CIDSE
together for global justice

The Climate Urgency:
SETTING SAIL FOR A NEW PARADIGM

IN THIS PAPER

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Contacts:
Giulia Bondi, Climate Justice and Energy Officer – Email: bondi@cidse.org
François Delvaux, Climate & Agriculture and Food Sovereignty Officer – Email: delvaux@cidse.org

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Proofreading: Anya Verkamp

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Executive Summary

This report aims to explore how a paradigm shift in our food and energy systems – supported by structural lifestyle and societal changes – could greatly contribute to limit rise in average global temperature to 1.5°C without relying on risky and unproven Negative Emissions Technologies (NETs) or geoengineering.

The UNFCCC Talanoa Dialogue is built on three fundamental questions: where are we, where do we want to go, and how do we get there? Despite efforts to promote viable solutions, biodiversity loss, environmental impacts, and Green House Gas (GHG) emissions continue to worsen in the midst of multiple crises that are rooted at the core of our current social, economic, and political system. Climate science is clear: there are just a few years left with current carbon budget reserves to stay within the 1.5°C limit. Hence, achieving the long-term goal of the Paris Agreement is of utmost importance and it requires countries to increase their ambition promptly.

Nevertheless, not all solutions promoted are putting people and planet at the centre but rather harmful and deeply controversial technologies are gaining traction as an effective way to achieve the 1.5°C threshold. The consequences of deploying such techno-fix solutions could be irreversible and would continue to hit the poorest and vulnerable communities the hardest. Instead, the energy and agriculture sectors need a fundamental transformation to reach the long-term goal.

On the one hand, the energy sector, representing two-thirds of total GHG emissions and 80% of CO2, must phase-out its dependence on fossil fuels and switch towards renewable energy systems. Such a transition must be just, inclusive, and transparent, and must not replicate the corporate structures that are currently governing the energy sector. Decentralisation, diversification, human rights, and gender equality have to be considered when developing such renewable energy systems, with finance flows shifting towards such viable alternatives. Meanwhile current levels of energy consumption must also be reconsidered to respect planetary boundaries and the understanding that we are living on a finite planet.

On the other hand, a transition towards agroecology would turn agriculture and the food system from problem to solution. The transition framework which comprises five different levels of actions helps clarify the integral nature of the changes required while highlighting their mitigation potential and multiple co-benefits they would bring. Such transition goes through shifting to organic agriculture as a first level, ramping up to the next one by redesigning agroecosystems to diversify and integrate them, to changing diets, reducing meat and dairy production and consumption by 50%, relocalising food systems to reduce food loss and waste and build food sovereignty.

CIDSE affirms that this transformation can only be achieved through a paradigm shift. We need a different system as a whole. This requires new narratives, a different cultural approach – putting sufficiency at its heart – and of course, transforming our political and economic systems – away from the destructive growth imperative that lies at the heart of the current system. CIDSE's arguments and vision for a new paradigm are based on values such as integral ecology, justice, and good governance, as also defined by Catholic Social Teaching and in the Papal Encyclical *Laudato SI'*. Equity, Common But Differentiated Responsibilities, as well as communities' involvement and participation in decision-making processes are some of the principles that must lie at the heart of the change needed.

Climate change is the tip of the iceberg of a failing system and solving it in conjunction with other crises requires political courage and efforts that can no longer wait.

LIST OF ACRONYMS

CBDR-RC: Common but Differentiated Responsibilities and Respective Capabilities

CFS: Committee on World Food Security (UN)

CH4: Methane

CO2: Carbon Dioxide

COP: Conference of the Parties

CSO: Civil Society Organisation

EU: European Union

FAO: Food and Agriculture Organisation (UN)

FLW: Food Loss and Waste

GDP: Gross Domestic Product

GHG: Greenhouse Gas

Gt: Gigatonne

GW: Gigawatt

IEA: International Energy Agency

IPCC: Intergovernmental Panel on Climate Change

LS: *Laudato Si'*

MW: Megawatts

N2O: Nitrous Oxide

NDC: Nationally Determined Contributions

NETs: Negative Emission Technologies

PVs: Photovoltaic System

SDGs: Sustainable Development Goals

UN: United Nations

UNEP: United Nations Environment Programme

UNFCCC: United Nations Framework Convention on Climate Change

WHO: World Health Organisation (UN)

Introduction

It's 3.23 in the morning
and I'm awake
because my dreams
won't let me sleep
my great-great-grandchildren
ask me in dreams
what did you do while the planet was plundered?
what did you do when the earth was unraveling?
surely you did something
when the seasons started failing?
as the mammals, reptiles, birds were all dying?
did you fill the streets with protest
when democracy was stolen?
what did you do
once
you
knew?

Drew Dellinger[1]

Where are we? Such is the first question of the Talanoa Dialogue Platform.[1] And where are we coming from? Climate change has been on the political agenda since 1989. In 1992, the UNFCCC was adopted together with other key decisions related to the environment, sustainable development and biodiversity. What did we do once we knew? What have we done since 1992? More importantly, what are the results of our actions so far? How successful have we been in preventing climate change? This requires looking at facts. Fortunately, facts are known. And they are piling up, day after day, week after week. With every day come more data, articles and headlines on our current state of emergency. See here a non-exhaustive sample:

- "A third of the planet's land is severely degraded, and fertile soil is being lost at the rate of 24bn tonnes a year".[2]
- "The biomass of flying insects in Germany has dropped by three-quarters since 1989, threatening an 'ecological Armageddon'. (…) their disappearance is a principal reason why Britain's farmland birds have more than halved in number since 1970".[3]
- "Exploitable fisheries in the world's most populous region – the Asia-Pacific – are on course to decline to zero by 2048; (…) freshwater availability in the Americas has halved since the 1950s".[4]
- "Carbon dioxide (…) reached its highest level in recorded history last month [April 2018], at 410 parts per million. This amount is the highest in at least the past 800,000 years".[5]
- "The world has lost over 130 million hectares of rainforest since 1990".[6]
- "In Europe, 9% of bee and butterfly species are threatened with extinction and populations are declining for 37% of bee species and 31% of butterfly species for which sufficient data is available". [7]
- While current levels of production are enough to meet the demands of human kind,[8] "global hunger appears to be on the rise, affecting 11% of the global population. In addition (…) adult obesity continues to rise everywhere (…) In 2014, more than 600 million adults were obese, equal to about 13% of the world's adult population".[9] Moreover, "from 1990 to 2010, global agricultural emissions increased 8%. They are projected to increase 15% above 2010 levels by 2030, when they will amount to nearly 7 billion tonnes per year".[10]
- Several planetary boundaries have been crossed: biogeochemical flows (nitrogen and phosphorus), and biosphere integrity (genetic diversity) and they are closely related to agriculture[11].
- "In recent decades, income inequality has increased in nearly all countries"[12] as "global economy enables a wealthy elite to accumulate vast fortunes while hundreds of millions of people are struggling to survive on poverty pay".[13]
- "In just over a decade, concerted investment has increased the proportion of world electricity generated by wind, solar and other renewable sources from around 5% to 12%".[14] On the other hand, global oil demand keeps rising year after year,[15] and so does demand for natural gas.[16] [17] And according to IEA scenarios" global energy needs (… will) still expand by 30% between today and 2040. This is the equivalent of adding another China and India to today's global demand".[18] Still, "over one billion people lack access to affordable, clean electricity". Moreover, "fossil fuels continue to dominate energy use, constituting 81% in 2017. This number has changed little over the past three decades".[19]

In 1992, scientist warned that humans were on a collision course with the natural world: "they expressed concern about current, impending, or potential damage on planet Earth involving ozone depletion, freshwater availability, marine life depletion, ocean dead zones, forest loss, biodiversity destruction, climate change, and continued human population growth. They proclaimed that fundamental changes were urgently needed to avoid the consequences our present course would bring".[20] By putting figures on the level of destruction, injustice, and inequalities we are facing and that we are fostering, recent reports are illustrating such a state of collision.

This is what we see when we look at the global picture - meanwhile the wealth of alternative ways of producing, consuming, and living has been growing in the shadow of the current system. We have seen the numerous struggles of peasants, indigenous people, women, men and citizens in favour of another world, against injustice, and against the destructive power of capitalism. It would be misleading if this overview gave the impression that nothing has changed. A lot has been done. Progress has been made, decisions have been taken and renewable energies have boomed. Nevertheless, the action undertaken has not led to curbing our emissions, inequalities, or the rate of biodiversity loss.

This is where we stand now.

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[1] "The Talanoa Dialogue is designed to take stock of collective efforts to reduce emissions in line with the long-term goals of the Paris Agreement and to inform the preparation of Nationally Determined Contributions (NDCs). Ultimately, the goal is to help countries increase the ambition of their NDCs by 2020". Source: UNFCCC Talanoa Dialogue Platform.

The second question of the Talanoa Dialogue is **"where do we want to go?"** This is also known. Even better: it's been agreed upon and all states have a duty to make this happen.

In 1948, the UN General Assembly adopted and proclaimed the "Universal Declaration of Human Rights as a common standard of achievement for all peoples and all nations".[21] Together with the International Covenant on Economic, Social and Cultural Rights adopted in 1966, they form the overarching framework under which any action should be developed.

In December 2015, 196 governments[II] [22] agreed on the Paris Agreement: it aims to hold "the increase in the global average temperature to well below 2°C above pre-industrial levels and pursuing efforts to limit the temperature increase to 1.5°C above pre-industrial levels (…). This Agreement will be implemented to reflect equity and the principle of common but differentiated responsibilities and respective capabilities, in the light of different national circumstances".[23] The preamble of the agreement highlights principles that should guide parties when working towards the achievement of the following objective: "safeguarding food security and ending hunger, taking into account the imperatives of a just transition, promote and consider their respective obligations on human rights as well as gender equality, empowerment of women and intergenerational equity, ensuring the integrity of all ecosystems", noting the importance of "climate justice" and "recognising that sustainable lifestyles and sustainable patterns of consumption and production, with developed country Parties taking the lead, play an important role in addressing climate change".[24]

Three months before the adoption of the Paris Agreement, the UN adopted the Sustainable Development Goals (SDGs). They stated that "we are resolved to free the human race from the tyranny of poverty and want, and to heal and secure our planet. We are determined to take the bold and transformative steps, which are urgently needed to shift the world on to a sustainable and resilient path. As we embark on this collective journey, we pledge that no one will be left behind".[25]

So we know where we want to go, and we also know what it means: at best, there are only a few years left before reaching such an increase in global temperature[26] (*see chapter: What carbon budgets are telling us about urgency?*). Therefore, emissions must immediately peak and decline. This is what we must keep aiming for.

The last question of the Talanoa Dialogue is **"how do we get there?"** Here we are at a crossroads. There are clearly divergent opinions, which translate into different potential pathways. One way or another, getting there will forever change the way we know the world - but the outcomes would differ greatly.

On one side, there's the idea that improvements in efficiency, clean energy, food production, and technological innovation (including Negative Emissions Technologies) will suffice. That's the mainstream scenario, which aims to deploy a green version of the system we currently have. This scenario goes together with the assumption that growth and the free market are the main tools that will allow us to naturally meet the temperature goal.

On the other side, there's a call for a paradigm shift. It is our conclusion that this is the only realistic strategy to cope with climate change while ensuring climate justice and respecting people's rights. This requires investing in the wealth of alternatives that currently exist in the shadow of the current system and understand how they could contribute to mitigating and adapting to climate change.

Hence, this report aims to explore transitions in our food and energy systems supported by deep lifestyle and system changes that would greatly contribute to hold warming below a 1.5°C increase above pre-industrial average global temperatures without relying on risky and unproven Negative Emissions Technologies or geoengineering.

[II] As of the 13th of July 2018, 195 Parties signed the agreement and 179 Parties have already ratified it.

CIDSE'S perspective and principles

CIDSE's vision of how the long-term temperature goal set in the Paris Agreement should be achieved is based on the principles of Catholic Social Teaching, such as solidarity, equity, and justice. CIDSE believes that such principles are key and central in the way the agriculture and energy sectors should be reformed in order to protect the planet and its living species and avoid irreversible climate change.

The paper makes use of previous CIDSE's analyses[III] concerning climate justice, agroecology, and renewable energy systems, as well as the Papal Encyclical *Laudato Si': On Care for Our Common Home.* These principles are the frames on which the analysis of this publication is based, and provide backing for CIDSE's assertions and conclusions. They have been categorised as follows:

- Integral ecology, which comprises concepts of human ecology, human dignity and human development;
- Justice, which embraces concepts of equity, Common But Differentiated Responsibilities and Respected Capabilities (CBDR-RC), gender equality, just transition, human rights, social and intergenerational justice;
- Good governance, which refers to principles of decentralisation, participation and dialogue.

» INTEGRAL ECOLOGY

The concept of integral ecology appears in the Encyclical *Laudato Si'* and it explains the interconnectedness that exists between humanity and nature, providing guidance on how such relationship should be addressed. Integral ecology understands the environment as a whole, where current multiple crises are both social and environmental, and holds up the dignity and development of all human beings. Therefore, it is important not to pursue separate solutions when addressing climate change, but rather it is crucial that an integrated approach is considered and applied at all levels of action.

» JUSTICE

Justice lies at the heart of CIDSE's work. The climate crisis perpetuates unequal economic, social, and political systems. Hence, justice needs to be met in order to shift towards a new paradigm that can ensure access to clean and safe energy, food, water, healthcare, and education. It is more necessary than ever that all countries increase their climate targets to reduce their greenhouse gas (GHG) emissions radically; however, this effort requires an equity approach. Indeed, those who contributed the most to the acceleration of climate change must take bolder action compared to those who are currently most impacted by the effects of climate change and have less historical responsibilities. This is recognised at the core of the UNFCCC as the principle of Common But Differentiated Responsibilities and Respected Capabilities (CBDR-RC).[27]

» GOOD GOVERNANCE

Decentralisation, participation, and dialogue are three important principles of good governance as we advocate and define it. A just agricultural or renewable energy system practices subsidiarity by dismantling power relations and putting people at the heart of decision-making. A decentralised system can indeed ensure food and energy access for all, particularly for the most vulnerable communities as witnessed by CIDSE member organisations working in the field with poor and rural groups. Additionally, participation and dialogue play a vital role in countries' decisions to increase their climate ambitions and discussions on how to shift to low-carbon and sustainable development: all parties – especially those most vulnerable and most affected by climate change – have the right to be informed and to express what is best for their communities and needs. It is particularly important that participation and dialogue are gender-sensitive and that any decisions are comprised of a strong gender equality dimension in order to overcome power unbalances, inequalities, and exclusion.

[III] CIDSE's papers are *Climate Action for the Common Good* (2017); CIDSE internal reflection on *principles for Renewable Energy Systems and Energy Access* (2017); *The Principles of Agroecology* (2018).

WHAT ARE CARBON BUDGETS telling us about urgency?

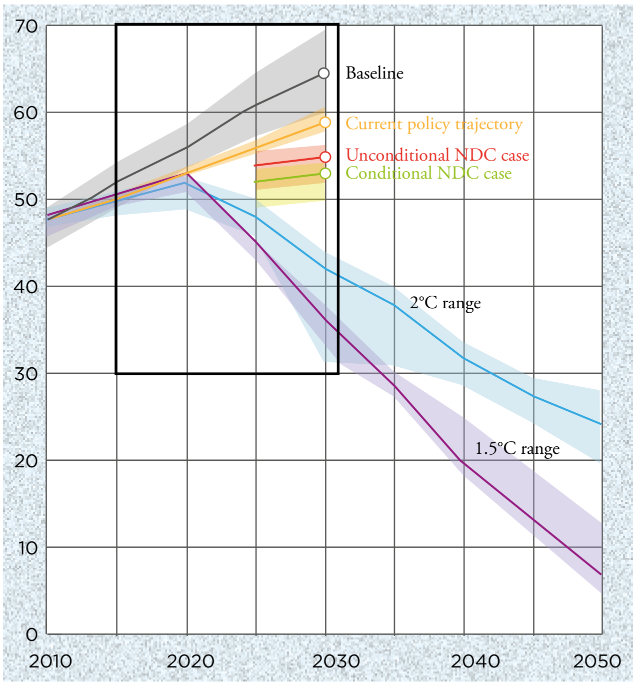
» THE PARIS AGREEMENT

One of the outcomes of the 2009 climate summit in Copenhagen (COP15) was an agreement on the long-term goal to hold warming below a 2°C increase above pre-industrial global average temperatures. However, at Copenhagen more than 100 vulnerable countries were calling for limiting warming to below 1.5°C. Recognising this, during the subsequent climate summit in Cancun (COP16) in 2010, the UNFCCC established a review process to evaluate whether holding warming below 2°C was adequate to avoid dangerous climate change, and the progress towards this long-term goal. The review process focused in particular on the differences in impacts between 1.5°C and 2°C warming above pre-industrial levels. This process ended in 2015 with the final report of its scientific arm (a "Structured Expert Dialogue") concluding that a warming of 2°C cannot be considered safe and that 1.5°C is closer to being a safe 'guardrail'.[28] This very important finding was reflected in the Paris Agreement's long-term goal of holding warming "well below 2°C and pursuing efforts to limit this increase to 1.5°C above preindustrial levels" (Art. 2).[29]

Specifically, at COP21 governments agreed:

- To a long-term goal of keeping the increase in global average temperature to well below 2°C above pre-industrial levels (Art. 2);
- To aim to limit the increase to 1.5°C, since this would significantly reduce risks and the impacts of climate change (Art. 2);
- On the need for global emissions to peak as soon as possible, recognising that this will take longer for developing countries (Art. 4);
- To undertake rapid reductions thereafter in accordance with the best available science so as to achieve a balance between anthropogenic emissions by sources and removals by sinks of greenhouse gases in the second half of this century, on the basis of equity, and in the context of sustainable development and efforts to eradicate poverty (Art. 4);
- To increase the ability to adapt to the adverse impacts of climate change and foster climate resilience and low greenhouse gas emissions development, in a manner that does not threaten food production (Art. 2);
- To make finance flows consistent with a pathway towards low greenhouse gas emissions and climate resilient development (Art. 2).

In the lead-up to COP21, countries were asked to submit intended nationally determined contributions (INDCs), i.e. plans to reduce GHGs. When a country submits its instrument of ratification, accession, or approval of the Paris Agreement, the 'intended' drops out and these become Nationally Determined Contributions (NDCs). However, as highlighted by the UNEP Emissions Gap Report released in 2017,[30] current NDCs represent approximately one-third of the emissions reductions needed to stay well below 2°C as such plans could only limit warming to below 3.5°C.[31]



Emission gap – Source: UNEP
X: Annual total greenhouse gas emissions (GtCO2e) –Y: years

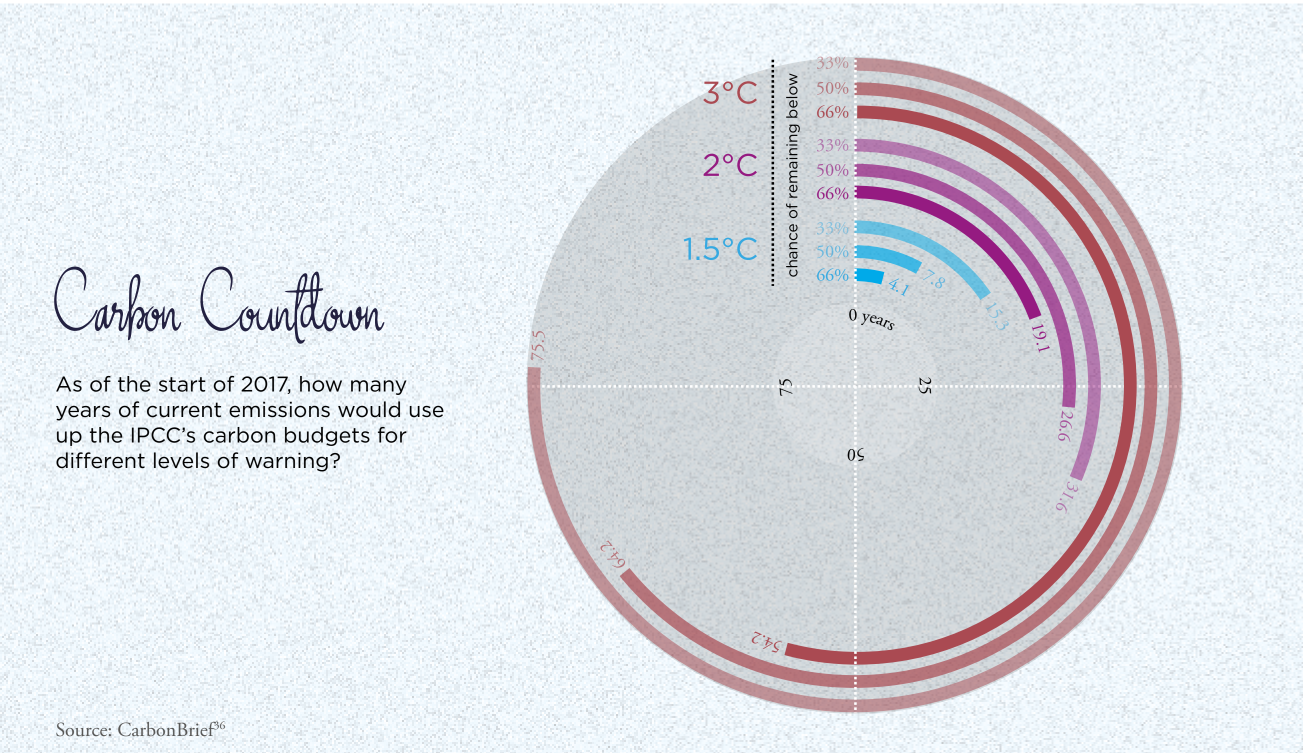
» CARBON BUDGET AND SCIENTIFIC SCENARIOS

A carbon budget is the cumulative amount of CO2 emissions permitted over a period of time to stay within a certain temperature threshold; they are typically calculated from pre-industrial levels.[IV] [32] Scientists have developed carbon budgets that indicate the GHGs the world can still emit before certain temperature thresholds are passed, and are consistent with certain likelihoods of achieving different temperature limits. Improvements in carbon removal can increase these budgets.

In terms of permissible emissions, the IPCC provides in the 5th Assessment Report (AR5) an overview of global carbon budgets for different likelihoods to limit temperature rise.It is important to note that the IPCC AR5 budgets[V] refer to all anthropogenic sources[VI] of CO2. This means the IPCC includes CO2 budgets for heavy industries, as well as land use, land-use change and forestry (LULUCF), factoring in non-CO2 emissions like methane and nitrous oxide.[VII] [33]

According to an analysis by Carbon Brief based on IPCC data[34] the carbon budget of 312 Gt CO2 as of 2017 allows for a 50% chance of remaining below 1.5°C. Current annual emissions are around 40 Gt CO2, resulting in 7-8 years of carbon budget at 2016 emissions. For a 66% chance of remaining below 1.5°C, the figure is 162 Gt CO2 as of 2017, corresponding to 4 years of carbon budget at 2016 emissions[35]. Hence, if carbon emissions continue at 2016 levels, the remaining budget to limit warming to 1.5°C is projected to run out in 2021. The graph below represents clearly how many years are available before overshooting the remaining carbon budget, taking into consideration 2016 emissions' levels.[36]

Although we think this is a useful tool for showing quite simply the urgency we face as well as the deep transformations that are needed in order to put us on the right trajectory, we recognise the limitations of these models and their uncertainty. This is due to the fact that they often rely heavily on Negative Emissions Technologies, which can falsely suggest we have a greater budget at hand (see chapter *Negative emissions: geoengineering vs. natural climate solutions*), and on growth assumptions that are not realistic or desirable (see chapter *Setting sail for a new paradigm)*. Looking at climate through models that rely on a quantitative lens obscures the full reality, and therefore these models cannot solely be relied upon.



Source: CarbonBrief[36]

[IV] Please note that to date, 1850-1900 has been the preferred baseline by institutions including the IPCC. However, some studies have suggested a 1720-1800 baseline would be more appropriate because GHG concentrations have been increasing since industrialisation began around 1750. The selection of pre-industrial baseline is important because it can affect the size of the remaining budget for each temperature threshold and the likelihood of breaking through that budget.

[V] The IPCC special report on 1.5°C will be released in October this year and will present updated figures.

[VI] Emissions due to human activity such as burning of fossil fuels for industrial/economic purposes.

[VII] When CO2 budgets are calculated, other GHG emissions are factored in though if assumptions of the size of such other emissions change this affect the size of the carbon budgets.

THE ENERGY SECTOR AT THE HEART OF GLOBAL ACTION against climate change

» WHY THE ENERGY SECTOR NEEDS TO BE TRANSFORMED

Energy production and use is responsible for two-thirds of total GHG emissions and 80% of CO2 [37] and it is of utmost urgency that this sector enters a process of deep transformation in order to stay within the 1.5°C temperature threshold and avoid further climate change impacts. Such transformation requires first a complete phase out from fossil energy sources like coal, oil, and gas and a rapid shift towards the production and consumption of renewable energy sources. What climate science is clearly indicating is that additional GHG emissions will put humanity on an irreversible pathway[38] and that efforts to mitigate need to come from everybody. However, some countries must take bolder action due to their higher income and wealth, level of development, and historic responsibilities. Indeed, developing countries are not only the first victims of climate change but they are also suffering from inequalities, wars, and poverty. Large sections of the population live without sufficient access to energy: today roughly 1 billion people (about 13% of the world's population) are lacking electricity in rural areas and 3 billion people (more than 40% of world's population) are still cooking with polluting fuels.[39] Energy poverty restricts peoples' fundamental rights and needs in a variety of ways: food and vaccines cannot be kept cool, energy for cooking is more costly than the food itself, and the lack of lighting on the roads comprises a safety risk, especially for women.[40] Indeed, women must work extremely long hours to meet household energy needs and consequently this restricts them to access to education, better livelihood choices and decent wage employment.[41] Therefore, the costs of continuing with such a development and energy model are too high and solutions must be implemented as soon as possible. Evidence worldwide shows that a 100% renewable energy future is possible: safe, affordable, reliable, and efficient energy systems that are based on renewable sources and meet communities' development needs can help tackle poverty and inequality while addressing the causes of climate change and increasing local resilience.[42]

» GUIDING PRINCIPLES FOR RENEWABLE ENERGY SYSTEMS

When designing renewable energy systems, CIDSE believes that several elements need to be taken into consideration in an integrated manner. Indeed, the transformation of the energy sector must embrace not only environmental and economic principles, but also social ones that would facilitate inclusive participation, better management of the energy system, and equal rights. Therefore, CIDSE considers a renewable energy system effective when it meets the following criteria:

- Lowest impact on biodiversity and recognising ecological limits (planetary boundaries);
- Avoiding one-size fits all approach through participatory processes and expand opportunities for local ownership;
- Contributing to the needs of vulnerable communities;
- Prioritising equitable access and distribution to energy and eradicate poverty;
- Increasing efficiency;
- Respecting human rights and address gender impact of energy poverty;
- Ensuring good governance in regulatory processes, establish transparency mechanisms and inclusive participation.

Such criteria reflect the call of tackling climate change not only with low-carbon technologies and innovation, but with a radical societal transformation that leaves no one behind. These are founded on the objectives of relieving energy poverty, respecting all fundamental human rights - from the right to food and water to energy access – and shrinking the gap of inequalities. This vision of a just transition conceives of an energy system that opens access and reduces costs, is in tune with people's interests and development needs, and that recognises ecological limits. Decentralisation, participation, and inclusiveness are necessary in order to achieve climate justice: the concerns of workers who are often times the most vulnerable must be heard and considered, and community-led energy initiatives must be scaled up and out, challenging the vested interests of international corporations that dominate the energy sector.

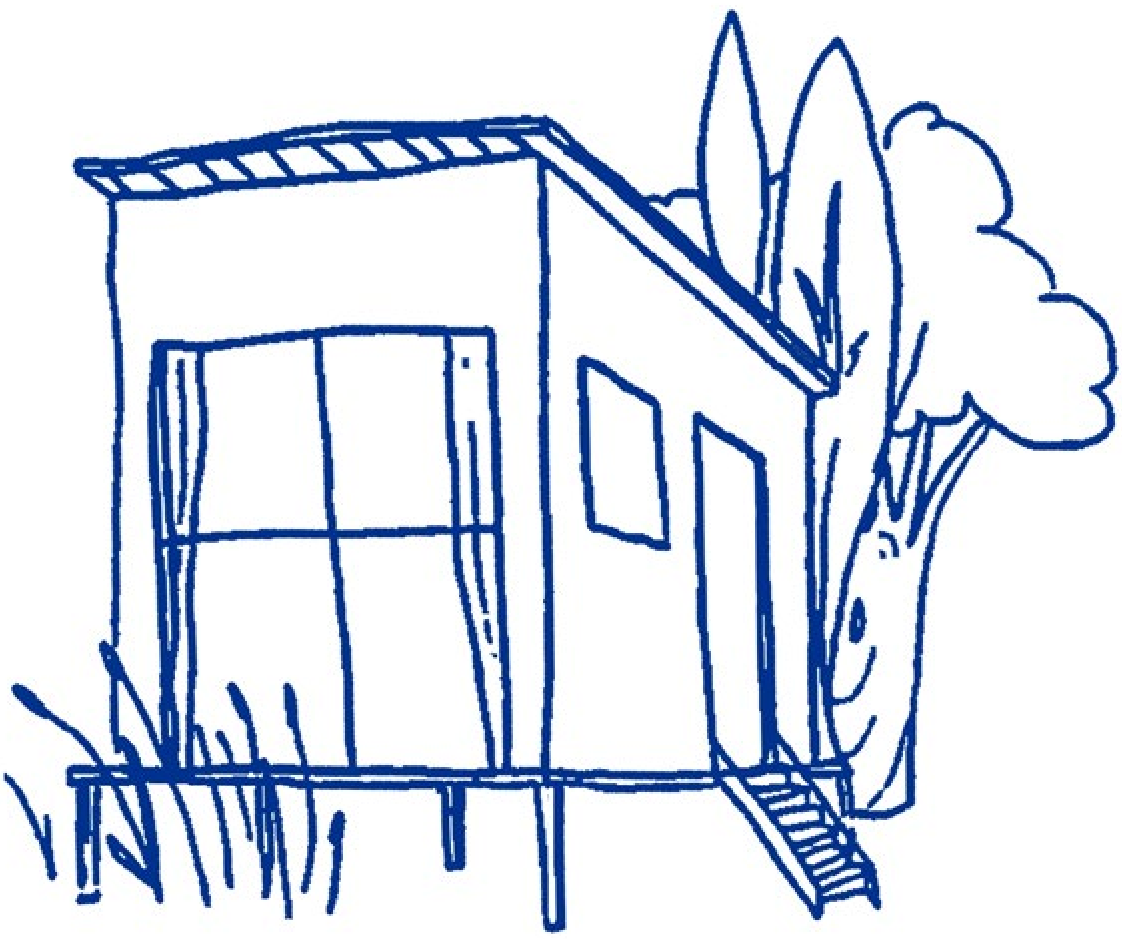
» THE POTENTIAL OF RENEWABLE ENERGY SYSTEMS AND THE NEED FOR A BOOST IN ENERGY ACCESS

In the past years, there has been a surge of research and innovation in the design and implementation of renewable energy systems worldwide and a lot of their potential is still untapped.

The International Energy Agency (IEA) expects an increase in renewable electricity generation by more than one-third by 2022.[43] Encouraged by a strong solar photovoltaic (PV) market, renewables accounted for almost two-thirds of net new power capacity around the world in 2016, with almost 165 gigawatts (GW) coming online. In 2016, new solar PV capacity around the world grew by 50%, reaching over 74 GW, and for the first time solar PV additions rose faster than any other fuel, surpassing the net growth in coal.[44] Such expansion indicates the ever-growing market of renewables: according to a recent report by UNEP and Bloomberg, in 2017, global investments in renewables exceeded US$ 200 billion.[45]

IEA is also reporting that off-grid solar PV capacity in developing Asia and Sub-Saharan Africa are forecasted to triple – reaching over 3,000 megawatts (MW) in 2022 – from industrial applications, solar home systems, and mini-grids driven by government electrification programmes, as well as private sector investments. Over the next five years, solar home systems – the most dynamic sector in the off-grid segment – are forecast to bring basic electricity services to almost 70 million more people in Asia and Sub-Saharan Africa. It will also lead to new business players bringing innovative payment solutions that allow low-income populations initial access to electricity services.

It is promising to see that overall in 2017, targets for the renewable share of primary and final energy were in place in 87 countries, while sector-specific targets for renewable power were in place in 146 countries, for renewable heating and cooling in 48 countries, and for renewable transport in 42 countries.[46] China is the global leader in such renewable expansion followed by India,[47] but small and large developing countries are also rapidly investing in renewables such as the Marshall Islands, Rwanda, the Solomon Islands, and Guinea-Bissau.[48] Industries spotlight some opportunities and challenges:



Electricity power	Heating and Cooling	Cooking	Transportation
• Renewable power generation capacity saw its largest annual increase ever in 2017, raising total capacity by almost 9% over 2016. Overall, renewables accounted for an estimated 70% of net additions to global power capacity in 2017[49]: Bangladesh, Ethiopia, Kenya and Tanzania, all increased their electricity access rate by 3% or more annually between 2010 and 2016. Over the same period, India provided electricity to 30 million people annually and Sub-Saharan Africa's electrification deficit has begun to fall in absolute terms for the first time.[50] • There is progress in access to electricity through solar home systems or connected to mini-grids but it's concentrated in a dozen pioneering countries.[51]	• Modern renewable energy supplied approximately 10.3% of total global energy consumption for heat in 2015. Another 16.4% was supplied by traditional biomass, predominantly for cooking and heating in the developing world.[52] • Demand for heating in buildings and industry outweighs demand for cooling. However, the latter is gradually growing, especially due to increasing demand for air conditioning or refrigeration of food and medical supplies. • Global energy demand for heating is projected to increase until 2030 and then stabilise. It is estimated that by about 2060 the amount of energy used worldwide in cooling will overtake that used in heating. • Generally heating and cooling is often distributed through pipelines primarily based on fossil fuels, but according to IRENA, contribution from renewables could increase to 3% by 2030.[53] • It is very important that energy efficiency measures are implemented rapidly, mostly in buildings and industry.	• The cooking sector is still lagging behind the targets of achieving energy access for all by 2030 with renewable and safe sources. This is mostly due to low consumer awareness, financing gaps, lack of technological progress and infrastructure for distribution and production. • More than 40% of the world's population does not have access to cooking fuels nor technologies and there are about 4 million deaths a year due to the burning of biomass for cooking and heating.[54]	• Transportation, together with the heating sector, accounts for 80% of global energy consumption. • The share of renewable energy in transport is rising but from very low base, amounting to only 2.8% in 2015. • Stronger policies and measures are needed to reduce the overall energy consumption from transportation and to shift from dependence on oil.[55]

» RENEWABLE ENERGY AT ALL COSTS? MIND THE MINING

The increasing demand in renewables and the urgency to phase out from fossil fuel extraction poses questions on how such renewable energy technologies affect the extractivist economic model, and subsequently, what are the implications for the extraction of natural resources that make it possible to build solar panels or wind turbines. One should not forget that mining activities have extreme impacts on the environment and biodiversity, as well as impacting people's lives with human rights violations, pollution, and grabbing of natural resources. Thus, it is important to understand the challenges and therefore the choices to make when shifting towards 100% renewables as this cannot be done without re-considering the current economic paradigm.

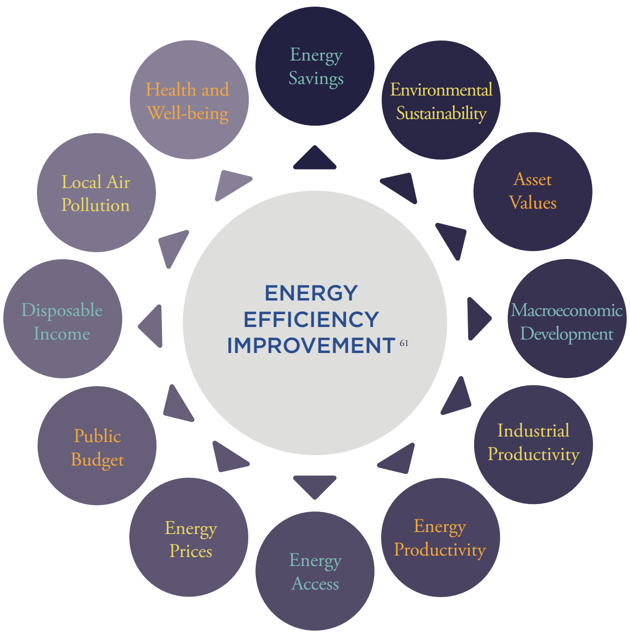
The arguments for the energy transition to happen as quickly as possible are multiple and undeniable. However, the costs of such a switch are equally many and are dependent on whether we choose to continue pursuing the business-as-usual development model, or instead resist the temptation to "greenwash", and truly provoke a systemic change that would reshuffle the capitalistic societal model we live in today.

Solar PVs, wind turbines and electric cars are all made of rare metals and other sources such as tungsten, cobalt, germanium, silicon, lithium and rare earths[VIII] [56] and are present in smart-phones, TV screens, and laptops. It is estimated that between 10 and 15 kg of rare earth elements are contained in the battery of a hybrid vehicle.[57] This includes lithium too, whose extraction is very harmful for the environment and its demand is ever increasing so as to respond to the needs for mobile electrical energy storage.[58] This is just a little example to show the dark side of innovations and low-carbon technologies: they are supporting the energy transition following the current extractivist economic model based on infinite growth and consumption.

The criteria presented in the section above for a type of renewable energy system that is just and fair are an important consideration for policy-making, given the implied human and ecological costs in developing renewable energy technologies within the same logic of consumption and production. Post-growth and degrowth arguments must enter the debate and inspire the shift in the global political economy. For further analysis, please see the chapter *Setting Sail for a New Paradigm.*

» EFFICIENCY-SUFFICIENCY: THE MISSING LINK IN THE ENERGY TRANSFORMATION?

Energy efficiency is very often considered as an indispensable measure to reduce carbon emissions. Generally, energy efficiency policies aim at reducing CO2 emissions by measuring avoided energy consumption. Such savings can bring real benefits to people, especially when targeted at the most vulnerable. Examples of such benefits include better health for households with clean and safe cooking energy, better transportation, less air pollution, new green local jobs, and reduction in energy bills.[59] Thus, it is understood that investing in energy efficiency and the introduction of renewable energy systems is a good way to lift people out of energy poverty, tackle waste, and increase resilience. Globally, energy intensity – the ratio of energy used per unit of GDP – fell at an accelerating pace of 2.8% in 2015, the fastest decline since 2010. This improved the average annual decline in energy intensity to 2.2% for the period 2010-2015.[60]



[VIII] Rare earth elements should not be confused with rare metals. Under the group of rare earths there are 17 metals that include scandium, yttrium and fifteen lanthanides.

Nonetheless, because overall projected energy use is higher than present energy use, energy efficiency policy takes for granted that total energy consumption will keep rising. The IEA projects a 30% expansion of energy use worldwide between today and 2040: this is due to a global economic growth rate at 3.4% per year, a population increase from 7.4 billion today to more than 9 billion in 2040, and a fast process of urbanisation worldwide.[62] The rebound effect or Jevon's paradox argument implies that the development of new low-carbon technology and hence improvements in energy efficiency actually encourages more use of the services which energy helps to provide.[63] For example, the advance of solid state lighting (also known as LEDs), which is six times more energy efficient than old-fashioned incandescent lighting, has not led to a decrease in energy demand for lighting, but rather resulted in six times more light.[64]

Therefore, somewhere between the extremes of excessive energy use and energy poverty lies 'energy sufficiency'. It can be argued that sufficient energy is "a human right and must be affordable for poor people".[65] Indeed, energy sufficiency goes a step further than energy efficiency: "an increase in resource efficiency alone leads to nothing, unless it goes hand in hand with an intelligent restraint of growth".[66] It is the concept of embracing a sustainable way of living and rethinking our behaviours in the way energy is consumed, especially in industrialised countries. Thus, it could be argued that energy efficiency should be conceived as a means rather than the end in itself and needs to be combined with a sufficiency approach. However, sufficiency should not just be a matter of judgement: policies need to be designed in order to fulfil the three conditions of personal, societal and economic affordability.[67] This ultimately should lead to a radical reduction of carbon emissions and hence remaining within the 1.5°C threshold.

» Spotlight: The 2000-Watt Society[68]

The 2000-Watt Society was developed about 10 years ago at the Swiss Federal Institute of Technology (ETH) in Zurich, with the aim of developing a model for energy policy that limits consumption within worldwide reserves, and which is justifiable in terms of the impact on the environment. The global average of energy required per person per year is 17,500 kilowatt-hours, which corresponds to a continuous requirement of 2000 watts.[69] However this amount is based on an uneven distribution of energy – in Switzerland it is estimated that an average person needs 6000 watts per person whereas in some Asian or African countries the figure is much less. Hence, the vision of a 2000-Watt Society is to facilitate an energy consumption balance between developed and developing countries and therefore for everyone to live in dignity and have a good quality of life.

» Spotlight on Finance

The decline in the use of fossil fuel production and consumption is directly proportioned with the amount of finance that is delivered to the polluting industry. Finance is key to achieve climate justice and to support a just energy transition, while creating low-carbon development opportunities for developing countries. Nevertheless, the numbers still do not address the urgency of climate change, and what is driving this trend is the lack of political will, particularly of the industrialised countries that have contributed the most to the perpetuation of climate change. Fossil fuel subsidies are still in practice worldwide: estimates of combined fossil fuel subsidies from the EU range from €39 billion to over €200 billion per annum.[70] The IEA has estimated that in 2017 global energy investment totalled US$1.8 trillion, a 2% decline in real terms from the previous year.[71] More than US$750 billion went to the electricity sector while US$715 billion was spent on oil and gas supply globally. However, this should not slow down the ever-increasing mobilisation of public and private investments, as well as the call for fossil fuel divestment. There are many examples of action taken in this regard: in July of 2018 the Irish Parliament adopted a bill that envisages the €8 billion sovereign fund to start divesting from all its oil, coal and gas assets[72]; the City of New York is divesting public funds from fossil fuel companies and filing a lawsuit in federal court against the five fossil fuel companies most responsible for global warming[73]; Norway's massive sovereign wealth fund is preparing to sell off its oil and gas holdings, valued at US$35 billion[74]; companies like AXA[75] and ING[76] strengthened their commitments to eliminate their exposure to coal and other climate killers such as tar sands. The Catholic Church is also playing its part in joining the movement with 60 Catholic institutions announcing their plans to divest from fossil fuels in April 2018.[77] According to the figures collated by 350.org, the approximate value of institutions divesting is US$6.24 trillion.[78]

It's now time for global financial investments to change their course to a new financial structure that puts people and planet first.

» OBSERVATIONS

This Changes Everything was the title of Naomi Klein's book on the climate crisis released in 2015. Such a concise but true sentence is simply reiterating the fact that climate change is asking us uncomfortable questions on the future of our societies. Brave and radical decisions must be taken as soon as climate science is clear on the fact that two-thirds of fossil fuel reserves must remain in the ground, as increased extraction would lead directly to higher emissions. Continued construction of fossil fuel mines would cause more than 2°C of warming, and a failure to embrace a shift towards renewable energy systems would doom the planet towards irreversible social and economic collapse. Meanwhile 13% of the world's population still has no access to electricity, and energy poverty is increasing the inequality gap, breaching fundamental human rights. As this chapter highlights, investments in renewable energy are indeed increasing, and projections for pumping our economies with renewable resources are positive, despite perverse political incentives that are influenced by vested interests. What is important however is the vision of the world that we want to live in and for which a strong political will is needed: one where people are in dialogue with policymakers and investors, where concerns are raised and considered and where decentralised energy grids are the mainstream model. We need a world without air pollution, where electricity for health care and clean cooking is accessible in rural areas. We seek a society where overconsumption of energy is tackled and all financial investments are re-directed to viable renewable energy systems. This would be the achievement of energy justice. It's about putting the energy sector at the heart of global action to address climate change in any possible meaningful way.

TRANSITIONING TOWARDS AGROECOLOGY: a recipe against climate change

» TACKLING AGRICULTURAL EMISSIONS IS KEY TO MEETING THE 1.5°C GOAL

The scale and depth of change required to be able to meet the 1.5°C goal is such that no sector can be left aside, and no possible effort can be spared. Agriculture, which is responsible for a large share of global GHG emissions (from 21%[79] to 24%[80] according to FAO and IPCC – taking into account 'Agriculture, Forestry, and Other Land Use' (AFOLU) – and up to 50%, if processing, packaging, transport, refrigeration and distribution are taken into account[81]) is no exception. Moreover, agricultural activities also account for almost 50% of the total anthropogenic methane emissions and 60% of the nitrous oxide emissions.[82]

If mitigation is a key area to focus on – and there have been different estimations of the efforts that would be required for the sector[IX] [83] – any proposed solution needs to be holistic, taking into account its resilience and adaption potential and aim for the realisation of the right to food for all. As the FAO acknowledges, "it will be difficult, if not impossible, to eradicate global poverty and end hunger without building resilience to climate change in smallholder agriculture through the widespread adoption of sustainable land, water, fisheries and forestry management practices".[84] Such a holistic approach is also needed because of the shortcomings of the current system: while climate change is already negatively affecting agriculture and food security,[85] hunger is again on the rise with 815 million people suffering from it.[86] Three-quarters of those people live in rural areas and most of them are dependent on agriculture for their livelihoods. These are also the people and the regions that are at the most at risk for severe climate change impacts. A holistic approach therefore requires us to put people at the centre of the strategies adopted, starting with women who are responsible for "60 to 90% of total food production".[87] It also requires a tremendous shift in the organisation of our agriculture and food systems. What would this transition look like?

» FOR AN AGROECOLOGICAL TRANSITION: MITIGATION AND POTENTIAL FOR CO-BENEFITS

> Agroecology simultaneously addresses climate change adaptation and mitigation, making it a promising option to implement the Paris Agreement.
>
> FAO[88]

At CIDSE we strongly believe that agroecology and its principles – when firmly rooted in food sovereignty and climate justice – are the way to move away from a model that threatens present and future agricultural production and food security (biodiversity losses, soil degradation, soil erosion…) while meeting the long-term goal of 1.5°C and contributing to the full realisation of the right to food.[89]

CIDSE recently published a report highlighting and illustrating the principles of agroecology, which have been sorted under the four dimensions of sustainability: environmental, socio-cultural, political and economic. In addition to those principles, the five-level framework developed by Gliessman[X] [90] helps to frame and understand the transition towards agroecology. The support for this framework goes well beyond academic and CSO circles where it is frequently used and cited. It was recently integrated and adapted by FAO[91] as they identified four different levels that would be part of a "transition towards agroecology-based sustainable agriculture and food systems".[92]

[IX] Limiting global warming to 2°C above pre-industrial levels would require an emission reduction of ~1 GtCO2 e/yr by 2030. While some advocate that achieving the Paris Long-term goal would change such objectives (Richards M. B., Wollenberg E., van Vuuren D., 2018), others estimate that meeting the Paris Agreement's 1.5°C warming limit requires an effort of 2.7 GtCO2 e/year (New Climate Institute, Ecofys, Climate Analytics, 2018).
[X] "The levels do not necessarily take place sequentially, but do shed some light on the various processes that take place in agroecological transitions".

Gliessman divided these levels in two sub-groups: "the first three levels describe the steps farmers can actually take on their farms for converting from industrial or conventional agroecosystems",[93] while the "two additional levels [fourth and fifth] go beyond the farm to the broader food system and the societies in which they are embedded".[94]

In the following pages, we explore how these different levels can help us adapt to and mitigate climate change while highlighting the numerous other benefits they would bring to society.

This is how we can summarise those five levels:

- **LEVEL 1:** Increase the efficiency of industrial/ conventional practices
- **LEVEL 2:** Substitute industrial/conventional inputs and practices, which we'll refer to as organic agriculture
- **LEVEL 3:** Re-design the agro-ecosystem towards integrated and resilient agroecosystems
- **LEVEL 4:** Establish alternative forms of economic exchange and market relationships
- **LEVEL 5:** Build a (new) global food system, that we will refer to as 'building food sovereignty'

Common but Differentiated Responsibilities and Respective Capabilities: at the heart of any transition

Before starting this exploration, we would like to highlight once more the importance of "Common But Differentiated Responsibilities". In our past publication on the risks related to climate-smart agriculture we highlighted what seems to be obvious: different agricultural models lead to differentiated impacts on climate.[95] Tackling climate change in a fair and equitable way therefore calls for the identification of the main structural sources of GHG emissions. Though it's difficult to estimate the precise share of emissions for which the industrial food chain is responsible, we can easily come to the conclusion that it is responsible for the larger share of the GHG emissions related to our food and agriculture systems. Examining the extent of resources used by different holders substantiates our argument: two-thirds of global farm land is occupied by farms larger than 50 hectares. This means that less than 2% of total farms across the earth referenced worldwide by FAO[96] occupy 66% of the agricultural land available. On the other hand, the 475 million farms of less than 2 hectares occupy only about 12% of global agricultural land[97] (and up to 25% according to GRAIN data analysis[98]). Though there's no automatic correlation between the size of the holding and the sustainability of the model nor with the type of chain it is part of, there are general and valid observations that can easily be made. According to the ETC group, "given that: most peasants have limited or no access to farm machinery; that they use small amounts of synthetic fertiliser; and that their production is unprocessed and marketed locally, it is difficult to imagine that they are responsible for anything more than a small percentage of global agricultural resource demand"[99] and therefore a small percentage of global GHG emissions. They have estimated that the industrial food chain was responsible for 85-90% of all agricultural emissions. The historical responsibility of developed countries (where per capita emissions have been the highest), and more broadly industrial agriculture, needs to be recognised and it entails them leading the mitigation efforts in the food and agriculture sector. This is not just a question of justice. It is also because the industrial food chain is where the biggest mitigation potential lies. It means that the burden of mitigation should not be placed on the shoulders of developing countries or on the shoulders of small-scale food producers alone. For the latter, a key strategy would be to strengthen their adaptive capacity first.

» LEVEL 1: INCREASE THE EFFICIENCY OF INDUSTRIAL/CONVENTIONAL PRACTICES IN ORDER TO REDUCE THE USE AND CONSUMPTION OF COSTLY, SCARCE, OR ENVIRONMENTALLY DAMAGING INPUTS

History and urgency do not allow us to spend much time on level one: it mainly focuses on decreasing GHG intensity of farm products and food and it appears irrelevant to tackle hunger and ensure food sovereignty. It is also on this level that much research and technology development is currently focused, as it's the silver bullet solution and the final horizon of the superficial transition supported by proponents of industrial agriculture. This approach is threatening the long-term ecological and economic resilience of agriculture and food systems as it undermines the elements we need for sustaining food production. It does also raise questions about what kind of farmer could make use of and afford such technologies: out of 570 million farms (83% of which are located in developing countries[100]), 84% are smaller than 2 hectares.[101] Given the size of the plots and the on-farm diversification at this level (and that we need to pursue as explained in the section dedicated to level 3 – *towards integrated and resilient agroecosystems*), efficiency intensification of industrial practices is a solution that does not address small-scale food producers' needs.

As this is already where we stand, and as an efficient use of natural resources is at the heart of the other levels of this framework, we believe we need to move away from this level and start our transition process by substituting conventional industrial inputs with organic agriculture (level 2). Let us be clear: we still think that efficiency is key. As the FAO highlights, agroecology – through the optimisation of biological processes, the promotion of more efficient value chains through short circuits, and the promotion of "agricultural systems with the necessary biological, socio-economic and institutional diversity"[102] – has efficiency at its heart. According to GRAIN, 70% of the world population get its food from the "peasant food web"[103] made of small-scale food producers using up to 25%[104] of global farm land. This is quite efficient.

As we will elaborate through the next two levels, moving away from this level will provide us with the biggest mitigation potential of food production.

» The need to get rid of the productivist and "we (need to) feed the world" narrative

In the narrative used by the global agribusiness and its supporters to defend a slightly greenish status quo as a potential solution to climate change, there are two arguments that keep being used. The first one focuses on the constant need to increase production, productivity, and efficiency in order to fight climate change: producing more with less, ignoring all the well documented negative externalities produced by our current production system. This would avoid the need to clear more land for food production – avoiding deforestation – while de facto decreasing the GHG intensity per product/output. It's called big data agriculture, precision agriculture, climate-smart agriculture,[105] and sustainable intensification. Of course, this is done in the name of a noble cause: feeding an ever-growing global population in a context where climate change will increasingly impact food and agriculture. The need to feed the world is the second argument. It hides a fact demonstrated many times: in theory, there are enough food calories produced worldwide to feed the current population and more[106] and that the issue is one of access to food.[XI] A recent report by the High Level Panel of Experts of the UN Committee on World Food Security (CFS) states: "today, people are hungry (...) because they cannot afford food or do not have the means to produce it. It is access to food (...) and how food is distributed across and within countries, as well as within households and across genders, that ultimately matter".[107] Beyond access it is also an issue of use, as 9% of these calories are transformed into biofuels or other industrial products and 36% "are used for animal feed (less than 10% of which is recovered in the form of animal-based food calories)".[108] Let us also recall here that a vast majority of food is produced by small-scale food producers.[109] They feed the world.

The report of the International Assessment of Agricultural Knowledge, Science and Technology for Development (IAASTD) has also highlighted that blindly following productivity and yield increases had "in some cases had negative consequences on environmental sustainability" and that the simplification of production systems "to maximise the harvest of a single component (...) has often led to degradation of environmental and natural resources".[110]

Productivity is another issue and it's a complex one. There are different views and numbers circulating by advocates of different models. When calculated in terms of outputs/farm rather than yield of a single crop, the productivity of agroecology has been demonstrated.[111] When looking at yields per crop, organic and agroecological practices have shown slightly lower yields than conventional systems in developed countries but result in important productivity increases in developing countries: does that translate into increased productivity at global level? How long can the higher productivity of industrial agriculture last when it is done at the expense of climate, health, and environment?

The capacity of agroecology to maintain high degrees of efficiency and productivity despite climate change (and extreme weather events such as typhoon, droughts, increased water scarcity...) has been demonstrated many times[112] and for CIDSE, agroecology is the only approach, science, and set of practices, which is truly productive in the face of climate change. Moving forward with agroecology requires different ways to measure success and performance of agriculture and food systems. As the International Panel of Experts on Sustainable Food Systems (IPES-Food) has demonstrated, this is one of the barriers to preventing a transition as "the benefits of diversified agroecological farming are systematically undervalued by classical measures of agricultural productivity".[113]

[XI] One of the 4 pillars of food security (together with availability, utilisation and stability).

» LEVEL 2: SUBSTITUTE INDUSTRIAL/CONVENTIONAL INPUTS AND PRACTICES, REPLACING THEM WITH ALTERNATIVE PRACTICES

LEVEL 2:
INPUT SUBSTITUTION/ORGANIC

LEVEL 3:
INTEGRATED AND RESILIENT AGROECOSYSTEMS

AGROECOLOGICAL TRANSITION

LEVEL 4:
ALTERNATIVE FORMS OF ECONOMIC EXCHANGE AND MARKET RELATIONSHIP

LEVEL 5:
BUILDING A (NEW) GLOBAL FOOD SYSTEM

Substituting industrial/conventional inputs and practices "(e.g. replacing synthetic fertilisers with compost, using alternative pest-control, reduced soil tillage, organic farming systems)" [114] is the basic starting point we have identified for the transition, a first and minimum step. It amounts to a conversion to organic agriculture.[XII] [115]

Understood here at minima as an input substitution strategy based on the adoption of alternative practices and nonuse of synthetic pesticides, organic agriculture could "reduce greenhouse gas emissions, the run-off of excess nitrogen from fertilisers, and cut pesticide use. It would also (…) be feasible to convert large amounts of currently conventionally farmed land without catastrophic harm to crop yields and without needing huge amounts of new land".[116] According to a comparative study done over a period of 30 years, organic farming uses 45% less energy and 40% less GHG emissions than conventional models of agriculture.[117] The mitigation potential of such a shift has been estimated at "4.5-6.5 Gt CO_2 -eq/yr, with potentially much higher amounts possible depending on agricultural management practices".[118] A shift to organic agriculture would also increase water quality,[119] and build life in soils by increasing its carbon content[120] while enhancing on-farm biodiversity[121], pest control[122] and overall resilience (organic agriculture outperforms the yields of conventional agriculture in years of drought[123] for instance). When it comes to productivity, numbers vary: in 2007 a meta study found that the potential increase of productivity in developing countries with organic agriculture was quite impressive (+80%) while its adoption in developed countries lead to a slight decrease (-8%).[124]

This level of transition would already fulfil several of the principles of agroecology that have been listed under the environmental dimension of sustainability (*see Annex and our publication on the principles of agroecology*). It also has a great mitigation potential. Nonetheless, taken in isolation, this level does not reduce the fundamental vulnerability of monocultures and would not entirely achieve the desired outcome. For instance, we've recently seen that organic agriculture can also go together with "heavy machinery, long distance transportation, delocalised and cheap work forces".[125] Furthermore, it does not automatically lead to a diversification which is key to increasing soil health and biodiversity while providing resilient livelihoods. In order to eliminate the root causes of many problems that remain at this level, we need to move towards holistic, integrated, and resilient agroecosystems (level 3).

Cotton, clothing, and agrochemical use: this shift to organic goes beyond food production: "Cotton uses approximately 25% of the world's insecticides and more than 11% of the world's pesticides, while occupying only 2.4% of its arable land".[126] It also "consumes around 4% of the world's nitrogen fertilisers".[127] As "organic cotton only accounts for less than 2% of global production",[128] it has a key role to play in the transition. Being a bit less productive than conventional cotton, and as the shift away from fossil fuels would mean a shift away from fossil fuel polymers, this could be translated into an increase in demands of land for raw materials that are fit for the clothing industry: cotton but also hemp, linen… *(see our section on livestock and the need to reduce meat and dairy production/consumption below and our chapter on negative emissions).*

[XII] According to the FAO, organic agriculture is "a system that relies on ecosystem management rather than external agricultural inputs. It is a system that begins to consider potential environmental and social impacts by eliminating the use of synthetic inputs, such as synthetic fertilisers and pesticides, veterinary drugs, genetically modified seeds and breeds, preservatives, additives and irradiation. These are replaced with site-specific management practices that maintain and increase long-term soil fertility and prevent pest and diseases".

» LEVEL 3: TOWARDS HOLISTIC, INTEGRATED AND RESILIENT AGROECOSYSTEMS

It's when organic agriculture goes together with redesign of the agroecosystem at farm and landscape level, that it reaches its true potential. Welcome to level 3, where we begin to "redesign systems based on ecological principles". Beyond input substitution, this level takes into account "the effects of the integration of plant and animal biodiversity, which enhance complex interactions and synergisms".[129]

This requires integration and aims to further assimilate component parts and diversify systems.[XIII] [130] This can result in different systems[131] and occurs in many forms: an integrated[XIV] [132] crop-livestock or agropastoral system; integrated forestry-livestock or silvipastoral system; integrated crop-forestry or silviagriculture; integrated crop-livestock-forestry or agrosilvipastoral. To this list we can also add polycultures, fish polycultures, mixed herds (species diversity) and intercrops. This can also apply "over different scales within field and landscape levels"[133] and it must be "accompanied by organic soil management, water conservation, and harvesting, and general enhancement of agrobiodiversity".[134]

» Avoiding and reducing GHG emissions

As the aforementioned systems are diverse, it is not possible for us to identify a specific amount of GHG reduction that it would lead to globally. We can nonetheless highlight some of the emissions that can be avoided through such biodiverse farms: lower N_2O emissions (due to lower nitrogen input), less CO_2 emissions through lower soil erosion (due to better soil structure and more plant cover)[135] and no reliance on synthetic inputs. The mitigation potential of such approaches should be at least as important as the one that would be brought by a shift to organic agriculture (see level 2) and could probably be higher because of the frequent integration of trees in such systems. For instance, systems integrating rice culture with duck or fish cultures have proven to "effectively decrease and control methane and nitrous oxide emissions, and (..) to reduce greenhouse gas from rice paddy fields".[136]

» Rebuilding soils, sequestering carbon

As highlighted by the FAO, through diversified and integrated systems, agroecology plays a key role in increasing soil fertility, building life in soils, de facto improving land management but also restoring degraded land.[137] Part of this can be achieved by the fact that "in polycultures, potential energy and resources are distributed efficiently between plants that have different root structures and distribution in the soil" but also thanks to "the various microclimates and beneficial organisms (predators, parasites, pollinators, and soil fauna) that thrive in diversified systems".[138] This is key if we are to aim for sustained production in the coming years. As we stated in previous publications,[139] whilst soil carbon sequestration may result from such practices, it should not be considered the primary goal of mitigation policies – we develop further on the role of soil carbon sequestration in the chapter *Negative emissions: geoengineering vs. natural climate solutions.*

» Building resilience, increasing efficiency and productivity

Diversified systems also build resilience[140]: reducing dependence on external and synthetic inputs; diversifying crops and diets; decreasing the exposure to shocks in international and financial markets; improving on-farm autonomy, biodiversity, and soil and water health; reducing vulnerability to pests, diseases, and weeds[141]; buffering "against shifting rainfall and

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[XIII] "Integration involves various components, namely crops, animals, land, and water. Integrated systems refer to approaches that link the components to economic, social and ecological perspectives (…) The integration of various crops and animals enables synergistic interactions, and results in a greater additive and total contribution than the sum of their individual effects".

[XIV] "Integrating components in succession, rotation, or combined in the same area and in the same agricultural year or for several years, sequentially or alternating".

temperature patterns";[142] … the benefits are countless. This increased resilience is also due to the various ecosystem services associated with diversified agroecological integrated systems, such as the "recycling of nutrients, pollination, pest control, regulation of microclimate and local hydrological processes, detoxification of noxious chemicals, (…) and the conservation of surrounding natural ecosystems".[143] Such resilience will be highly needed to weather the impacts of climate change.[144]

This level also encompasses the benefits of previous levels as "resource efficiency (in terms of water, light, nutrients and land) is also maximised and waste reduced in farming systems that integrate a variety of species and production types, as well as in organic farming".[145] These systems "are generally highly productive in terms of their use of energy and unit land area (or unit water volume)".[146] According to the FAO, "integrated agroecological systems frequently demonstrate higher Land Equivalent Ratios[XV] (LER)".[147] This is how production and productivity will be sustained over time since "agricultural production itself depends on healthy eco-systems".[148]

» The role of livestock in integrated systems

In these integrated systems, animals and livestock have a key role to play. Indeed, animals can help "optimise the use and cycling of nutrients and, in many regions, are used for necessary farm work, an additional form of income and insurance".[149] Moreover, "grazing is a fundamental ecological function that should be maintained in agroecosystems and integrated with crop production, particularly in low-input systems".[150] Manure can also play a key role in building soil fertility.[151] This can help close the nutrient loop at farm/local level. As presented here, the transition of agricultural production systems (integration and diversification) would mean the end of industrial livestock monoculture, calling for a process of extensification of livestock farming which would rely on grass and on (waste-based) feed that are produced on-farm or locally. It would, among others, limit the amount of meat available per capita and should therefore go along with a change in diets and eating habits (*see box next page*).

[XV] LER compares the yields from growing two or more components (e.g. crops, trees, animals) together with yields from growing the same components in monocultures.

» The need to reduce meat and dairy production and consumption by half

As it is one of the main drivers of deforestation (65% of deforestation in rainforest areas is due to livestock[152]) and a huge contributor to GHG emissions (estimated from 9%[153] to 14.5%[XVI] [154] of global CO_2 emissions, 35-40% of global CH_4 emissions, and 65% of NO_2 emissions[155]) tackling this issue is key to a transition towards sustainable food systems. Without addressing the livestock issue, we cannot meet the Paris Agreement's long-term goal.[156]

Following previous work done by Greenpeace[157], CIDSE advocates for a minimum 50% reduction in meat and dairy production and consumption by 2050. This has the potential to reduce GHG emissions "from the agriculture sector by 64% compared to projected emissions under the 2050 baseline trajectories".[158] It could also increase "carbon sequestration in soils and biomass on the land potentially freed"[159] and therefore "potentially reduce emissions from deforestation".[160] In accordance with the concept of Common But Differentiated Responsibilities (CBDR), this needs to be done in an equitable manner: "this will mean drastic cuts in the consumption of animal protein in high meat-consuming parts of society (…) and it will allow a moderate increase of consumption in less affluent parts of societies, following the shrink and share principle".[161]

Health co-benefits

A change in diets would have tremendous positive impacts on health and lead to huge savings in healthcare costs[162]: "overconsumption of animal products has been connected with heart disease and diabetes"[163] and obesity[164] while the World Health Organisation (WHO) has linked processed meat and red meat to various forms of cancers.[165] Livestock and environmental health would also benefit from such a shift.

Land sparing?

According to FAO, livestock (including pastures, feed production…) is using as much as "80% of total agricultural land".[166] Reducing the amount of meat and dairy produced and consumed would free up land which is needed for other agricultural products: just to meet the nutrition requirements of WHO, we would need to increase production at global levels of vegetables by 11%, of seeds and nuts by 58%, of fruits by 34%, etc.[167]

The need to go beyond individual action

Such a shift cannot rely only on "consumers", it requires supportive government policies, not only favouring the agroecological transition at farm and landscape levels but also adequate regulations – e.g. incentives and disincentives such as a shift in subsidies[168] or the introduction of national dietary guidelines as China did in 2016, recommending "a daily meat intake half that of current consumption levels".[169] It also requires a cultural shift in education, cooking, eating, shopping, distributing/selling food, etc. that policy and CSOs can spread.

Fisheries and oceans

The role of seafood and fish cannot be disregarded. As highlighted by the FAO, "the sector is already under stress from pollution, habitat degradation, overfishing and harmful practices. Climate variability, climate change, and ocean acidification represent additional threats to the sector and dependent communities".[170] This trend continues to worsen.[171] Usually, GHG emissions related to fisheries are either not included in global projections or they are poorly taken into account in the agriculture sector. Scientists have estimated that fishery "generated a total of 179 million tonnes of CO_2-equivalent GHGs (4% of global food production)",[172] 60 to 90% of which are associated with fuel.[173] There are different models of fisheries and "low-impact small-scale fishing has the potential to co-exist with well-preserved ecosystems and abundant fish populations, as well as to support the lives of hundreds of millions of people",[174] ensuring a decent livelihood for communities dependent on fisheries. As is the case for meat, a certain level of reduction in fish consumption and production is necessary.[175]

[XVI] When taking into account deforestation, demand for deed, transportation and processing infrastructure, the livestock sector would be "directly and indirectly responsible for 14.5 percent of greenhouse gas (GHG) emissions." (HLPE, 2016)

LEVEL 4 AND 5: TOWARDS FOOD SOVEREIGNTY[XVII]

LEVEL 2: INPUT SUBSTITUTION/ORGANIC

LEVEL 3: INTEGRATED AND RESILIENT AGROECOSYSTEMS

AGROECOLOGICAL TRANSITION

LEVEL 4: ALTERNATIVE FORMS OF ECONOMIC EXCHANGE AND MARKET RELATIONSHIP

LEVEL 5: BUILDING A (NEW) GLOBAL FOOD SYSTEM

Levels 4 and 5 of the agroecological transition call for a profound redesign of our food systems:

- **Level 4:** "systems reinforce connections between producers and consumers by enabling socio-economic measures such as policies and incentives to encourage the engagement of communities and businesses in sustainable operations; e.g. short food chains and webs, Community Supported Agriculture (CSA) schemes; re-localisation of food systems and markets within same territories".[176]
- **Level 5:** "the agroecological practices of Level 3 and the alternative forms of economic exchange and market relationships of Level 4 are fully developed and integrated into a (global) sustainable food system".[177] This level "involves change that is global in scope and reaches beyond the food system to the nature of human culture, civilization, progress, and development".[178]

This calls both for relocalising and shortening food systems and their different components (distribution, transformation, technology adapted to different sizes of holdings, infrastructure,…) and globalising such approaches through shifts in trade, as well as local, regional, national, and international governance of food systems. "Agroecology (…) is also a powerful tool to achieve change in the food system, in other words, a massive re-design of the economic structures that govern our food systems".[179]

Localising North and South

Under such a shift, regions would "become more self-sufficient when it comes to products that can be locally produced; growing protein and oil crops in particular are viable alternatives to importing soybeans, palm oil, and biofuels, as the latter three have devastating effects on farmers and the environment in producer countries".[180] The FAO itself acknowledges that food security is a local problem in poor and agriculture-dependent societies and that "unless local agriculture is developed and/or other income-earning opportunities open up, the food insecurity determined by limited local production potential will persist, even in the middle of potential plenty at the world level".[181]

The mitigation potential of localised food systems

In our globalised food systems, transportation has become key. Three-fourths of transportation associated with the food system occurs upstream (before farm gate).[182] Level 2 and 3 changes are therefore of utmost importance as they allow to reduce dependence on inputs (and the related transport link to their production and distribution).

When focusing on final delivery emissions (from farm gate to plate), we have to differentiate among different products. For instance, for red meat, transport will "constitute only 1% of total emissions for that commodity, while the proportion is much higher in fruits and vegetables (11%)".[183] If we look at the whole fruit and vegetable supply chain emissions, "total freight emissions account for 18%".[184] As diets have to radically change, robust local food chains of fruits and vegetables are of utmost importance. Canadian scientists have estimated that shifting supply of fruits and vegetables from California to the surroundings of Toronto would lead to a reduction of 336 tonnes of CO2 per year[185] just in transportation. Generally speaking, they have also shown that increasing efficiency through innovative local distribution schemes can lead to significant GHG savings.[186] Because the debate is often limited to the issue of food miles or life cycle assessments, there are a lot of discussions around the potential positive impacts of local food chains. When looking at the broader picture, we see that when coupled with the issue of food loss and waste, reduced transportation and relocalisation of food systems can really have a great mitigation impact.

[XVII] Food sovereignty is a policy framework which addresses the root problems of hunger and poverty by refocusing the control of food production and consumption within democratic processes rooted in localised food systems. More information on our views on food sovereignty here.

Addressing food loss and waste through relocalisation

As underlined by the FAO: "global food loss and waste generate annually 4.4 GtCO2 eq, or about 8% of total anthropogenic GHG emissions".[187] In 2013, scientists were already showing that "decreasing food loss and waste by 15% (…) would reduce emissions by 0.79–2.00 GtCO2 e yr^{-1}".[188]

Food loss and waste (FLW) is the expression of a greater waste of natural resources: waste of energy (for production, transport, packaging, processing,…), of water use, and of land ("according to FAO, produced but uneaten food (…) represents close to 30% of the world's agricultural land area"[189]). FLW is all about the way our food and agriculture systems are organised (supermarkets, highly processed food, marketing and promotional packs, standardisation and "beauty" requirements for fruits and vegetables) as well as to our throw-away culture. Tackling it requires a change at system level in which people's-led initiatives could play an important role[XVIII]. Relocalisation and short/local food chains can help reduce FLW by:

- Facilitating the "commercialisation of less standardised products";
- Decreasing dependence on international trade, since FLW often occurs when shipments are rejected because they don't succeed tests "to check adherence to phytosanitary, veterinary and food safety regulations";[190]
- Reducing losses due to transportation of food (mechanical and heat injuries; decreased nutritional contents; shorter shelf life …)[191] and livestock (stress, injuries, sickness, death …).[192]

Building a thriving and resilient food system is part of the solution (allowing transformation of food at the local level in order to avoid loss and extend shelf life, having local food hubs, building infrastructure such as roads where access to local markets might lead to losses…). Mobile slaughterhouse units, allowing animals to be slaughtered at the farm, (re-) installing local and smaller slaughterhouse facilities would further help reduce loss from transport.

Once again, we think efficiency without systemic change risks being another trapdoor that would lock us into potentially unsustainable pathways; efficiency in transport might lead to increased GHG: "for instance, shipping food by refrigerated units can reduce food loss in transport, but the gains from this may be for naught if the result is increased consumption of foods trucked by refrigerated units, which have a higher carbon footprint".[193]

Agroecology: ready for a 100% Renewable Energy Future

In the past decades, the EROEI of food (Energy Returned On Energy Invested) has been declining, as more calories of energy are needed to produce a calorie of food. In the US it takes 10 to 15 calories of fossil fuel energy for every calorie of energy produced.[194] Over reliance of our food systems on fossil fuels poses a serious threat both to the climate/environment and the resilience of our food systems. CIDSE advocates for a 100% renewable energy production by no later than 2050.[195] This also supports our call for a deep and rapid shift in food production and the organisation of our food systems, with an aim to delink food production from fossil fuels. Level 2 of the transition (towards organic agriculture) would already lead to an interesting decrease in fossil fuel use. On top of that, Level 3 (towards integrated and resilient agroecosystems) and 4 (promoting short supply chains) also reinforce closed energy and nutrient cycles at the farm.[196]

Energy efficiency is an important first step in the transition and would de facto lead to more resilient food and farming systems. But while doing this, we cannot promote solutions that would lead to increases in energy consumption, even if it is renewable energy. Internet and big data are already using 10% of energy produced and could represent 20% of energy use by 2025.[197] The mix between big data, climate-smart agriculture and precision agriculture – currently heavily promoted in some circles as a solution to climate change – does not fit the degree of change needed. On the contrary, we need to put low and small-scale tech and renewable energy at the heart of the transition process. It could further spread solutions such as fermentation (to preserve without heat or fridges); low tech wind power; pedal powered processing tools; animal traction; "do-it-yourself solar heat collectors to warm livestock buildings, greenhouses, and homes; small or cooperatively owned wind and water turbines"[198]; solar hot water heaters; and solar photovoltaic water pumps and electricity.[199]

XVIII We've recently seen citizens' initiatives exploring ways in which such losses and waste could be reduced (transforming leftovers, redistributing them, gleaning or harvesting fruits that owners would normally leave on trees …).

» OBSERVATIONS

When talking about alternative pathways and alternative agriculture and food systems, we are always asked about evidence, numbers, and concrete proposals. Our aim is not to develop a detailed ready to use roadmap for policymakers. We strongly believe that such roadmaps will vary according to places and contexts and that they need to be developed by and with people directly involved in the food systems. We are confident there is enough proof for change to occur, as there is also more than enough evidence warning us to stop with the existing policies and structures that support our current food and agriculture systems. We have the duty to do things differently: new or different practices, policies, understanding of efficiency, accountability – the required shift is deep. Changing our narrative also matters, and using different indicators could provide the necessary compass to navigate the transition. The solutions highlighted in this chapter would easily allow us to review the share of reduction attributed presently to agriculture, increasing our chances to not exceed 1.5°C.

There is an urgent need for bold action in support of alternatives and existing "niches", rather than investing available resources in the increased efficiency of conventional industrial agriculture. The key role of the public sector should be to prioritise alternatives. We believe that this five level transition framework – together with the principles of agroecology – present a comprehensive framework to start paving the way for this transition to be implemented (*see Annex: interlinkages between the principles of agroecology and the agroecological transition framework*).

NEGATIVE EMISSIONS: geoengineering vs. natural climate solutions

» GEOENGINEERING AND NEGATIVE EMISSIONS

This paper has presented viable measures and solutions that can be taken in the energy and agricultural sectors for staying within the 1.5°C threshold. However, a large part of the scientific literature builds upon two assumptions for limiting warming of temperatures: a) a temporal overshoot of temperature rise to come back to 1.5°C as soon as possible and b) to filter CO2 out of the atmosphere. This section of the paper aims to reveal the flaws in these two arguments, how they undermine the urgency of mitigation efforts, and how other types of solutions would reach the 1.5°C goal. It also aims to unveil the strategies and conditions for natural climate solutions to play a role in carbon sequestration.

Negative emissions refers to removing CO2 from the atmosphere as a way of addressing climate change. To do so, a diverse set of techniques have been suggested: enhancing natural aspects of the carbon cycle, and capturing and storing carbon when burning biofuels or directly from the air. Some of these techniques rely on developing new industrial engineering processes like carbon capture while others overlap with already existing land use practices like avoiding deforestation, ecosystem protection and restoration and sustainable agricultural models. It is important to distinguish between what is considered as "natural negative emissions" (named natural climate solutions from here onwards) and what can be the technological approach of Negative Emissions Technologies (NETs). Theoretically, the use of such NETs might contribute to enhance mitigation targets, but in real context, there are many limitations to their application in terms of their extensive use of energy, land, and water as well as the associated social and economic costs. Furthermore, some are yet unproven, and none have been deployed at a large scale.

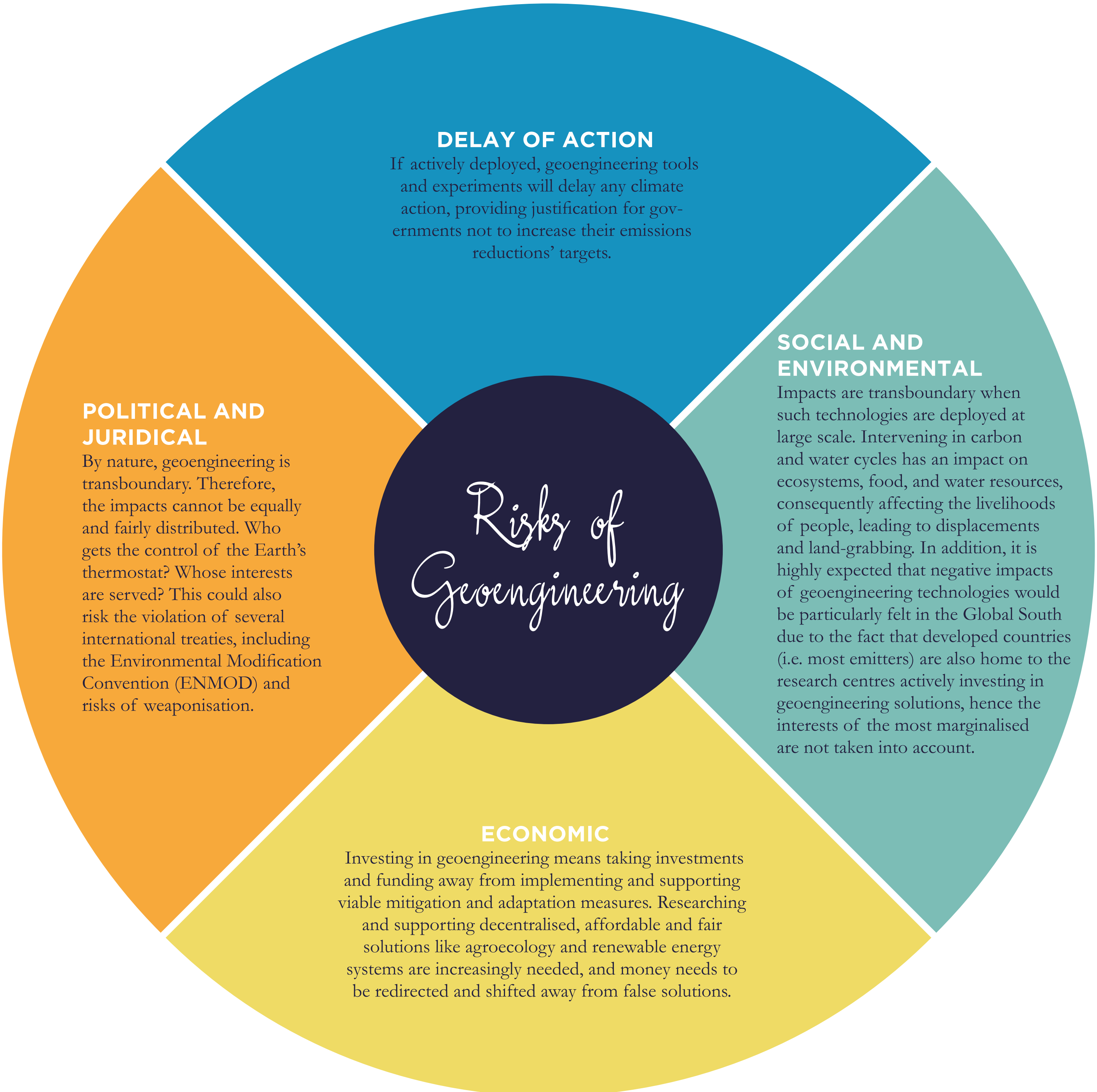
Alongside the NETs discussion, there is the proposal to limit global temperatures through geoengineering. Geoengineering was mostly discussed until recently as a proposed military tool to control weather for hostile purposes but the spectrum has increased and today there is an argument for using geoengineering to address climate change.[200] Geoengineering technologies are divided into two general categories: Greenhouse Gas Removal (GGR)/Carbon Dioxide Removal (CDR) that aim to lower the level of GHG in the atmosphere, and Solar Radiation Management (SRM) that aims to alter the amount of heat in the atmosphere. Weather modification methods are also considered geoengineering, and these techniques are applied to three natural systems: land, oceans, and air:

- **Land,** i.e terrestrial ecosystems. There are several examples of geoengineering techniques that aim at sequestrating CO2 from smokestacks and storing it underground in reservoirs for long periods: these are Carbon Capture Storage (CCS), Carbon Capture Use and Storage (CCUS), Bioenergy with Carbon Capture & Storage (BECCS), Afforestation, Direct Air Capture (DAC), Enhanced weathering (terrestrial), Biochar, Photosynthesis enhancement, High albedo crops and Surface Albedo Modification.[201]
- **Oceans,** i.e marine ecosystems. One of the most popular techniques is Ocean Fertilisation (OF), dumping iron filings into the seawater to stimulate phytoplankton growth, allowing high absorption of CO2 and its storage once they die on the ocean floor. Other examples are enhanced weathering (marine), artificial upwelling, Crop Residue Ocean Permanent Sequestration (CROPS), and microbubbles and sea foams.[202]
- **Air,** i.e atmosphere. Direct Air Capture (DAC) removes CO2 from the air and stores it in underground reservoirs. The main techniques deployed are Stratospheric Aerosol Injection (SAI), Marine Cloud Brightening (MCB) or increasing cloud cover, cirrus cloud thinning, storm modification and suppression, space sunshades and space mirrors.[203]

» IMPACTS

This section does not intend to analyse each specific NETs or every potential problem related to geoengineering, but instead to highlight the many common concerns and risks in applying such techniques. Overall, geoengineering technologies are highly unreliable and present high risks that can lead to irreversible climatic tipping points. This is because its deployment should be done at a massive scale in order to have a meaningful impact, hence any negative consequences would damage ecosystems and people permanently. It is also important to note that geoengineering proposals neither have an ecological or sociological approach; therefore, their proposed solutions are not contextualised because climate change is a complex and interconnected issue that requires different levels of action. Obviously, geoengineering solutions are not developed within the principles of justice or equity, in line with the perspectives presented above. Moreover, the poorest and most vulnerable communities who are already hit the hardest by the impacts of climate change would continue to suffer from the irreversible consequences of such technological solutions.

Generally, the risks and concerns identified are:[204]



> The technocratic paradigm also tends to dominate economic and political life. The economy accepts every advance in technology with a view to profit, without concern for its potentially negative impact on human beings.
>
> Pope Francis (LS, 109:81)[205]

» RELYING ON NATURAL CLIMATE SOLUTIONS FOR NEGATIVE EMISSIONS

As we've seen in the previous section, the paradigm of infinite growth remains a foundation assumption of climate mitigation scenarios. Relying on NETs is one of the other biases as nearly all of current 1.5°C (and even 2°C) scenarios include NETs in place of other mitigation strategies that are considered too costly or unavailable. This means that in order to meet the Paris Agreement's long-term goal, we will need to rely on scenarios which put faith in the fact that in the coming years a new technology will be discovered and brought to scale. It is unfortunately on this basis that we enter discussions about overshooting the targets of the Paris Agreement.

However, an increasing body of literature has been exploring alternative scenarios, which reduce the need of negative emissions to really low levels or near to zero, that could be met with natural climate solutions such as building up the carbon content by halting deforestation and restoring forests. To add to the economic and societal level changes we have explored in previous chapters, we also believe that additional mitigation can occur in the land sector in the form of carbon sequestration. This is also referred to as natural climate solutions. Below, we will explore the potential of such solutions.

» AVOIDED EMISSIONS FROM DEFORESTATION AND REVERSING DEGRADATION (ECOSYSTEMS AND FOREST RESTORATION)

The first action that needs to take place involves halting current deforestation, forest degradation, land clearing, and draining of peatlands. This is about preventing our current carbon stock to be further depleted. Currently, these actions are contributing significantly to climate change and avoiding them has the largest mitigation potential.[206]

Forests and natural ecosystems (such as peatlands) have already hugely been degraded. Beyond preserving the remaining stocks, we therefore also have to replenish the ones that have been ripped off. This calls for massive and global scale restoration policies and practices. "Though often dismissed as "wasteland" ripe for development, degraded forests are actually a valuable resource in their own right, retaining much of their biodiversity and rapidly capturing carbon from the atmosphere as it regrows". [207]

» How much carbon could be potentially sequestrated?

Dooley and Kartha have estimated that a potential 370-480 Gt CO2 carbon removal could be achieved over the century "without jeopardising other critical land uses and sustainable development objectives".[208] Reforestation ("active re-establishment of forests on lands that were previously forest"[209]) could remove as much as 150 Gt CO2 while ecosystems restoration ("allowing the recovery of degraded forests, by withdrawing current human interference") could sequester 220 to 330 Gt CO2 by the end of this century.

» The way you do it matters

One of the key ideas here is to put people, not markets, at the forefront of this mitigation option. It is even more necessary since "many of the most promising areas for forest restoration are under the legal or customary ownership of local forest-dependent people".[210] In Nepal, "30% of forests [are] now managed by community user groups"[211] and it led to a 20% forest cover increase.[212] This example shows that community presence and control over the forest management are among the best preservation and restoration strategies. Studies have also shown that "securing rights to collective and customarily held land for indigenous peoples and forest-dependent communities is one of the most effective and low-cost strategies available for protecting forest ecosystems".[213] For instance, a review of 130 studies from 14 countries showed that "legally recognised indigenous community forests have consistently lower deforestation rates: 6-22 times less for Brazil, Guatemala, and Bolivia, and the indigenous forests also lock away more carbon per hectare".[214] Putting local communities and their rights at the centre of such mitigation is key and we must ensure that such a strategy is good for the environment and the climate in the long term. The "overarching principles for rights-based forest restoration"[215] developed by several members of the Climate, Land, Ambition and Rights Alliance (CLARA) should be used to implement and assess such strategies.

» LAND AND SOIL CARBON SEQUESTRATION AND AGRICULTURE

As stated in the introduction, a third of the planet's land is severely degraded and fertile soil is being lost at the rate of 24bn tonnes per year. [216] There's an urgent need to restore degraded soils and to enhance their fertility. The current model of agriculture is mainly responsible for such losses and degradation.[217] As we have seen, a transition towards agroecology would help restore or strengthen soil health by increasing soil organic carbon. A shift to organic agriculture (level 2), the use of manure and closing the nutrient loop at farm and/or landscape levels (level 2 and 3) would also bring positive results. Various analyses have indeed shown that soil organic carbon concentrations were 14% higher in organic[218] while a "23-year study (…) showed that organically managed grain production sequestered 15-28% more carbon in the soil than equivalent conventional production".[219] We have also shown that diversified and integrated systems (level 3) would play a key role in (re)building soils. While soil carbon sequestration may result from a transition towards agroecology, it should not be considered the primary strategy of mitigation policies, but rather one that offers co-benefits in the social, environmental, and economic dimensions. We have several reasons to stand firm on this position:

- Non permanence: carbon sequestration in soils can easily be reverted, either by a change in practices (ploughing or use of synthetic nitrogen fertilisers) or through climatic events such as droughts or high temperatures.[220] Several field experiments have indeed proven that increasing temperatures would "stimulate the net loss of soil carbon to the atmosphere".[221] The potential of such actions is also decreasing as global temperatures increase.[222]
- Complex,[223] costly, time consuming,[224] and uncertain[225] measurability of soil carbon accounting, and the difficulty of adopting a standard accounting system[226] is frequently highlighted in scientific literature.

Agricultural soil carbon must therefore be excluded from offsetting and carbon markets schemes.[227]

» Don't get too excited: It's a one-time thing

Restoring degraded land and forests and increasing soil fertility through carbon sequestration cannot be a recurrent practice as "intact ecosystems do reach 'carbon saturation' points. The process can take a half-century or more, during which time there is significant net mitigation benefit".[228]

» Competing use of land and natural resources: towards an "agrarian climate justice"

Land rights will be key if we want to address climate change without increasing power and resource inequalities. Any mitigation options that would drive people off their land and lead to land grabs would be disastrous.

The problem with mitigation options in land and agriculture (and in part for broader food systems) is that everyone seems to look at them as ways to mitigate or to adapt. We are talking about forest and ecosystems restoration, afforestation, producing agrofuels for cars and aviation, producing biogas with manure and sequestering carbon with NETs or in agricultural soils. What will happen with clothes and plastic production if we cannot rely anymore on polymers made out of fossil fuels? Will we need more land for linen, hemp, or cotton production? Some now discuss the solution of plant-based polymers and plastic: where would they come from? Urbanisation and infrastructure development is still eating more arable land year after year: will this keep growing?

What about the land needed to welcome the solar panels, windmills and small-scale hydropower plants of our transition to renewable energy? It seems that the competition for land we have seen increasing tremendously around the food crisis of 2008 might just be the tip of the iceberg.

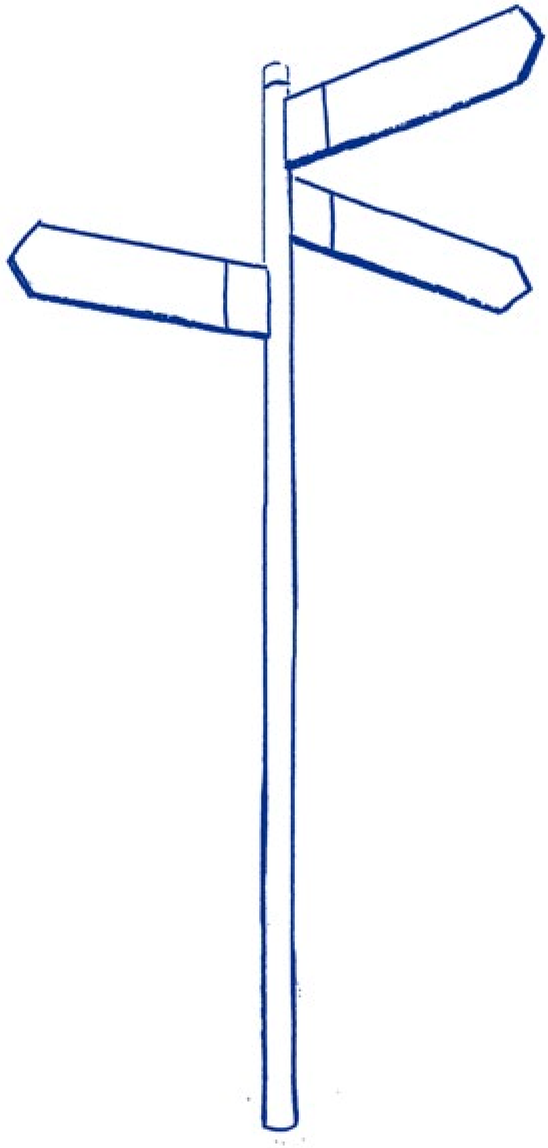
Just as any other natural resource, the earth is a finite planet. Land constitutes 29% of the surface of the planet. 71% of this land area is "habitable",[XIX] 50% of which is dedicated to agriculture and 37% to forests.[229] As land cannot fulfil all the expectations put on it, meeting the 1.5°C goal will require us to decide how land will be allocated and used and by whom. It might require freeing up land from a certain activity so that other uses can thrive. In previous chapters we have seen that reducing meat and dairy production and reducing food loss and waste would contribute to such a shift. But this cannot be done at the expense of people and communities. Part of it could also be used for expanding natural forests and other natural climate solutions.

This potential "green grab rush" goes together with a problematic narrative that certain "resource users and uses are economically inefficient"[230] or that the land and forests targeted are mainly unoccupied. These narratives justify the continuous dispossession of communities resources and rights. If we are to avoid the expansion of "exclusionary and ecologically problematic industrial agriculture and neoliberal nature conservation systems"[231], land redistribution, recognition, and restitution reforms should be implemented and enforced. According to Borras, "these three policies can only be pursued if sandwiched by the twin principles of 'maximum land size' ('size ceiling') to put a limit to how much land corporations and wealthy individuals can accumulate, and a 'guaranteed minimum land access' ('size floor') to everyone who would want to work the land".[232] This would also facilitate agroecology; community lead regeneration, conservation, and restoration of soils; and ultimately the flourishing of ecosystems.

[XIX] The rest being barren land and glaciers.

» OBSERVATIONS

As we have seen, when looking at potential mitigation strategies, we must be conscious of their social impacts. There are risks to people's rights and lives associated with them. Land-use is complex and dynamic and one cannot realistically assume that half of agricultural land could easily be converted to bioenergy plantations for instance. If we consider the fact that it would be a non-recurrent strategy, we come to the conclusion that we need to rely as little as possible on such natural solutions. This is why we must maximise the significant mitigation potential in all sectors. The approaches and strategies highlighted in the previous sections and above (forests and ecosystems restoration) would allow us to reach these objectives. Unlike NETs and geoengineering, these approaches and solutions "are not speculative; they are already proven to work at scale".[233] It is also important to remember that a lack of clear intergovernmental regulation of geoengineering technologies put risk to upset the global geopolitical balances.



SETTING SAIL for a new paradigm

> Rarely in human history have so many things gone so badly wrong in so short a time. The global social and economic systems must make a U-turn if they are not to destroy their own physical basis.[234]
>
> Joachim Spangenberg

In the previous sections, we have explored ways in which we would be able as societies to tackle climate change – and its consequences on the planet and people – without relying on false solutions such as NETs or climate-smart agriculture for instance. We took a closer look at the energy and the food/agriculture sectors including sustainable lifestyles. We are aware that the changes we are calling for cannot be made by one sector alone and that for such changes to happen, we need a paradigm shift at multiple levels. We need a different system as a whole. This requires new narratives, a different cultural approach, and of course, transforming our political and economic systems.

» Infinite growth on a finite planet? The math does not add up

In its 2014 report, the IPCC has already recognised that economic growth is fuelling climate change.[235] "The core of our problems is that the dominant narrative on sustainable consumption takes the current consumption levels as a given and proposes to satisfy them with fewer resource inputs".[236] Moreover, it suggests that such affluence (considered the most advanced phase of "progress") should become the norm for all, "developed" and "developing" countries. This is exactly the same narrative used to promote a greener status quo when discussing agriculture and energy in terms of productivity, efficiency, and GHG intensity. As for agriculture and energy, the mainstream position is that some minor additions and technological updates to the current model will help solve the problems this model created. The same goes for the dominant political and economic perspectives that more growth will help us solve problems that growth itself created in the first place. This seems a clear recipe for disaster.

» Avoiding the delusion of decoupling and "trickle down"

The theory behind such discourses can be summarised by one word: decoupling. The theory of decoupling holds that economic growth can be decoupled from carbon emissions, environmental impact, and the extraction of natural resources. It also suggests that our affluent lifestyle can be further spread around the planet while saving the planet. How? Progress, in the form of technological innovation, circular economy (recycling and reusing more), and a shift to a service economy is supposed to fill the gap.

But such decoupling has been proven to be impossible in a society where growth is the imperative. The proof is in the "rebound effect" or the "Jevon's Paradox". The paradox is such: instead of decreasing a given resource consumption, the saved resources from efficiency are actually reinvested in further consumption leading to an overall increased consumption of the very same resource. This effect fuels further economic growth[237] and has a negative impact on the climate and the environment.

Decoupling is accompanied by the narrative that increased growth and increased wealth at the global level will end up benefiting people at the bottom of the wealth ladder, thus decreasing inequality and further spreading affluence.

As it has been demonstrated, substantial reductions in GHG emissions will not be achieved by reductions in GHG intensity alone. Reductions in the scale of the economy will also be necessary.[238] We need to go beyond green capitalism and green growth. Concepts like development and progress have now largely been widespread, accepted, embed in a globalised narrative and used to drive policymaking. However they lead to the destruction of our planet and society as we know it.

Current scenarios that would allow us to meet the Paris goals are based on the same bias of infinite growth.[XX] [239] Unfortunately, so are the SDGs. CIDSE's assessment of the SDGs has already highlighted that they were not overcoming "contradictions in seeking harmony with nature while prioritising sustained growth for all nations. The SDGs imply continued competition for limited natural resources and, hence, further rise in GHG emissions. The SDGs do not tackle unjust global rules of finance, taxation, trade, and investment, essential to realising the structural transformation needed to address the root causes of poverty and inequality".[240]

» The need for a post growth society

> Imagining an economy beyond growth is one of the great challenges of our times, to prevent a social and environmental debacle which could threaten humanity itself.[241]
>
> Alberto Acosta

The crisis we are currently facing is not an ecological crisis alone. We are facing a social, cultural, economic, political and ecological crisis. Such crises are the symptoms of a system that feeds on fossil fuels; inequalities; patriarchy; extraction; exploitation; privatisation of life; financial, social, and ecological debt; and destruction. Such a system called capitalism keeps pursuing growth at all costs. Having been globally promoted by western society as the principle economic and social model for development, it has proven its failings. It cannot guide us in the new world that needs to be quickly unfolded. We therefore need a systemic change. Here we refer to the new system as a post-growth society.

This includes the need for "wealthier" or "developed" countries to switch from a growth imperative to degrowth.[XXI] [242] By definition, a degrowth society "challenges the hegemony of growth and calls for a democratically led redistributive downscaling of production and consumption in industrialised countries as a means to achieve environmental sustainability, social justice and well-being".[243] It amounts to choosing a "form of life in which the overall consumption of energy and resources is progressively reduced and eventually stabilised at a level that lies within the planet's sustainable carrying capacity".[244]

It is a pre-condition for not exceeding the binding objectives set in the Paris Agreement.[245] It has been estimated that "moving the global poor to an income level of US$ 3–8 per day income will consume 66% of the available two-degree global carbon budget"[246] while transitioning to low carbon economies, including renewable energy, would "use up a significant share of the two-degree carbon budget".[247] And we are aiming not to go beyond a 1.5°C increase. An overall consumption and production reduction is therefore urgently needed to achieve the goals of the Paris Agreement.

» The importance of CBDR-RC

The concept of CBDR-RC takes into account the historical contributions of developed countries to carbon emissions. Regarding the need to reduce overall consumption and production, this implies different responsibilities between countries as well as within countries.[248] Overall, reducing affluence to the rich would allow the poor to reach a certain level of material well-being and improve living standards through a certain form of growth and distributive justice that would tackle inequalities, including "carbon inequalities".

> That is why the time has come to accept decreased growth in some parts of the world, in order to provide resources for other places to experience healthy growth.
>
> Pope Francis (LS, 193:141)[249]

[XX] Some scenarios rely on a high annual GDP growth rate (2.9%). This would "translate into a 25-fold expansion of global GDP (…) by 2100".
[XXI] "Degrowth (a planned economic contraction) must be differentiated from recession (unplanned economic contraction)".

» *Laudato Si'* call

The Encyclical letter *Laudato Si'*, issued by Pope Francis in 2015, has brought into the public debate a strong call towards a radical paradigm shift that concerns all societal elements, and demands that we address overconsumption and "growth at all costs". *Laudato Si'* put the accent on demystifying the traditional concept of "development" by bringing together as one: "the cry of the poor and the cry of the earth". This shows clearly that we cannot tackle poverty and environmental degradation separately and that there is a critical link and conflict between the continuous demand of resources dictated by our consumption style and the unstoppable race of climate change. By reading the current crises we live in as one crisis, Pope Francis is calling on humanity to look at integral human development for all human beings not only in economic terms but rather to be vigilant to false solutions that keep us in the same logic/narrative that caused the injustices we see today in the world.

The spirituality of *Laudato Si'*, as well as of many longstanding concepts such as *Buen Vivir* in Latin America or *Ubuntu* in African tradition, provides humanity with the opportunity to redefine our needs with regards to development and to reframe what a healthy and successful existence looks like, and what it means to live in harmony with nature. It is a call to re-organise the set of values we strive for and this first requires us to listen carefully and meaningfully to the experiences of people who are struggling every day with the most severe effects of climate change and to the symptoms of a broken planet. Secondly, it requires a cultural shift – or as Pope Francis defined it, an "ecological conversion" – that should include all levels of societies, and this must start with dialogue.

» Policy frameworks for a paradigm shift

Much needs to be done in order to "establish economic systems that can support people's well-being and fulfil their needs while simultaneously reducing global energy and material flows".[250] This requires ambitious and deep structural reforms, calling on our society to anchor itself in new approaches and policies: a new trade regime in which "investment agreements will have to be amended, or even terminated",[251] (re)localisation, a social and solidarity economy, a different banking and financial system – this is a whole paradigm shift. It's quite easy to recognise the seeds of some of these needed shifts in the transition pathways we have explored on energy, food, and agriculture. But as previously stated, we need to aim broader than these two sectors and we need to go beyond the "niche" where such alternatives are being explored. Further exploring degrowth, post-growth, steady-state economics, deglobalisation,[XXII] [252] post-growth measures of progress, and their policy implications would help pave the way for the deep changes needed at a broader scale.

> System change, not climate change.
>
> Climate Movement

[XXII] "Deglobalisation is not a synonym for withdrawing from the world economy. It means a process of restructuring the world economic and political system so that the latter builds the capacity of local and national economies instead of degrading them. Deglobalisation means the transformation of a global economy from one integrated around the needs of transnational corporations to one integrated around the needs of peoples, nations, and communities."

» For a new societal and cultural compass

> At every level the greatest obstacle to transforming the world is that we lack the clarity and imagination to conceive that it could be different.
>
> Roberto Unger

As history has shown, real change happens from the bottom-up, from a deep cultural shift in people's mindsets. CIDSE acknowledges that several different narratives of a "good life" are needed across the globe. There are many experiences in different traditions and cultures that are inspiring us and guiding us to reset the values and drivers of our daily life and choices we make in our consumption. Inspirations that acknowledge how care for the planet and care of all human beings go together and are inseparable.

This new narrative should help each of us to understand the significance of our lives, lifestyles, and consumption choices in contributing to the just transition and therefore empowering citizens in their own choices. In promoting a holistic approach, we can develop solutions that address not only efficiency and ecology but also sufficiency.

Aside from the closed loop of logic that "consumerism feeds growth, growth feeds consumerism", "enough" or "sufficiency" should guide us in bringing the cultural shift that would support a post-growth society. This raises the perennial philosophical question: "what is a good life?"[253] Such questioning could help us understand progress as a movement toward "a world in which everyone's basic needs are modestly but sufficiently met, in an ecologically sustainable, highly localised, and socially equitable manner".[254]

Moreover, there is a need to overcome individualism and strengthen a "community approach", relationships based on sharing and on the concept of the "commons". As such, Catholic Social Teaching serves as an important framework in communicating these messages, not only on a scientific or intellectual level, but at a very personal and human level.

Conclusion

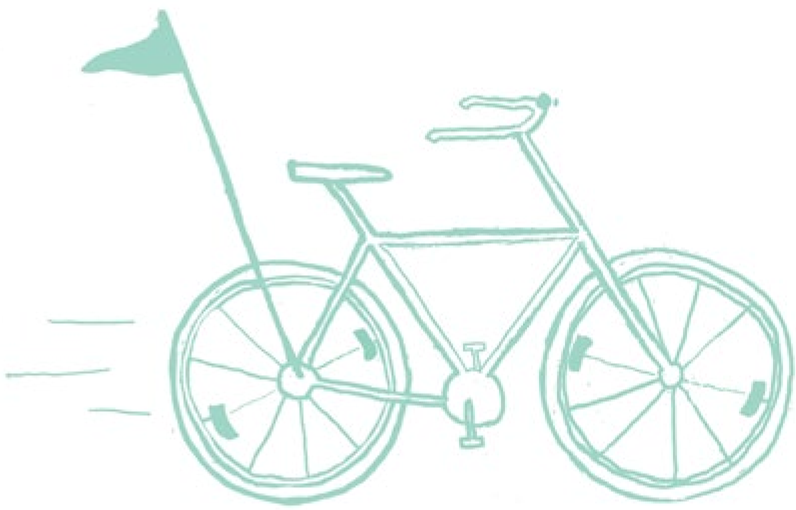
Climate change is not about the uncertain future of our grandchildren, nor of the future of the next generation. Climate change is happening now and the decisions we are taking today, and the ones we will take in the next decade, will define the fate of society as a whole. The pledges for emission reduction pathways that governments put on the table in 2015, called NDCs, are incompatible with what scientific research is highlighting: the carbon budget is shrinking and after 2021 there may be no chance of staying within the 1.5°C temperature threshold. Instead, current NDCs are leading us to a >3°C warmer world, where natural catastrophes, heatwaves, and sea level rise become the new normal. Hence, there's an immediate need to increase ambition.

Climate change is not the only crisis we have to face: inequalities, injustice, hunger, energy poverty, biodiversity extinction, and human rights violations show us we are facing multiple crises that take root in our social, political, and economic system. They are all the symptoms of a system that structurally feeds and drives climate change. As we cannot solve one of those crises at the expense of the others and as the window of opportunity to tackle climate change is shrinking we urgently need to act.

Thinking that we can solve everything with economic progress will only sustain our proven capacity to fail in addressing climate change. If we keep being locked in infinite growth scenarios in which we will try to "offset the impact of production with ever more technology",[255] we will render the use of technologies such as NETs and geoengineering inevitable. Sustaining growth on a finite planet is the perfect recipe for dystopia. We need to get out of that trap.

Ambition should translate into a vision of a transformed society, in which all elements fall into harmony and are subordinated to one another. That is the paradigm shift we are calling for and we need to get serious about it. The energy and agricultural sectors must swiftly shift towards renewable energy and agroecological models that are people centred and respect planetary boundaries. Many are the examples around the world where such systems are proving to be viable and just, but such systems must be backed up by a new economic and political narrative that allows space for rethinking our consumption and production patterns, taking into account our common but differentiated responsibilities.

There is no such thing as neutral technology, no neutral economic system nor market. It all goes down to a direction we set through our political decisions. Climate change is the tip of the iceberg of a failing system and solving it together with the other crises requires political courage and efforts that can no longer wait.



Annex

INTERLINKAGES BETWEEN THE PRINCIPLES OF AGROECOLOGY AND THE AGROECOLOGICAL TRANSITION FRAMEWORK

AGROECOLOGICAL TRANSITION

LEVEL 2: INPUT SUBSTITUTION/ORGANIC	**LEVEL 3:** INTEGRATED AND RESILIENT AGROECOSYSTEMS
LEVEL 4: ALTERNATIVE FORMS OF ECONOMIC EXCHANGE AND MARKET RELATIONSHIP	**LEVEL 5:** BUILDING A (NEW) GLOBAL FOOD SYSTEM

The Principles of Agroecology: the transition levels		Level 2	Level 3	Level 4-5
Environmental dimension of agroecology				
1.1	Enhances positive interactions, synergy between elements of agro-ecosystems		x	
1.2	Builds and conserves life in the soil	x	x	
1.3	Optimises and closes resource loops		x	x
1.4	Optimises and maintains biodiversity above and below ground over time and space		x	
1.5	Eliminates the use and dependency on external synthetic inputs	x	x	
1.6	Supports climate adaptation and resilience while contributing to GHG mitigation	x	x	x
Socio-cultural dimension of agroecology				
2.1	Rooted in the culture, innovation, and knowledge of local communities			
2.2	Contributes to healthy, diversified, seasonally, and culturally appropriate diets	x	x	x
2.3	Is knowledge intensive and promotes horizontal contacts for sharing of knowledge, skills…			x
2.4	Creates opportunities for solidarity and discussion between and among culturally diverse people			x
2.5	Respects diversity between people in terms of gender, race… and creates opportunities for young people and women			x
2.6	Does not necessarily require expensive external certification as it often relies on producer consumer relations			x
2.7	Supports people and communities in maintaining their spiritual and material relationship with their land and environment			x
Economic dimension of agroecology				
3.1	Promotes fair, short distribution networks			x
3.2	Primarily helps provide livelihoods for peasant families and contributes to making local markets and employment more robust			x
3.3	Is built on a vision of social and solidarity economy			x
3.4	Promotes diversification of on-farm incomes, giving farmers greater financial independence, resilience, independence from external inputs…		x	x
3.5	Harnesses the power of local markets			x
3.6	Reduces dependence on aid and increases community autonomy	x	x	x
Political dimension of agroecology				
4.1	Prioritises the needs and interest of small scale food producers and de-emphasises the interests of large industrial and agricultural systems			x
4.2	Puts control of seed, biodiversity, land, territories, water, and knowledge in the hands of people who are part of the food system			x
4.3	Changes power relationships by encouraging greater participation of food producers and consumers in decision-making of food systems			x
4.4	Requires a set of supportive, complementary public policies and investment			x
4.5	Encourages forms of social organisation needed for decentralised governance and local adaptive management of food and agriculture systems			x

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USA

Contact details

CIDSE – Rue Stévin 16 – B-1000 Brussels
T: +32 (0)2 230 77 22 – F: +32 (0)2 230 70 82 – postmaster@cidse.org
www.cidse.org