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COLABORADOR: MTRO. ALFREDO ÁLVAREZ PÉREZ
COODINADORA: DRA. ISABELLE ROUSSEAU

Beyond Net-Zero Emissions

Climate Justice

Alfredo Álvarez Pérez

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Introduction

This article explores the energy sector's role in dealing with climate change, considering some of the risks, questions, and opportunities that the energy sector faces. It points out the complexity involved in defining responsibilities when addressing climate change. It argues that the mechanisms implemented to address climate change (i.e., Nationally Determined Contributions and, more recently, Net-Zero emissions pledges) have not been sufficient to put us on track to achieve climate goals in time. And that an operational framework in which all the Parts acknowledge their responsibilities and climate justice is essential to collectively achieving the most urgent climate targets. The central hypothesis is that new paradigms in sociotechnical systems and sustainability governance are required to achieve global climatic goals in time. The objective is to open a discussion about what is needed to reach climate goals as soon as possible.

The Urgency for energy transitions

Climate change is a multidimensional and multifactorial phenomenon. The IPCC Special Report on Global Warming of 1.5º C exposed in 2018 that anthropogenic greenhouse gases (GHG) emissions are estimated to have had already caused approximately 1.0º C of global warming above pre-industrial levels. And It also states with *high confidence* that global warming is likely to reach 1.5º C by mid-century or earlier if the increase rate of 0.2º C per decade continues its trend (IPCC 2018). The IPCC's Sixth Assessment Report +on the physical science basis of climate change ratifies that the increasingly higher concentrations of well-mixed GHG (CO_2, CH_4, N_2O, and others) due to human activities are the primary cause of global warming (IPCC 2021).

Human activities are broad and diverse, and in each human industry, great changes are required to eradicate GHG emissions. To undertake the necessary changes, lifestyles, business models, and consumption patterns of the great majority living in modern societies must also change. Therefore, political will and collective awareness must be the basis to develop the framework to do this. From all these fronts, energy production and consumption stand out as the largest driver of GHG emissions by far. Table 1 shows that 73.2% of the global GHG emissions of 2016 correspond to energy consumption in different sectors (industry: 24.2%; transport: 16.2%; residential: 17.5%; and others: 13.6%.) Only considering CO_2, the energy sector is accountable for about 90% of global emissions (IEA 2019). From that 90% of global CO2 emissions, more than 70% is concentrated in few countries, which shows the first picture to talk about climate change justice. This reveals how capital it is for the energy industry to cut its GHG emissions as fast as possible, and not limited to but even more urgently in countries that produce more CO2 emissions.

Table 1. Global greenhouse gas emissions by sector in 2016

Energy (transport, industry, building)	73.2%
Industry	5.2%
Waste	3.2%
Agriculture, forest, and land use	18.4%

Source: Climate Watch. The World Resources Institute (2020)

Table 2. Global CO2 emissions shared in 2017

Country	Share of total	Tonnes Per Capita
China	28.2%	6.86
U.S.	14.5%	16.16
India	6.6%	1.84
Rusia	4.7%	11.31
Japan	3.4%	9.31
Germany	2.2%	9.52
S. Korea	1.8%	12.15
Canada	1.7%	15.59
Indonesia	0.0%	2.01
Mexico	1.4%	3.7
Brasil	1.3%	2.33
Australia	1.2%	16.88
England	1.1%	5.82
Italy	1.0%	5.79
France	0.9%	5.33
Total	70.0%	

Sources: (Ritchie and Roser 2020)

To address climate change, relevant actors in governments, industry, international organizations, and so on have committed to induce massive changes on many fronts to reduce GHG emissions. The most notable mechanisms through which international commitments have been made are the nationally determined contributions (NDC). After the Paris Agreements, 191 countries submitted their NDCs [IEA 2021b]. More recently, the pledges for net-zero carbon (NZC) emissions or net zero emissions (NZE) have been made by some countries.

However, few of these pledges are supported with policy documents and fewer with binding laws [IEA 2021b]. Sustainable development goals (SDG) are another framework through which United Nations member States agree to act with Urgency to achieve peace and prosperity sustainably. Although the 17 SDGs are interwoven in many ways, SDG7 specifically addresses the energy sector by setting the goal of ensuring access to affordable, reliable, sustainable, and modern energy for all.

These commitments have led to a rush of policy changes and energy transitions to make more efficient use of energy to keep economic growth on track while reducing GHG emissions. Nonetheless, besides the difficulty to enforce these commitments, even if the countries that have pledged for NZE achieve their targets, the climate goal will not be reached on time if all countries do not reach zero emissions by midcentury. Moreover, energy transitions vary between countries and regions due to various factors, such as the unique geographic, economic, demographic, and political conditions. Table 3 presents panel data from which the difficulty to decarbonize modern economies, the slow pace until now, and the differences between countries in time can be inferred.

Table 3. Selected CO2 Parameters by Country from 2010 to 2020

	Total CO2 Emissions (GtCO2)				Average Carbon Factor (CF)(tCO2/toe)				CO2 Intensity (kgCO2/$15USD)			
	2010	2020	change	annual rate*	2010	2020	change	annual rate*	2010	2020	change	annual rate*
Canada	0.546	0.516	-5.49%	-0.51%	1.39	1.02	-26.62%	-2.77%	0.254	0.176	-30.71%	-3.28%
United States	5.445	4.405	-19.10%	-1.91%	2.46	2.15	-12.60%	-1.22%	0.333	0.229	-31.23%	-3.35%
Mexico	0.446	0.371	-16.82%	-1.66%	2.5	2.45	-2.00%	-0.18%	0.231	0.17	-26.41%	-2.75%
China	7.798	9.717	24.61%	2.02%	3.07	2.87	-6.51%	-0.61%	0.643	0.418	-34.99%	-3.84%
Japan	1.055	0.979	-7.20%	-0.68%	2.22	2.54	14.41%	1.23%	0.228	0.193	-15.35%	-1.50%
South Korea	0.594	0.57	-4.04%	-0.37%	2.32	2.02	-12.93%	-1.25%	0.377	0.284	-24.67%	-2.54%
Sweden	0.049	0.032	-34.69%	-3.80%	0.97	0.69	-28.87%	-3.05%	0.114	0.064	-43.86%	-5.11%
Spain	0.267	0.191	-28.46%	-3.00%	2.1	1.79	-14.76%	-1.44%	0.164	0.12	-26.83%	-2.80%
Germany	0.781	0.617	-21.00%	-2.12%	1.76	1.54	-12.50%	-1.21%	0.162	0.107	-33.95%	-3.70%
France	0.356	0.272	-23.60%	-2.42%	1.36	1.25	-8.09%	-0.76%	0.138	0.102	-26.09%	-2.71%
South Africa	0.43	0.395	-8.14%	-0.77%	3.2	3.18	-0.62%	-0.06%	0.69	0.595	-13.77%	-1.34%
Australia	0.391	0.372	-4.86%	-0.45%	3.1	2.95	-4.84%	-0.45%	0.406	0.314	-22.66%	-2.31%
Brazil	0.377	0.385	2.12%	0.19%	1.41	1.35	-4.26%	-0.39%	0.132	0.133	0.76%	0.07%

Colombia	0.06	0.075	25.00%	2.05%	1.97	1.94	-1.52%	-0.14%	0.114	0.111	-2.63%	-0.24%
Venezuela	0.157	0.085	-45.86%	-5.43%	2.08	2.92	40.38%	3.13%	0.306	0.602	96.73%	6.34%

Source: (Enerdata 2021)

The first thing to note in Table 3 is that between 2010 and 2020, countries like Sweden or Spain reduced their CO_2 emissions relatively fast (annual average rate of 3.80% and 3.00%, respectively). On the other hand, there are countries whose emissions declined comparatively slowly (Australia and South Korea) or contrarily increased (China, Brazil, and Colombia). Now, when looking at each county's carbon factor (C.F.) and carbon intensity (CI), the complexity of the problem starts to emerge. China's C.F. decreased 6.51%, which means that in that proportion, China reduced its CO_2 emissions from energy production for each unit of energy produced; yet, China's CO2 emissions increased during this period by 24.61%. This is contrasting, for example, with the case of South Africa, that its C.F. improved 0.62%, about ten times less than China's, but its CO_2 emissions declined by 8.14% over the same period. The same thing comes up with both countries' carbon intensity. While China improved by 34.99%, South Africa's improvement of 13.77% was about 2.5 times smaller; yet, China's emissions' increased while South Africa's declined. The case of China shows one of the highest increases in Carbon Factor and Carbon intensity, but because of China's rapid economic growth and population size, it has become the highest CO2 contributor, and those emissions are likely to continue growing before they decline. This is an example of how these factors, among others, play an essential role in understanding each country's energy transition.

Another interesting comparison is that of Japan and Brazil. Japan's CO_2 emissions were reduced by 7.2% during the last decade, and its economy became less carbon-intensive by 15.35%. On the other hand, Japan's energy sector became more carbon-intensive (14.41%), despite the growth of renewable energies in its mix (from 8% to 18% approximately) and due to the shutdown of almost all its nuclear power reactors after the nuclear disaster in Fukushima. Contrastingly, Brazil's energy sector achieved a reduction of 4.26% of its C.F. Nonetheless, its economy grew more carbon intensively (0.76%) over the same period, and its emissions increased by 2.12%. These examples show the tip of the iceberg of the complexity involved when analyzing energy transitions; and draw on how complex it is to designate responsibilities, goals, and accountabilities for reaching those goals.

Despite all the efforts done so far, the commitments, pledges, summits, and so on, the world is not even close to being on track to stop global warming in 1.5º C, or 2.0º C. Fossil fuels still are the most important source of energy today, and even though transitions towards cleaner and more diverse energy portfolios are ongoing in many countries, the global CO_2 emissions continue rising at an annual average rate of 1.11% (from 2010 to 2018). These emissions reached a new historical record of more than 33 giga-tones (billions of tonnes) of CO_2 for one year in 2018 (see Table 4). The road to staying beneath 1.5º C or even 2º C is getting steeper. Other indicators also demonstrate that the pace of change must be accelerated. For example, energy efficiency, one of the targets of SDG 7, is also falling short. In global terms, SDG7.3 stated a goal of a 2.6% annual reduction of energy intensity. Nonetheless, the progress in 2017 (1.7%) and 2018 (1.2%) had raised the annual rate to 2.9% to achieve SDG7.3 (IEA 2020).

Table 4. Global CO2 emissions from the energy sector in 2018

	2018	2017	2016	2015	2014	2013	2012	2011	2010	2009	2008	2007	2006	2005	2004	2003	2002	2001	2000
global energy-related CO2 emissions and annual growth	33.398	32.84	32.414	32.431	32.439	32.363	31.777	31.393	30.571	28.845	29.229	28.984	27.934	27.075	26.117	24.943	23.906	23.588	23.24
	1.70%	1.314%	-0.052%	-0.025%	0.235%	1.844%	1.223%	2.689%	5.984%	-1.314%	0.845%	3.759%	3.173%	3.668%	4.707%	4.338%	1.348%	1.497%	

Source: (IEA 2021)

The difficulty to make relevant progress also reflects how much economies depend on fossil fuels and other activities attached to GHG emissions. Economic growth and development are fundamentally correlated with the use of energy, and therefore lifestyles and life quality are also linked to those conditions. At least, it is like that under the modern paradigm of growth and development. It has been pointed out that developed countries are diminishing their CO_2 emissions and energy consumption while developing countries show the opposite trends. This is a clue of the direction that future investment and technological support should flow to. And this condition opens another thread of debate in terms of climate justice and fairness. When looking at energy consumption per capita, that other picture of the world becomes clearer (see Table 2). One insightful example is that of India. It is the 3rd largest CO_2 emitting country, but the per capita energy consumption is one of the lowest in the world. This is revealing in at least two ways. One, a country or entity with low consumption per capita is not necessarily a low carbon-emitting country. And two, people in India consume very little energy (per capita), and that average is the target for everyone.

Energy transitions are supposed to bring all the energy required to support the economy and the living standards of billions of persons while cutting fossil fuels and GHG emissions. The mechanisms applied to put in motion energy transitions have shown that the change rate is slow compared to demand growth and other factors. This fact and the pace for decarbonizing demonstrated until now are discouraging. The COP26 in Glasgow will be crucial for achieving consensus and a framework to make Paris Agreements operational. There, the mechanisms for achieving a global Net Zero Emissions agreement must be laid once and for all. Glasgow will set the tone for the entire 2020s decade. And it is not only an agreement that has to be achieved but the plans to mobilize financial resources, technology transfers, and political will must also be set up.

Thus, the question that arises is if pushing these mechanisms even to their limits will bring the momentum required to achieve energy transitions in time to meet climate goals? This work's hypothesis to answer the first question is that the mechanisms utilized so far are likely not leading the way to achieve climate goals in time. These mechanisms and pathways set to reach climate goals arguably focus on indexes and parameters that do not necessarily reflect the structural changes that they are intended to attain.

And importantly, the basis of those mechanisms may recognize but do not necessarily consider climate fairness and justice in their implementation. It is through paradigm shifts of modern sociotechnical systems and sustainability governance that attaining energy transitions (and thus climate goals) by midcentury would be possible. Paradigm shifts must be undertaken on many fronts, but the energy sector could/must take the leading baton because of its reach and nature. A paradigm shift in the energy sector would affect the way we think, cooperate and work. To induce these changes, the new paradigms (and the pathways towards them) should be more inclusive by bringing opportunities for growth and development for everyone, and their departure point (i.e., the mechanisms to undertake the desired paradigm shifts) must be a consensus on climate justice, legally bounding (private and public sectors) through international treatises and law. Climate justice is understood here as the shared but differentiated responsibility of anthropogenic climate change in terms of biospheric and environmental degradation, biodiversity and ecosystems extinction, resource use inequalities, and human vulnerabilities and circumstances. From there derives that stopping anthropogenic global warming soon is a fair and just thing to do, and in that sense, the efforts of all the Parts must be channeled to comply with that responsibility. Such consensus would be a step forward beyond NDC and NZE pledges, and it would open opportunities for paradigm shifts to occur. Ideals of those new paradigms can already be seen on the SDGs statements and goals, and climate justice and fairness issues are already sketched in general terms on the Paris Rulebook. To pursue these paradigm shifts with climate justice as a directional axis with concrete binding treatises and law is what this paper states as a necessary condition to mobilize effectively (or not, and how, in a case by case approach) resources and to put *humans* in the center of energy sociotechnical systems and sustainability governance.

The 3rd and 4th goals of COP26 (Mobilize finance from developed countries and work together to deliver) must be adequately achieved to secure close cooperation among the Parts. Nonetheless, as this paper argues, if climate justice is not at the center in every negotiation and project from now on, these goals and the shape of development in the next decade may deviate from the cooperation framework required to induce the changes and paradigm shifts necessary to attain climate goals.

The Risks and Opportunities

Whether under new paradigms or net-zero pledges approach, the energy sector faces several risks. Political risk is probably the most threatening for both the energy industry and for achieving climate goals. So far, the most significant expression of the political risk was embodied by Donald Trump's presidency. His discourse of climate change denial became popular. With executive actions, he terminated the participation of the U.S. in international agreements and favored policies that delayed the energy transition in many States and even in other countries as other mandataries followed his leadership. This kind of political discourse represents a risk for climate goals, but like any other, this risk cannot be eliminated. It must be countered domestically by other political forces and with more inclusive energy programs and with a new sustainability governance paradigm in the international arena. Whether president Biden's green new deal be a suitable model to address U.S. energy transition and work against denial discourses is a question of utter importance to the U.S. and the world. Political risks may also discourage investment in energy transitions, and under an NDC or NZE pledges, the risks for public and private entities might prove considerably higher than under a scheme in which international treatises and law bind all parties at least to a certain extent and for some time.

The responses of each country to the COVID19 pandemic could be studied from this point of view and regarded as one of the first global problems that have affected humanity in the Anthropocene. As health authorities have stated, this global problem is not likely to be resolved unless a more collaborative international approach is set, instead of each country looking only inwards. Indeed, the COVID19 pandemic crisis may be a good example of how not to work out global problems and reveals the fragility of the international framework that has dealt with them. The problems that climate change will trigger are also global in cause and effect, and political risks will aggravate these problems if a different approach is not implemented.

Another set of risks that threaten the energy industry and the climate goals concerns the overreliance on disruptive technological breakthroughs. In most –if not in all– NZE roadmaps, technologies such as hydrogen as a fuel or carbon capture, use, and storage (CCUS) play to a different extent a critical role. To relay in technologies that are not commercially available yet, and for which decades are required to develop a significant market after the commercial demonstration, might lead to plotting critical paths deviated from the industry's goals. It is important to continue all efforts in R&D. However, it might be a significant risk to consider the availability of viable technologies when there is still a degree of uncertainty on whether they can deliver on time or not. It might be a clever way for policymakers to secure the political support required to continue with expensive R&D programs, but then there must be mechanisms to compensate in case of delays of technological breakthroughs. Furthermore, how new technologies will be commercialized, shared, sold, or transferred to other countries or private entities, is another issue related to a framework of international cooperation and justice that must be addressed to advance the shared goals collectively.

Moreover, securing the resources required to sustain many new technologies and the energy transitions themselves is another issue that concerns the framework and departing point of climate fairness and justice. Rare earths, lithium, magnesium, aluminum, and other resources that conform the core of the transitioning to cleaner energy sources are the center of the new geopolitics of energy and an important source of geopolitical risks. These risks, again, must be addressed through a cooperative approach based on climate justice and enhanced sustainability governance.

Final Thoughts

- The mechanisms implemented so far (nationally determined contributions and net-zero emission pledges) are not inducing changes and energy transitions as necessary to attain global climate goals in time.
- The energy industry sector is the largest source of CO_2 and other GHGs. It must be a leading actor implementing energy transitions and paradigm shifts (new sociotechnical paradigms). The necessary changes include: how public and private actors interact, business models, technology transfers, redirection of the workforce, avoiding top-down intervention methods as much as possible, and others.
- The need for change must be acknowledged and embraced as an opportunity rather than as a load.
- To implement the required changes globally, it is necessary to acknowledge climate justice as the basis of a cooperative framework for sustainability governance. An important step forward in this direction would be the definition of the Paris Rulebook in COP26.
- About COP26: How we start this decade will be crucial. Climate change will bring many other challenges to humanity, and now how we deal with this goal will set a precedent for the future.

- There are political risks that threaten the pathways traced to achieve climate goals. And there are technical risks when over-relying on technological breakthroughs.
- The combination of political and technical risks presented might lead to a worse scenario not (only) in climatic terms but in social, economic, and political terms.

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