHG emissions.
- Reducing agricultural methane: Both animals and waste plant emit methane gas, which is 30 times more harmful than carbon dioxide. Policies to reduce agricultural methane include adjusting feed practices, implementing methane recovery technologies in landfills and increasing recycling and composting rates.

- Wasted food: In the US, approx. 40% of all food - enough to fill a semi-trailer every 20 seconds - becomes waste that generates extremely high methane emissions. Strategies to reduce these emissions refer to improving the efficiency of operations and supply chains and finding uses for edible by-products.

3.2.5 Buildings- source of GHG

Fig.10: The top 5 major GHG emitting countries in the world



Source: Gates, 2021.

Buildings emit carbon in two ways: when we build them (using cement, concrete, steel and iron) and when we use them (with heating and air conditioning-HVAC). The construction should be considered that 1 ton of cement generates 1ton of CO₂ and 1ton of steel generates 1.8 tons of CO₂. Between 2000 and 2016, for example, China used more concrete than the United States throughout the 20th century (Gates 2021). When using buildings, 1.6 billion air conditioners are currently used worldwide. Most of them operate in rich countries, not in the warmest places in the world. It is estimated that by 2050 the number of HVACs will increase to 5 billion, and by 2060, the global stock of buildings is expected to double. In fact, a new New York City will actually be added to the planet every month for the next 40 years. From greener materials to cleaner industrial processes, ways must be found to build and use buildings without emitting carbon.

Recommendations on areas of interest for reducing GHG emissions focused on building policies:

- Electrification: Heat pumps with air source for heating and cooling, electrified appliances and electrification of buildings with clean energy can accelerate the achievement of zero net emissions.
- Low-carbon building materials: Smart low-carbon design strategies (optimization and reuse of materials) can further reduce these emissions.
- Energy efficiency: Building efficiency strategies include replacing old equipment and using sensors and energy management software to optimize a building's emissions and energy use.

4. Conclusions

In the book “*How to avoid a climate disaster*”, Bill Gates sets out a wide-ranging, practical and accessible plan for how the world can get to zero greenhouse gas emissions just in time to avoid a climate catastrophe. With the help of experts in the fields of physics, chemistry, biology, engineering, political science, and finance, he has focused on what must be done in order to stop the planet's slide toward what is a certain environmental disaster.

The main conclusions of Bill Gates expressed in his book are included in the following message:

“If there's one idea I want the world to take from the book, it's this: we need to cut Green Premium. The higher the Green Premium for a particular product, the more expensive it will be to eliminate emissions from that product - and the harder it will be to achieve. Reducing these premiums, which will take some time, is the only way to reduce emissions to zero without making things significantly more expensive” (Gates, 2021). According to Gates, "to prevent the worst effects of climate change, we have to get to net-zero emissions of greenhouse

gases. This problem is urgent, and the debate is complex, but I believe we can come together to invent new carbon-zero technologies, deploy the ones we have, and ultimately avoid a climate catastrophe."

As Bill Gates demonstrated in his book, but also from the recent strategies of the European Union, it results that in order to save the Planet, zero net GHG emissions have to be a must to be reached by 2050. Like the European Union in the Europe Green Deal (2019), Gates is advancing an action plan with recommendations, which involves globally major changes in economic and social life, at enormous cost.

The question that arises in many circles of experts is whether politicians and big producers in those parts of the world enriched by carbon-emitting companies will volunteer for a reduction in living standards. Moreover, there is the problem of those in parts of the world who are not yet rich to sacrifice the chance to become so in the future. In this case, it is logical to focus on doing things that affect neither the comfort of the former nor the aspirations of the latter. But, technological changes that move economies away from the use of fossil fuels as primary energy sources could achieve this in the long run.

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