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Sustainability, common concern and public goods

Rafael Leal-Arcas

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By
Rafael Leal-Arcas¹

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Abstract

This article analyzes the conceptual links between sustainability, common concern and public goods. It examines the mega-trends of the 21st century in the context of sustainability. By doing so, it brings forward the novel idea of how greater participation of citizens can be very promising in helping achieve the Sustainable Development Goals. The article also examines incentives for regional and global cooperation on decarbonizing the economy. It does so by proposing the novel idea of using mega-regional trade agreements (RTAs) to mitigate climate change and enhance sustainable energy. It proposes the argument that only a few major greenhouse gas emitters and just three mega-RTAs can make a great contribution towards climate change mitigation and the enhancement of sustainable energy. The article then explores sustainability in the context of innovation, research, technology and spirituality. The article concludes with the expression that there is a knowledge gap on the links between four major global concerns: trade, energy, climate change, and sustainability. With the threat of climate change looming, and energy increasingly important to all aspects of human and economic development, learning more about these links is extremely timely.

Keywords: sustainable development, international trade, climate change, sustainable energy, citizens' empowerment, public goods, common concern, sustainable companies

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¹ Jean Monnet Chaired Professor in EU International Economic Law and Professor of Law, Queen Mary University of London (Centre for Commercial Law Studies), United Kingdom. Editor-in-Chief, *Renewable Energy Law and Policy Review*. Ph.D. (European University Institute, Florence); JSM (Stanford Law School); LL.M. (Columbia Law School); M.Phil. (London School of Economics and Political Science); BA, JD (Granada University). Member of the Madrid Bar. Some of the ideas in this chapter have benefited from my participation in the 1st Yale sustainability leadership forum, which took place in September 2016 at Yale University. I am very grateful to all the forum participants for lively discussions on the topic. I also benefited from my stint at Sustainable Energy for All, Washington, D.C. I am grateful to Thomas Schoenbaum, Rachel Kyte and Jane Ebinger for stimulating discussions. The financial help from two EU Horizon 2020 grants is greatly acknowledged: Jean Monnet Chair in EU International Economic Law (PROJECT NUMBER - 575061-EPP-1-2016-1-UK-EPPJMO-CHAIR) and the WiseGRID project (NUMBER - 731205). I am grateful to Mariya Peykova for excellent research assistance.

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I. Introduction to sustainability

Sustainability is a necessity for the 21st century. Given the urgency of the issue, scientists have proposed concepts such as ‘planetary boundaries’ to define a “safe operating space for humanity”² to continue to thrive for years to come.³ The concept of planetary boundaries is based on scientific research that indicates that, since the Industrial

² Rockström, J. “Planetary Boundaries: Exploring the Safe Operating Space for Humanity,” Stockholm Resilience Centre, Biodiversity and Ecosystem Services, Master Class, Club of Rome General Assembly, 26 October 2009.

³ <http://www.stockholmresilience.org/research/planetary-boundaries.html>.

Revolution at the end of the 18th century/beginning of the 19th century, human activity has gradually become the main driver of global environmental degradation.

Moreover, a related concept—sustainable development—was coined by the Brundtland Commission⁴ in a report titled ‘Our Common Future.’⁵ The concept has three main pillars:

1. A recognition that a part of the environmental challenge is poverty. For example, in certain communities, one needs to cut down a tree to have dinner;
2. The importance of an integrated approach to sustainable development. One of the mandates of the Brundtland Commission was to raise awareness that the various areas (now goals) of sustainable development cannot be addressed in clinical isolation; and
3. The inter-generational ethics of sustainable development. The idea is that, traditionally, a short-term approach to issues has been rewarded, as opposed to a long-term approach.

In addition, back in 2005, there was a prediction⁶ about humanity’s top 10 problems for the next 50 years. The outcome was as follows: 1) energy; 2) water; 3) food; 4) environment; 5) poverty; 6) terrorism and war; 7) disease; 8) education; 9) democracy; and 10) population. The context of this prediction was based on the fact that in 2004 world population was 6.5 billion and in 2050 it is expected to be 10 billion. However, new predictions are that world population will be 11 billion by 2050.⁷

Given that energy is one of humanity’s main challenges, in February 2015, the European Commission launched the Framework Strategy for a European Energy Union,⁸ a project that envisages a resilient Energy Union⁹ with a forward-looking climate change policy. To achieve greater energy security, sustainability and competitiveness, the Commission aims to strengthen and promote solidarity and trust, the full integration of the European market, energy efficiency that will contribute to moderation of demand, the effective decarbonization of the economy, and the promotion of research, innovation and

⁴ Formally known as the World Commission on Environment and Development, the Brundtland Commission was created to persuade countries to aim at sustainable development.

⁵ Report of the World Commission on Environment and Development: Our Common Future, available at <http://www.un-documents.net/our-common-future.pdf>.

⁶ See generally the views of Smalley, R. of Rice University.

⁷ See speech by UK Foreign Secretary Boris Johnson at Chatham House, London, on 2 December 2016, available at <https://www.chathamhouse.org/event/global-britain-uk-foreign-policy-era-brexite>.

⁸ Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee, the Committee of the Regions and the European Investment Bank, “A Framework Strategy for a Resilient Energy Union with a Forward-Looking Climate Change Policy,” 25.2.2015, COM (2015) 80 final, accessible at http://eur-lex.europa.eu/resource.html?uri=cellar:1bd46c90-bdd4-11e4-bbe1-01aa75ed71a1.0001.03/DOC_1&format=PDF

⁹ The European Energy Union is an ambitious project aiming at secure, affordable and climate-friendly energy in the EU. See http://ec.europa.eu/priorities/energy-union-and-climate_en. For an analysis, see Leal-Arcas, R. *The European Energy Union: The quest for secure, affordable and sustainable energy*, Claeys & Casteels, 2016.

competitiveness.¹⁰ Decarbonization¹¹ is one of the pillars of the European Energy Union, because it is a way to achieve both *energy security*¹² and *climate change mitigation*.¹³ Latest data indicate that in 2014 the EU imported 53% of its energy, which makes it the largest energy importer in the world.¹⁴ In addition, six EU Member states still depend entirely on a single supplier for their gas imports, which makes them vulnerable to supply shocks.¹⁵ The disputes between Ukraine and Russia in 2006, 2009 and 2014, had severe consequences for the EU economy and its citizens' quality of life. Sudden disruptions of energy supply could cripple the EU and have devastating consequences.

The decarbonization of the economy through the use of renewable energy sources can lead to greater energy security, as the EU can decrease its reliance on external energy suppliers. This approach will make the bloc less vulnerable to unexpected disruptions of energy supplies. Finally, decarbonization through renewables could significantly reduce greenhouse gas (GHG) emissions, and contribute to climate change mitigation. The Paris Agreement on Climate Change, negotiated in December 2015, sets a goal of keeping global average temperatures below 2°C above pre-industrial levels, as well as pursuing efforts to limit the temperature increase to 1.5°C above pre-industrial levels,¹⁶ 'recognizing that this would significantly reduce the risks and impacts of climate change.'¹⁷ After its negotiation, it was said that the Paris Agreement on Climate Change was a success, but real success will

¹⁰ Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee, the Committee of the Regions and the European Investment Bank, "A Framework Strategy for a Resilient Energy Union with a Forward-Looking Climate Change Policy," 25.2.2015, COM (2015) 80 final, page 4.

¹¹ Decarbonization refers to the increased use of low-carbon energy sources, such as renewables and nuclear, as well as the act of capping greenhouse gas emissions. For the purposes of this chapter, decarbonization refers to the transition to a low-carbon economy through the use of renewable energy sources, unless stated otherwise.

¹² The International Energy Agency defines energy security as "the uninterrupted availability of energy sources at an affordable price". See <https://www.iea.org/topics/energysecurity/>. For an analysis of energy security in the context of international trade, see Leal-Arcas, R., Grasso, C. and Alemany Rios, J. *Energy security, trade and the EU: Regional and international perspectives*, Edward Elgar, 2016.

¹³ See generally Leal-Arcas, R. *Climate Change and International Trade*, Edward Elgar, 2013.

¹⁴ Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee, the Committee of the Regions and the European Investment Bank, "A Framework Strategy for a Resilient Energy Union with a Forward-Looking Climate Change Policy," 25.2.2015, COM (2015) 80 final, accessible at http://eur-lex.europa.eu/resource.html?uri=cellar:1bd46c90-bdd4-11e4-bbe1-01aa75ed71a1.0001.03/DOC_1&format=PDF

¹⁵ *Ibid.*

¹⁶ Interestingly, despite what we are told every time there is a heat wave, more people die because of cold weather than hot weather. For instance, almost twice as many Americans died between 1979 and 2006 from excess cold than from excess heat. See Goklany, I. "Deaths and death rates from extreme weather events: 1990-2008," *Journal of American Physicians and Surgeons*, Vol. 14 (4), 2009, pp. 102-9.

¹⁷ See Article 2(1) of the Paris Agreement on Climate Change, available at <https://unfccc.int/resource/docs/2015/cop21/eng/109r01.pdf>.

come once it is implemented and GHG emissions are reduced. The 2016 Kigali amendment¹⁸ to the Montreal Protocol¹⁹ will also serve as a catalyst for climate action.

Fulfilment of the European Commission's ambitious plan for a resilient Energy Union requires a degree of unity and dedication, as well as enhanced cooperation among Member States, both regionally and globally. However, the EU is currently facing serious challenges to its security, sustainability, stability, and ultimately its *legitimacy*. In the wake of raging war on the outskirts of Europe's borders, an unprecedented refugee crisis, an economic debt crisis, and the recent challenges associated with the UK's decision to leave the European Union,²⁰ the EU is facing serious integration challenges that threaten not only on its legitimacy, but also its very future. This raises a vital question: why would EU Member States cooperate regionally and globally towards the decarbonization of the economy when they are already facing serious integration challenges? And more importantly, why would EU member states concede to speaking with one voice on energy matters when that voice is already fragmented?

This chapter will demonstrate that despite the notable integration challenges currently looming over the EU, EU Member States have a number of economic, legal and political incentives to cooperate both regionally and globally. Issues such as climate change and energy supply are matters of common concern that require collaboration at the global level. Climate change mitigation is a global public good, which requires collective action by states and concerted efforts at the regional and global level. We contend that energy security that is achieved through the use of renewable energy sources is in fact a global public good, the type that requires and enables collective action at the global level. The changing global landscape of the 21st century saw the emergence of new challenges, which threaten the economic prosperity of states, the well-being of nations, and the human rights of individuals.

We take the view that some of those challenges, which have affected the EU and its citizens profoundly, can be resolved through an effective and unified system of energy governance.²¹ In line with this, we will demonstrate that successful decarbonization through regional and global collective action will boost the economy and contribute to the

¹⁸ In October 2016, 197 countries adopted an amendment to phase down hydrofluorocarbons (HFCs) under the Montreal Protocol on Substances that Deplete the Ozone Layer in Kigali (Rwanda), 'committing to cutting the production and consumption of HFCs by more than 80 percent over the next 30 years.' See US Environmental Protection Agency, "Recent international developments under the Montreal Protocol," available at <https://www.epa.gov/ozone-layer-protection/recent-international-developments-under-montreal-protocol>.

¹⁹ Montreal Protocol on Substances that Deplete the Ozone Layer, 26 ILM 1550 (1987). Its objective was to phase out consumption of replaceable chemical products that harmed the ozone layer but entailed profits for the chemical industry.

²⁰ On the UK leaving the EU (i.e., Brexit), see Leal-Arcas, R. "Three thoughts on Brexit," *Queen Mary School of Law Legal Studies Research Paper 249/2016*, pp. 1-5.

²¹ For instance, there are proponents that suggest the concept of 'energy citizens' to refer to the idea that over 250 million Europeans could produce their own renewable electricity by 2050. This suggests that a bottom-up approach to renewable energy generation is desirable. We subscribe to this idea. See Kampman, B., Afman, M. and Blommerde, J. "The potential of energy citizens in the European Union," CE Delft, 2016; see also Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee, the Committee of the Regions and the European Investment Bank, "A Framework Strategy for a Resilient Energy Union with a Forward-Looking Climate Change Policy", at p. 2, COM(2015) 80 final (25 February 2015) (where it is stated that the European Commission's vision is 'an Energy Union with citizens at its core, where citizens take ownership of the energy transition...').

resolution of significant human rights issues and concerns that continue to plague the EU, such as the current refugee crisis in the EU.

After this introduction, section II explores the notion of public goods in the broader context of international economic law and governance, section III examines possible incentives for regional and global cooperation to decarbonize the economy, whereas section IV offers ideas on research, technology, innovation and spirituality for sustainability. Section V concludes the chapter.

II. Public goods and matters of common concern

This section deals with public goods, such as the climate, common concerns, such as climate change, and what constitutes mega-trends in the 21st century. The tragedy of the commons²² is an economic theory used to explain a situation where there are shared resources and self-interest undermines collective public goods. Such a situation raises the questions of who pays the costs and who reaps the benefits. The defining features of what makes the tragedy of the commons happen are excludability and rivalry (see Table 1).

Table 1: Indicators in the tragedy of the commons²³

	Rivalrous	Non-rivalrous
Excludable	Private goods	Club goods
	Food Car House	Cable TV Some social services
Non-excludable	Common pool resources	Public goods
	Forests Fisheries Wildlife Fossil fuels	Air Law enforcement Public radio Streetlights

(a) *What are public goods?*

(i) *The concept*

Public goods, also known as ‘collective consumption goods’, are defined by economists as the kind of goods that one individual can consume without reducing their availability to and access by others. For this reason, economists characterize public goods as ‘*non-rivalrous*’ and ‘*non-excludable*’. Classic examples of public goods include, *inter alia*, public water supplies, street lighting, lighthouse protection for ships, and national defense services. Unlike private goods, which are usually excludable and rivalrous, public goods are not generally supplied by the private sector, as they cannot be supplied for a *profit*. The key to why public goods present a challenge for the private sector lies in the potential for *unfettered*

²² Hardin, G. (1968) “The Tragedy of the Commons,” *Science*, 162 (3859): 1243-1248.

²³ Dale, L. “Multiple scales of sustainability governance,” lecture given at the Yale sustainability leadership forum, September 2016, Yale University, New Haven, USA.

access to the benefits derived from such goods once they are made available, a phenomenon that is known as the *free-rider* problem.²⁴

Thus, the provision of public goods is usually left to governments, which undertake the task of evaluating the social benefits of supplying public goods, as well as making them widely available to the public, usually by taxing the use of such goods and benefits. Apart from the *free-rider* problem, public goods give rise to what some have referred to as '*the prisoner's dilemma*'.²⁵ The prisoner's dilemma represents a situation in which the lack of information impedes collaboration between two parties.²⁶ In the context of supplying public goods, the 'prisoner's dilemma' could arise where the process is not supported by effective cooperation mechanisms between those who supply the goods and benefit from them, and those who simply benefit as free riders.²⁷ In line with this, experts and academics have contended that without a mechanism for *collective action*, public goods are at risk of being under-produced.²⁸

Finally, even though the list of criteria that define a public good is exhaustive, the list of current public goods is not. Goods that were previously classified as private could later become public, and vice versa. The phenomenon of globalization, technological advancements in recent years, as well as the discovery of new sources of energy, could eventually lead to the re-classification of certain goods and commodities as public, and even the creation of new ones.

²⁴ The *free rider problem* leads to under-provision of a good, and thus to market failure. This is so because access to a public good cannot be restricted once it is made available, thus it is difficult to charge people for benefiting from it.

²⁵ See Kaul, Grunberg and Stern, *Public Goods: International Cooperation in the 21st Century*, Oxford University Press, 1999, page 7.

²⁶ The authors explain the prisoner's dilemma using the example of two prisoners who are faced with a choice of denying or confessing to a crime. If one confesses and the other denies, the one who confesses will be granted his freedom, while the other will serve five years in prison. If they both confess, they will both serve a reduced term of three years. If they both deny, they will both serve one year on a lesser charge that can be proven without a confession. As the prisoners are held in separate cells, they cannot communicate and agree on a common story. Prisoner A quickly realizes that no matter what prisoner B chooses (deny or confess), he is always better off confessing to the crime. If prisoner B denies the crime, prisoner A can get off with no punishment by confessing. If prisoner B confesses, prisoner A faces three years in jail if he also confesses the crime, and five years if he denies it. Thus prisoner A will confess. Prisoner B, facing identical choices, will also confess. The result: both prisoners will confess to the crime and will each serve three years in jail. The prisoner's "dilemma" arises from the fact that both would be better off cooperating—by denying the crime—than defecting—by confessing. If they could maintain their silence, they could each serve one year, rather than three. See Kaul, Grunberg and Stern, *Public Goods: International Cooperation in the 21st Century*, Oxford University Press, 1999, page 7. The concept of the prisoner's dilemma was originally framed by Merrill Flood and Melvin Dresher.

²⁷ A good example would be where the government provides street lighting. Street lighting is a public good, thus its supply gives rise to the *free-rider* and *prisoner's dilemma* problems. The government cannot exclude its citizens from benefiting from the street lighting it provides, as once it is made available, everyone can benefit from it. In addition, if the government does not communicate to its citizens that without their contribution, the government will not be able to supply street lighting (due to lack of funds and resources), its citizens will make the selfish choice of free-riding until lighting is cut off or a cooperation mechanism is established (i.e., agreement to pay taxes). Once the government effectively communicates to its citizens that contributing (by way of taxes) will enable it to keep supplying the street lighting that everyone benefits from, this will give rise to a mutual agreement to collaborate and contribute for the common good.

²⁸ Kaul, Grunberg and Stern, *Public Goods: International Cooperation in the 21st Century*, Oxford University Press, 1999, page 20.

(ii) Global public goods

In recent years, the notion of a public good has expanded significantly. In an increasingly globalized world, issues such as poverty, war, climate change, blatant abuses of human rights, and market failures, have caused ripple effects across the globe. In a world where states have built bridges connecting themselves through trade and technology, the production and supply of public goods has far-reaching, global implications. In line with this, a growing number of experts has written about the rise of the ‘global public good’,²⁹ a tangible or intangible commodity that benefits the wider public, not just at the national level, but also at the international. For the purposes of this chapter, we take the view that a global public good is a tangible or intangible product, whose production and supply gives rise to the infamous *free rider* and *prisoner’s dilemma* issues, it is non-excludable and non-rivalrous, and is more or less available worldwide. Consequently, to avoid the underproduction of global public goods, effective mechanisms of collaboration must be established at the global level, including, *inter alia*, incentives and effective tools that encourage state-to-state cooperation.

(b) Matters of common concern

Matters of common concern represent the worries and issues that drive people to cooperate.³⁰ The principle of cooperation underlies all national and international efforts to find solutions to common problems, reflected in the proliferation of international treaties and institutions. The very concept of the European Union arose out of a need for consolidated efforts to tackle matters of common concern. Issues such as war, climate change, and economic crises, are matters of common concern at the global level, as they have far-reaching and devastating effects. In line with this, states enter into international agreements, transforming mere desire and willingness to cooperate into legally binding obligations.³¹ Thus, when it comes to *some* matters of common concern, states are not simply *encouraged* to cooperate; they are in fact *obliged* to do so, in line with their responsibilities under international law.³²

²⁹ *Ibid.*, page 9.

³⁰ What makes a concern a ‘common’ one is the importance of the values at stake. This idea is also implicit in the Martens Clause and in the ICJ’s recognition that *erga omnes* obligations arise “by their very nature” “in view of the importance of the rights involved.” Issues of common concern are connected to the recognition of *erga omnes* obligations and the formation of collective compliance institutions and procedures that reinforce the *erga omnes* obligations imposed in the common interest. See Shelton, Dinah, ‘*Common Concern of Humanity*’, *Iustum Aequum Salutare* Vol 2009/133–40; Kiss, Alexandre, Shelton, Dinah, ‘*A Guide to International Environmental Law*’, pages 13-14.

³¹ For example, the Paris Conference of the Parties, held in December 2015, demonstrated how states could transform the desire to cooperate on common concerns, such as climate change, into a legally binding obligation. The Paris Agreement on Climate Change, which will come into force in 2020, is in the form of an internationally legally binding instrument, which has been signed and ratified. Legally, there is no higher level of commitment at the international level.

³² For example, some international treaties have called for cooperation on environmental issues, such as the 1992 UN Framework Convention on Climate Change (Article 4(5)), the Convention on Biological Diversity (Article 20(2)), the Convention to Combat Desertification in Those Countries Experiencing Serious Drought and/or Desertification, Particularly in Africa (Articles 20 and 21). In addition, the International Tribunal on the Law of the Sea issued an order on provisional measures on December 3, 2001 in the *Mox Case (Ireland v U.K.)*, where it indicated that the duty to cooperate may be legally enforceable. Ireland had invoked UNCLOS Article 123, which requires states to cooperate in exercising their rights and performing their duties with regard to enclosed or semi-enclosed seas. The court, at paragraph 82 of its order held that UNCLOS and general international law make the duty to cooperate a

(c) Mega-trends of the 21st century

The scientific community is by now almost in unanimous agreement that the greenhouse gas effect is real. The level of GHG emissions in the atmosphere has increased. There are clear policy actions to tackle climate change: mitigation, adaptation and geoengineering. As a result of the Paris Agreement on Climate Change, new avenues to tackle climate change more effectively have emerged. One interesting case in point is the fact that mayors,³³ governors³⁴ and CEOs are involved. From this perspective, the Paris Agreement combines the action of both State and non-State actors, either during the negotiating phase or in its implementation.

This shift to what we describe as a ‘bottom-up approach’ in the *democratic* (in the true sense of the term, namely that power remains with the citizens) implementation of climate change mitigation plans—a creation of the Paris Agreement, which has become the locomotive of climate action—is one of the mega-trends of the 21st century. Since 80% of global economic activity takes place in cities³⁵ and since 80% of GHG emissions comes from cities,³⁶ this new mega-trend of climate action at the city-level is very promising. So why should cities take climate action? Because they are the main polluters and the main implementers of legislation, because today the majority of the world’s population lives in cities³⁷ – and this trend to urban migration is on the rise – and because mayors of cities are pragmatic with global issues such as climate change, poverty or terrorism. Also because such issues are too big for nation-states and because cities arguably offer better governance on these matters.³⁸ Moreover, mayors tend to come from the cities they govern and therefore have a much higher level of trust than politicians at the national level.

A proliferation of governance of global issues at city- and local-level is on the rise. Some of these initiatives even go beyond climate action. Examples of such bottom-up structures are: the C40 mayors summits,³⁹ the Compact of mayors,⁴⁰ the Covenant of mayors for climate and energy,⁴¹ the Global Covenant of mayors for climate and energy,⁴² RESURBE,⁴³ the “100 resilient cities” scheme pioneered by the Rockefeller Foundation,⁴⁴ United Cities and Local Governments,⁴⁵ International Council of Local Environmental

fundamental principle for the prevention of marine pollution (in our view, a matter of common concern), and that certain rights arise from it, which the tribunal can enforce by ordering provisional measures.

³³ <http://www.c40.org/>.

³⁴ <http://regions20.org/>.

³⁵ Dobbs, R. *et al.*, “Urban world: Mapping the economic power of cities,” *McKinsey Global Institute*, 2011.

³⁶ United Nations Environment Program, “Cities and Buildings: UNEP initiatives and projects,” p. 5, available at http://www.unep.org/SBCI/pdfs/Cities_and_Buildings-UNEP_DTIE_Initiatives_and_projects_hd.pdf.

³⁷ <http://www.un.org/en/development/desa/news/population/world-urbanization-prospects-2014.html>.

³⁸ For further details on the potential of cities to solve global problems locally, see Barber, B. *If Mayors Ruled the World: Dysfunctional nations, rising cities*, Yale University Press, 2013 (who argues that local executives exhibit a non-partisan and pragmatic style of governance that is lacking in national and international halls of power).

³⁹ <https://mayorssummit2016.c40.org/>.

⁴⁰ <https://www.compactofmayors.org/>.

⁴¹ http://www.covenantofmayors.eu/index_en.html.

⁴² <https://www.compactofmayors.org/globalcovenantofmayors/>.

⁴³ <http://www.unescosost.org/en/project/resurbe/>.

⁴⁴ http://www.100resilientcities.org/#/-/_/.

⁴⁵ <https://www.uclg.org/en>.

Initiatives,⁴⁶ CityNet,⁴⁷ City Protocol,⁴⁸ the United States Conference of Mayors, Habitat III,⁴⁹ and the “Making Cities Resilient” campaign⁵⁰ in the framework of the UN Office for Disaster Risk Reduction.⁵¹ All of this shows that, until recently, there has been a legal and policy vacuum at city-level regarding climate action and that city networks for climate deliberation are on the rise. It also means that there is a lot that cities can do even when difficult nations refuse to act on climate change or other global issues. This could even take us to create a ‘League of Cities,’ to quote Benjamin Barber.

Mayors’ and governors’ plans of action for climate change mitigation and adaptation could be emulated in other cities and regions of the world with similar concerns. For instance, the mayor of Rio de Janeiro (Brazil) may have a plan to mitigate climate change that is opportune for Manila (The Philippines). To make sure that inter-city networks remain coordinated, there have been proposals for the creation of a world Parliament of Mayors⁵² to enable cities to have a stronger voice on global issues and address global priorities more democratically and closer to citizens.⁵³ The idea is to democratize globalization or to globalize democracy.⁵⁴

Moving forward, the international community may also consider putting a price on harm-causing.⁵⁵ What is needed is a top-down guidance that will come from intergovernmental decisions and a bottom-up implementation of the climate change goals to make things happen, which will take place via citizens’ participation. In this sense, for the implementation of any policy, good legislation is key. And incomplete policy is non-implementable policy.

We are also observing that clean energy is increasingly popular. It is therefore necessary to find a way to finance it. As a result, there is an innovation race across the world. Creating a policy framework for people to be willing to accept failure and not be afraid of making mistakes seems to be a good course of action. All of this raises the interesting question of how to manage globalization in a sustainability era. Table 2 below offers the main trends of the 21st century in a sustainability context.

Table 2: The mega-trends of the 21st century⁵⁶

20 th century	21 st century
Focus of attention was government	Focus of attention should be business
Environmental silos; little attention to economics	Since <i>vox populi</i> is that economics will always prevail over the environment, it is

⁴⁶ <http://www.iclei.org/>.

⁴⁷ <http://citynet-ap.org/>.

⁴⁸ <http://cityprotocol.org/>.

⁴⁹ <https://habitat3.org/>.

⁵⁰ <https://www.unisdr.org/we/campaign/cities>.

⁵¹ <https://www.unisdr.org/>.

⁵² <http://www.globalparliamentofmayors.org/>.

⁵³ See generally Barber, B. *If Mayors Ruled the World: Dysfunctional nations, rising cities*, Yale University Press, 2013.

⁵⁴ Idem.

⁵⁵ See the proposal of senior Republican statesmen regarding a carbon tax in the US. Mooney, C. and Eilperin, J. “Senior Republican statesmen propose replacing Obama’s climate policies with a carbon tax,” The Washington Post, 8 February 2017, available at https://www.washingtonpost.com/news/energy-environment/wp/2017/02/07/senior-republican-leaders-propose-replacing-obamas-climate-plans-with-a-carbon-tax/?utm_term=.1ceadf0fe007.

⁵⁶ This list is based on a ‘Decalogue’ developed by Daniel Esty of Yale University.

	necessary to have an integrated approach between the environment, energy and the economy. The international trading system unites the three sectors. ⁵⁷
Top-down approach to climate change mitigation=> participation of presidents and prime ministers of countries	Bottom-up approach to climate change mitigation=> participation of citizens, mayors, governors, CEOs and billionaires
Command and control approach; ‘polluter pays’ principle	Market mechanisms; economic incentives not to pollute
Prohibition	Problem-solving
Good consumers not rewarded	Reward individuals who solve problems
Gurus gave prescriptions	Big data ⁵⁸ usage for better analysis to inform decisions
Success was tracked based on money expenditure	Outcomes and implementation
Environmental protection as a moral good	Price-based approach
Innovation in technology	Innovation in government and finance
Limited infrastructure	Technological revolution: Using technology to help with infrastructure

The US National Intelligence Council (NIC) published in January 2017 its public Global Trends Report titled “Global Trends: The Paradox of Progress.”⁵⁹ One of the seven global trends that the NIC projects will continue through 2035 is, not surprisingly, the fact that “climate change, environment, and health issues will demand attention.”⁶⁰ In the next sections, we present the novel idea of how greater participation of citizens can be very promising in helping achieve that required attention.

(i) Power to the Citizens

From Table 2 above, one very promising development in the 21st century is the empowerment of citizens on issues of common concern such as climate change, sustainable energy or international trade (see Figure 1 below). By citizens’ empowerment, we mean that civil society could play an important role in the new challenges of trade diplomacy, such as the integration of non-economic aspects of trade in trade policy and in the inclusion of trade policies in the democratic debate. This approach makes the system of decision-making closer to the citizens and therefore less technocratic. The empowerment of citizens could potentially help towards a more effective way of mitigating climate change, enhancing sustainable energy and a more democratic and transparent trade policy-making process. Moving forward, we need to think of specific ways in which citizens can contribute and engage to have a more effective way to obtain sustainable energy and mitigate climate change. Citizen participation is a promising way of providing better management of environmental issues.

⁵⁷ For an elaboration of this idea, see section below ‘How can the trading system help mitigate climate change and enhance sustainable energy?’

⁵⁸ See for instance European Political Strategy Centre, “Enter the Data Economy: EU policies for a thriving data ecosystem,” Issue 21, 11 January 2017.

⁵⁹ <https://www.dni.gov/files/images/globalTrends/documents/GT-Full-Report.pdf>.

⁶⁰ *Ibid.*, at p. 6.

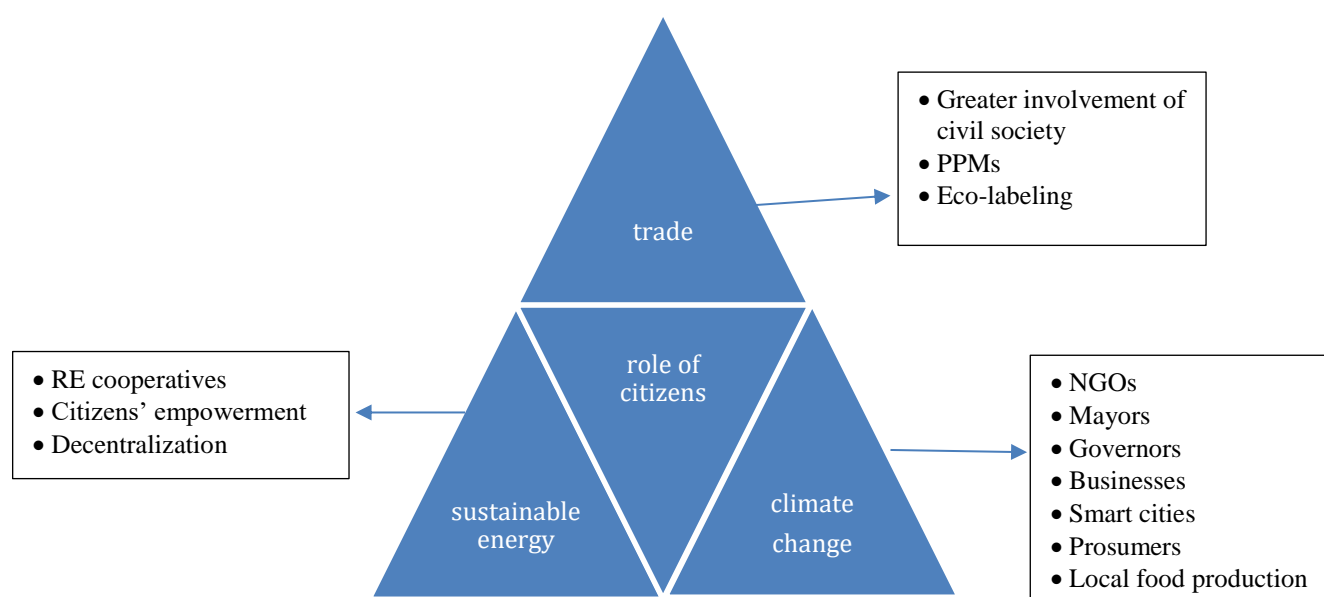


Figure 1: Citizens' empowerment

This novel idea of greater participation of citizens can be very promising in helping achieve the Sustainable Development Goals (SDGs).⁶¹ Figure 1 shows that empowering the people will help mitigate climate change, enhance sustainable energy and make citizens richer thanks to free and open environmental trade. People's empowerment can be achieved by making them more participative in the process of decision-making. More broadly, regression analyses show that when society allows free choice, it has a considerable impact on happiness. Since the beginning of the 1980s, democratization, economic development and increasing social tolerance all have increased people's perception that they have free choice and therefore higher levels of happiness.⁶²

(ii) Citizens and trade (and climate change)

Traditionally, governments discuss trade measures and their links with climate change, without giving room to citizens' participation. This rather technocratic exercise of mitigating climate and links to trade policy can have the potential of becoming more democratic.

Regarding empowerment of people and the link to international trade, trade will need to be substantially re-conceptualized. For instance, contemporary provisions on intellectual property rights make the transmittance of knowledge significantly blocked. If we aim at emancipating people around the world and benefiting from the wealth of transnational insights, perceptions and resources different groups of people can offer, we should aim at facilitating access to knowledge globally. Moreover, emphasis should be placed on trade of technological equipment, smart appliances and applications that serve to reduce energy

⁶¹ http://www.un.org/ga/search/view_doc.asp?symbol=A/RES/70/1&Lang=E.

⁶² Inglehart, R., Foa, R., Peterson, C. and Welzel, C. "Development, freedom, and rising happiness: A global perspective (1981-2007)," *Association for Psychological Science*, 3, 4 (2008), pp. 264-285, at 264.

consumption and GHG emissions. Furthermore, trade subsidization is distortive of markets and leads to more GHG emissions than would otherwise be the case.⁶³

Trade is an essential component that places a spotlight on the dynamic shifts that are taking place and will take place globally in the so-called processes and production methods (PPMs) of goods. This means that consumers are increasingly seeking information on how the PPMs of the products they buy affect the environment, eco-labeling as well as labeling and traceability of genetically modified organisms. There will be a transformation in the geographies of trade, both spatially and temporally. The importance of new technologies is a crucial aspect to factor in here.

International trade agreements could have provisions that empower citizens as consumers to better scrutinize trade agreements. This addition would make trade governance closer to citizens. It would be necessary to examine the rules of international trade that need to be amended to make trade green.⁶⁴ In broad terms, trade rules are not guided towards environmental protection as much as they could be.

Similarly, thanks to the internet—which provides more transparency and access to information than ever before—people are more aware of trade negotiations and go out to demonstrate on the streets against what they consider unfair and detrimental trade agreements that are supposed to be for ordinary citizens but in reality only a few benefit from. Classic examples are massive demonstrations against the Trans-Pacific Partnership (TPP) in the US and against the Trans-Atlantic Trade and Investment Partnership (TTIP) on the streets of Germany, Austria, France or the UK. This is the case because trade is widely considered to be designed by and for the interest of large transnational corporations, rather than for the needs of the people. Hence, reshuffling political processes by drawing citizens in these processes arises as promising (one could argue also indispensable). It is, therefore, worth exploring how levels below the national government, such as that of cities/municipalities represented by their mayors, can better represent the interests of their people. For example, in the case of the global commons, cities with concentrated population could improve their transport system, whereas cities with a lower level of population concentration could invest more in reforestation.

Accountability, efficiency (via more rapid feedback loops) and transparency are enhanced at the level closest to the citizens. Macroscopically, there is nothing a priori given in the preponderance of the state as the foremost unit, neither of political analysis nor as political, social or economic organization. In a post-Westphalian world, neo-medievalism⁶⁵ may prevail and the role of the city will be preponderant in this respect. The involvement of citizens can be approached in different intellectual and cultural ways, such as within civil society's role in liberal Western democracies, within the Asian-values context in China, or citizens' empowerment in theocracies. Politically, the principle of subsidiarity, devolution, federal systems, regional schemes and closer ties between specific cities (not least within

⁶³ One could make the case whether some WTO rules need clarification, especially in the field of subsidies and ask the question whether good subsidies should exist if they are for a good purpose such as a public good, namely climate change mitigation.

⁶⁴ Esty, D. and Winston, A. *Green to Gold: How smart companies use environmental strategy to innovate, create value, and build competitive advantage*, John Wiley & Sons, Inc., 2009; Esty, D. *Greening the GATT: Trade, Environment, and the Future*, Washington, D.C., Peterson Institute for International Economics, 1994.

⁶⁵ Neo-medievalism is a term often used as a political theory about modern international relations. See Kobrin, S. "Back to the Future: Neomedievalism and the postmodern digital world economy," available at <http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.131.6106&rep=rep1&type=pdf>.

the EU) form the background for a rising role for the cities of the world to come together. All these innovative options of governance make decision-making easier and more impactful and aim at a decentralized system of governance.

Lastly, given that citizens' role in trade is primarily as consumers, in order for their activities to have an impact on climate change mitigation efforts, consumer activity, i.e., purchases, must be of significant importance with the broader economic dynamic of a country. Table 3 assesses the consumer habits in eight major GHG emitters that are also Parties to three mega-RTA (TPP, TTIP and the Regional Comprehensive Economic Partnership (RCEP)) in order to ascertain whether consumer spending is of significant importance such that a change in consumer habits could influence trade patterns in these jurisdictions. Table 3 indicates consumer spending as a percentage of GDP. The figures are based on the market value of all goods and services, including durable products (such as cars, washing machines, and home computers), purchased by households.

Table 3: Household final consumption expenditure⁶⁶

Country	Consumer Spending as percentage of GDP
China	37.0
USA	68.1
EU	56.3
India	59.6
Russia	51.9
Indonesia	55.4
Brazil	63.4
Japan	58.6
Canada	57.5
Mexico	67.1

Source: World Bank national accounts data, and OECD national accounts data files. Figures for 2015.

With the exception of China, one could argue that, since consumer spending contributes significantly to the GDPs of the countries in Table 3, empowering citizens to be more climate change-conscious in purchases could spur the growth of 'greener' markets in the jurisdictions that are Parties to the three mega-RTAs mentioned above in the process towards the supply of greener goods.

(iii) Citizens, climate change and sustainable energy (and trade)

The empowerment of citizens in climate change mitigation is promising via greater input from NGOs, mayors and governors representing citizens, smart cities, prosumers and local food production. The same is true with the enhancement of sustainable energy via renewable energy cooperatives and energy decentralization. The decentralization and localization of energy dependency could potentially lead to a change in the relationship between energy producers and governance institutions, including municipal administrations and city mayors. The Paris Agreement on Climate Change can be characterized as a hybridized global agreement that facilitates these changes within a

⁶⁶

http://data.worldbank.org/indicator/NE.CON.PETC.ZS?end=2015&name_desc=false&start=1967&view=chart.

multipolar world. The global stock-take (Article 14 of the Paris Agreement) will foster new ways of valuing, seeing and comparing between sectors, communities (rich/poor/urban/rural), countries and regions. This data will inform other agreements as well as policy on resource management (such as eco-labelling and PPMs).

The opportunities ahead in part exist due to technology potentially enabling a decentralization of production and processing of goods (for instance, 3-D printing), away from old Fordist-style manufacturing, and services (for instance, the gig economy), will be a dynamic hybridization away from old hierarchical and linear models towards multilevel and circular ones. The form these will take will depend on how the power dynamics will play out, including the backlash by those with the most to lose within the existing globalized trade system. This hybridization indicates a recognition that there is no inevitable, single pathway or outcome; rather, that the political economy within, and between, regional contexts will influence the potential opportunities and outcomes for citizens' engagement.

III. Incentives for regional and global cooperation on decarbonizing the economy

Climate change and energy supply issues are matters of common concern that give rise to *erga omnes* obligations, due to the value and importance of the rights involved. The destructive impact of climate change can only be mitigated through joint efforts and collective action at the global level. Energy supply issues have become more prevalent in recent years, as states become increasingly more conscious of the dangers associated with heavy reliance on traditional energy resources. In a world of growing energy demands, the rising scarcity of traditional energy resources and the soaring levels of pollution highlight the urgent need for collective global action to mitigate the negative effects of climate change and ensure global energy security.

(a) *Climate change mitigation is a global public good that calls for collaborative effort*

Climate change mitigation has long been regarded as a public good. The atmosphere is an international public good in that all countries benefit from each country's reduction of greenhouse gas emissions.⁶⁷ Climate change mitigation is both *non-rivalrous* and *non-excludable* and, because it is available on a worldwide basis, it is a global public good.⁶⁸ In line with this, the reduction of greenhouse gas emissions presents the same issues and challenges that are commonly associated with the provision of public goods at the national level, such as the lack of economic incentives, and the infamous free rider and prisoner's dilemma issues.⁶⁹ Hence, from an economic perspective, climate change mitigation requires collaborative effort and *collective action*.

⁶⁷ See Bruce, J., Lee, H. and Haites, E. (eds.) *Climate Change 1995: Economic and Social Dimensions of Climate Change*, page 21, Cambridge University Press, 1996, at https://www.ipcc.ch/ipccreports/sar/wg_III/ipcc_sar_wg_III_full_report.pdf.

⁶⁸ See Kaul, Inge (2012), "Rethinking public goods and global public goods," in Éric Brousseau, Tom Dedeurwaerdere, and Bernd Siebenhüner (eds.), *Reflexive Governance for Global Public Goods*. Cambridge, MS: The MIT Press, pp. 37-54.

⁶⁹ The 'prisoner's dilemma' issue presents itself in the context of climate change mitigation, as in the absence of effective cooperation between states, the negative effects of climate change cannot be mitigated. States must exchange information on emission cuts, as well as knowledge and expertise, in order to effectively mitigate the effects of climate change.

(b) *Energy security through the lens of a public-goods analysis*

Energy security has become a significant issue of concern for the EU, given the Union's precarious energy situation.⁷⁰ The traditional concept of energy security focuses on the *continual* availability of energy sources at an affordable price, which has so far been associated with a steady and constant availability and supply of traditional energy resources, such as oil and gas. While it is generally agreed that climate change mitigation, as seen above, is a global public good,⁷¹ the classification of energy security as a public good has divided experts and academics. The traditional interpretation of a public good cannot be applied to the concept of energy security, as the latter does not fall under the definition of a non-rivalrous and non-excludable good, as defined by economists.⁷² The consumption of traditional resources of energy, such as oil and gas, naturally leads to depletion and excludability; hence energy security in this context cannot be classified as a public good. However, by shifting the focus of global efforts towards the creation of a framework that delivers uninterrupted, secure, affordable, clean and *sustainable* energy through the use of modern technology, states can achieve *global renewable energy security*, which, in our view, is a global public good. So renewable energy may become the engine to obtain the three attributes of sustainable energy in the energy trilemma,⁷³ namely clean, secure and affordable energy (see Figure 2).

⁷⁰ See Leal-Arcas, Rafael, *The European Energy Union: The quest for secure, affordable and sustainable energy* (Claeys & Casteels Publishing 2016), Chapter 1; Leal-Arcas, R., Grasso, C. and Alemany Rios, J. *Energy Security, Trade and the EU: Regional and International Perspectives*, Edward Elgar, 2016.

⁷¹ See Leal-Arcas, Rafael, "Unilateral Trade-Related Climate Change Measures," *The Journal of World Investment and Trade*, Vol. 13, No. 6, 2012.

⁷² A rival good is a good whose consumption by one consumer prevents simultaneous consumption by other consumers. See David L. Weimer and Aidan R. Vining, *Policy Analysis: Concepts and Practice*, Routledge, 4th ed., Pearson: Prentice Hall. p. 72.

⁷³ The World Energy Council's definition of sustainability of energy is 'based on three core dimensions – energy security, energy equity, and environmental sustainability. These three goals constitute a 'trilemma', entailing complex interwoven links between public and private actors, governments and regulators, economic and social factors, national resources, environmental concerns, and individual behaviours.' See World Energy Council, "World Energy Trilemma," available at <https://www.worldenergy.org/work-programme/strategic-insight/assessment-of-energy-climate-change-policy/>.

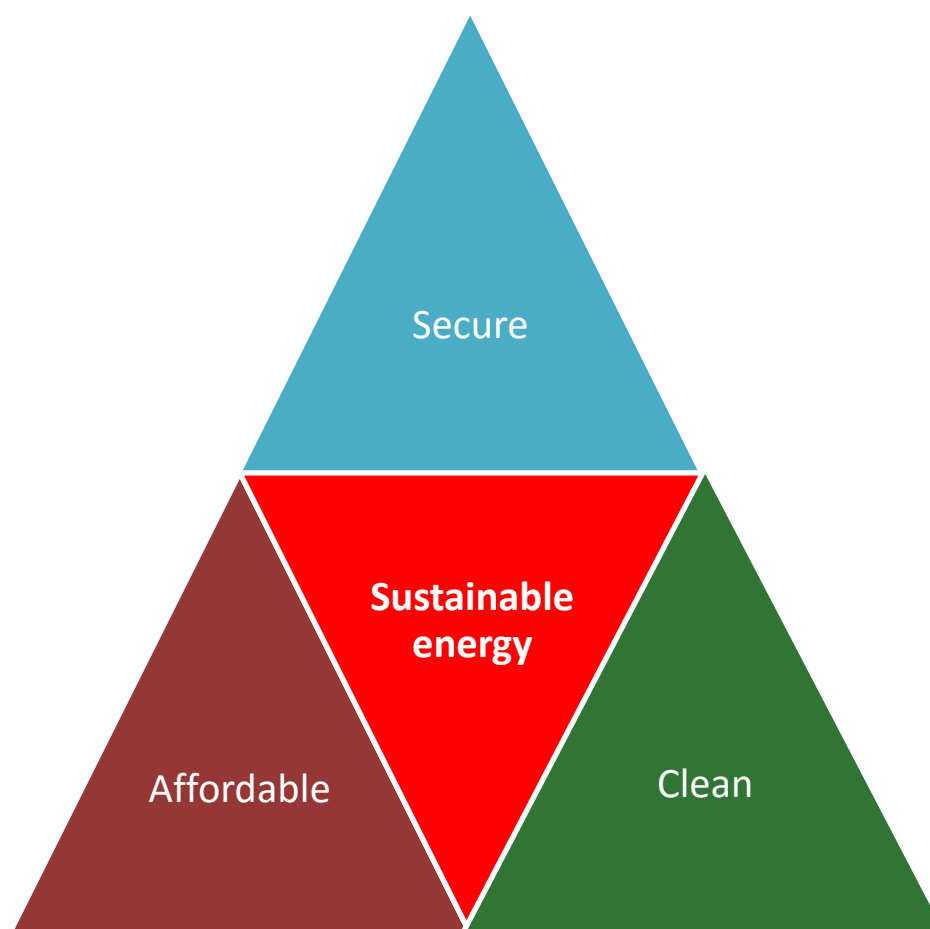


Figure 2: The attributes of sustainable energy in the energy trilemma

(i) *Global renewable energy security*

The concept of global renewable energy security is rooted in a belief that states – with the help of modern technology - can achieve uninterrupted, secure, clean, sustainable and affordable energy through the use of renewable energy resources. The concept of global renewable energy security is better understood through examples A and B, illustrated below.

Example A

State A is rich in sunlight, but lacks the technological capacity to process solar energy. State B, on the other hand, possesses the technological capacity to process solar energy, but does not have renewable energy capacity, because it is not rich in renewable natural resources, such as sunlight, in this case. State A and state B enter into an agreement whereby state B supplies state A with access to the technology it needs to process solar energy and, in turn, state A gives state B access to processed renewable energy. As a result, both states A and B gain access to uninterrupted, secure, clean, sustainable and affordable energy.

In the example above, the benefits reaped by states A and B become available to the wider global community, as surplus renewable energy can then be sold to other states.⁷⁴ Other states can now gain access to renewable energy generated by states A and B, even if those other states do not have the technological capacity to process raw renewable material. This is illustrated in example B below.

Example B

State C, which is not rich in sunlight,⁷⁵ does not have the technological capacity to process raw renewable energy resources, such as solar energy. Thus, state C relies on supplies of conventional fossil fuels to meet its energy demands. However, state C can now enter into an agreement with either state A or state B, and secure its supply of renewable energy through a separate agreement with either or both states.⁷⁶

Example B demonstrates just a fraction of the vast potential of renewable energy to help meet global energy demands, and the model above could be applied to any type of renewable energy resource, such as wind, sunlight, rain, and others. The agreement between states A and B in the example above opens the door for trade in renewable energy at the regional and global level, with endless possibilities for states to engage in bilateral, trilateral, plurilateral and multilateral arrangements for the trade in renewable energy. Such arrangements could lead to increased flows of renewable energy throughout the globe, through the use of various mechanisms, such as renewable energy trading platforms or intergovernmental agreements on energy trade. The gradual proliferation of renewable energy around the world resembles a spider web, at whose center lies the union between modern technology and renewable energy sources. This gradual and incremental spread of renewable energy across the globe – made possible by modern technology and innovation – will ultimately lead to *global renewable energy security*.

⁷⁴ Scientists are working on developing new and effective mechanisms that allow for the storage of different types of renewable energy in times of deficit or surplus in production, and the subsequent transportation of any excesses. Common forms of renewable energy storage include pumped-storage hydroelectric dams, rechargeable batteries, thermal storage including molten salts that can store and release large amounts of heat energy, and compressed air energy storage, flywheels, cryogenic systems and superconducting magnetic coils. For example, one way to store and transport renewable energy is through the ‘Power-to-Gas’ method. The term “Power-to-Gas” refers to the new technologies that are used for the storage and transport of regenerative energy in the form of methane or hydrogen. For example, renewable electric energy can be transformed into storable methane via electrolysis and subsequent methanation. See Manuel Gotz, Jonathan Lefebvre, Friedemann Mors, Amy McDaniel Koch, Frank Graf, Siegfried Bajohr, Rainer Reimert, Thomas Kolb, ‘Renewable Power-to-Gas: A technological and economic review’, *Renewable Energy* 85 (2016) 1371-1390 <http://ac.els-cdn.com/S0960148115301610/1-s2.0-S0960148115301610-main.pdf?tid=e636a4d6-7dcf-11e6-9abc-00000aab0f6c&acdnat=1474224435_246a718737dbfbae9fce393c2ff40717>.

⁷⁵ Even though all states have access to sunlight, the sun is not as strong in all parts of the world. In addition, energy generated by solar power can be quite unpredictable, as its supply depends on, *inter alia*, the weather conditions. Thus, energy generated by solar power can be produced in excess or deficit and can be quite volatile. One way to resolve issues related to the variability of renewable-energy production could be through state-to-state trade in renewable energy.

⁷⁶ Renewable energy trading is a good way for states that do not have renewable energy capacity to secure access to clean, sustainable energy. Directive 2009/28/EC, adopted under the auspices of the EU’s 2020 action plan, encourages states to exchange energy from renewable sources through a combination of domestic production and imports. See Directive 2009/28/EC of the European Parliament and of the Council of 23 April 2009 on the promotion of the use of energy from renewable sources and amending and subsequently repealing Directives 2001/77/EC and 2003/30/EC, available at <http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32009L0028&from=EN>.

(ii) Global renewable energy security as a global public good

Rapid changes in technology can alter the nature of goods, turning previously private goods into public goods, and vice versa. For this reason, we claim that global renewable energy security is a global public good, as it is *non-excludable*⁷⁷ and *non-rivalrous*,⁷⁸ and it is available, to a greater or lesser extent, on a worldwide scale. Common issues associated with the provision of public goods - such as the free rider issue and the prisoner's dilemma - could arise when renewable energy becomes widely and globally available. For example, where a state secures uninterrupted access to sustainable energy, that energy becomes a common good, whose benefits are freely enjoyed by the wider public. Because of the non-excludability of global renewable energy security, there is a risk that people will take advantage of the benefits it generates without paying for them.

Finally, achieving global renewable energy security requires collective action and cooperation between the various actors involved in the supply and demand chain. Without effective collaborative mechanisms in place, which ensure the free flow of information, technical knowledge and skills, global renewable energy security cannot be achieved.

(c) Regional and global cooperation on decarbonizing the economy will contribute to climate change mitigation

In line with its obligations under the Paris Climate Agreement,⁷⁹ the EU has already made a pledge to reduce greenhouse gas emissions by at least 40% by 2030,⁸⁰ 60% by 2040, and 80% below 1990 levels by 2050.⁸¹ The 2030 climate and energy framework also sets two additional targets for the year 2030, that of achieving at least a 27% share of renewable energy, and at least a 27% improvement in energy efficiency.⁸² A shift away from volatile

⁷⁷ When global renewable energy security is achieved, no person in the world can be excluded from consuming the available energy, as it becomes freely and widely available.

⁷⁸ The fact that one state agrees to supply another state with renewable energy does not diminish the overall capacity of renewable energy available, and thus, use by one state does not reduce availability for other states. In addition, where an individual consumes renewable energy, her consumption does not reduce the availability for other individuals in the same or other states.

⁷⁹ The Agreement will enter into force when at least 55 Parties representing at least an estimated 55% of total greenhouse gas emissions join, by ratifying, accepting or approving the Agreement, depending on their constitutional framework.

⁸⁰ See 2030 climate and energy framework, at http://ec.europa.eu/clima/policies/strategies/2030/index_en.htm and INDC submissions, as communicated by Parties, at <http://www4.unfccc.int/Submissions/INDC/Published%20Documents/Latvia/1/LV-03-06-EU%20INDC.pdf>

⁸¹ The European Commission is looking at cost-efficient ways to make the European economy more climate-friendly and less energy consuming. The roadmap suggests that, by 2050, the EU should cut its emissions to 80% below 1990 levels through domestic reductions alone (i.e. rather than relying on international credits). This is in line with EU leaders' commitment to reducing emissions by 80-95% by 2050 in the context of similar reductions to be taken by developed countries as a group. To reach this goal, the EU must make continued progress towards a low-carbon society. Clean technologies play an important role. See '2050 low-carbon economy', at http://ec.europa.eu/clima/policies/strategies/2050/index_en.htm

⁸² See 2030 climate and energy framework, at http://ec.europa.eu/clima/policies/strategies/2030/index_en.htm and INDC submissions, as communicated by Parties, at <http://www4.unfccc.int/Submissions/INDC/Published%20Documents/Latvia/1/LV-03-06-EU%20INDC.pdf>

fossil fuels will ensure that the EU reaches its greenhouse gas emission targets, and that it introduces a higher share of renewable energy resources in its economy, in line with its 2030 climate and energy framework, and its obligations under the Paris Climate Agreement. The effective decarbonization of the economy, however, cannot occur if EU member states act in isolation. If the EU is to reach its target goals by 2030, its member states must cooperate on decarbonizing the economy, both regionally and globally.⁸³

Concerted action is needed in order to tackle poverty and low standards of living, as developing states that are still grappling with such issues are less likely to achieve low carbon economies within the timeframe set under the framework of the Paris Climate Agreement. Cooperation between developed and developing states, for example, could lead to the exchange of technology, skills, expert knowledge, and resources. This, in turn, can stimulate economic growth in developing states, and accelerate the process of decarbonization. Otherwise, developing states may be less willing to cut their emissions, as slowing down the process of industrialization could harm their economies. As deep and successful decarbonization requires profound changes to countries' energy and production systems, the only way to achieve this by 2030, or as soon as possible, is through deep collaborative efforts. By establishing solid collaborative mechanisms that encourage the exchange of renewable energy resources and technology,⁸⁴ EU member states can become the driving actors in promoting the development of critical low carbon technologies and making them commercially available and accessible to both developed and developing states. The establishment of collaborative mechanisms can catalyze the process of decarbonization, allowing the EU to quickly and effectively honor its international responsibilities and obligations on climate change mitigation.

(d) Regional and global efforts towards decarbonization could contribute to the resolution of pressing economic and human rights issues

This section focuses on the importance of sustainable development in the context of economic growth. A good example of sustainable development is access to energy. And it is a well-known fact that development leads to an increment in the level of per capita energy consumption. Energy security, or access to energy at an affordable price, is a burning issue in a world where, according to the International Energy Agency, in 2013, 1.2

⁸³ Article 6 of the Paris Climate Agreement outlines the different methods by which market mechanisms that were established under the Kyoto Protocol can be developed into mechanisms that allow for the sharing of responsibility for climate action across borders. Article 6 recognizes the potential of cooperation to promote sustainable development and environmental integrity.

⁸⁴ For example, the UK and France signed a declaration on nuclear energy and cooperation on climate change action in 2014. The declaration paved the way for, *inter alia*, the successful mitigation of climate change, and the development of low-carbon secure electricity, which provides new green jobs and investment. In addition, in 2012, the UK and Iceland signed an agreement aimed at encouraging enhanced cooperation between the two states, as well as greater use of interconnectors for the transportation of energy under the sea. Further agreements on cooperation on renewables have been signed between, *inter alia*, Denmark and China, and the South West of England and the Channel Islands. See 'UK and Iceland sign energy agreement', at <https://www.gov.uk/government/news/uk-and-iceland-sign-energy-agreement>; 'UK and France sign declaration on nuclear energy and agree cooperation on ambitious climate change action', at <https://www.gov.uk/government/news/uk-and-france-sign-declaration-on-nuclear-energy-and-agree-cooperation-on-ambitious-climate-change-action>; 'Channel Islands' link with south-west England on marine power', BBC news, 3 December 2013, at <http://www.bbc.co.uk/news/world-europe-guernsey-25200486>; 'China and Denmark sign new cooperation agreement on energy efficiency', 1 May 2014, at <http://www.efkm.dk/en/news/china-and-denmark-sign-new-cooperation-agreement-on-energy-efficiency>.

billion people (i.e., 17% of the world population) had no access to electricity.⁸⁵ Most of those living without electricity (around 95%) are in Sub-Saharan Africa and developing Asia.⁸⁶ Eighty per cent of them live in rural areas.⁸⁷ Yet, in the case of Africa, it receives the least amount of climate finance in the world (around 4%). Energy costs and availability will ensure a more efficient use of it as well as changes in life style. They also limit economic growth in the developing world. For all these reasons, the energy future should be sustainable, based on renewable energy.

(i) *The EU's human rights crisis*

Poverty, war and repression have driven thousands of people to seek refuge in the EU.⁸⁸ A large number of refugees that attempt to cross the Union's borders risk their lives and those of their loved ones in order to escape poverty and pitiable living conditions, brought about mostly by conflicts, climate change and environmental degradation. Energy poverty, in particular, is a serious issue in sub-Saharan Africa.⁸⁹ It has led to an increase in migration to the EU, and is regarded by many as a security problem associated with international crime, terrorism and trafficking,⁹⁰ which has contributed to xenophobia and racism in the EU.⁹¹

⁸⁵ International Energy Agency, WEO 2015 Electricity Access Database, available at <http://www.worldenergyoutlook.org/resources/energydevelopment/energyaccessdatabase/>.

⁸⁶ Ibid.

⁸⁷ Ibid.

⁸⁸ Various reports and articles published in the last 10 years demonstrate that there has been a surge in the influx of refugees from the African continent, particularly from North and sub-Saharan Africa. The majority of refugees are forced to seek refuge in European countries due to war, conflict, political upheaval, poverty and climate change. An increasing number of refugees come from sub-Saharan Africa, a region that suffers from energy poverty and where the negative effects of climate change have driven many to relocate in search of a better future. See 'Key Facts: Africa to Europe Migration', BBC News, 2 July 2007, at <http://news.bbc.co.uk/1/hi/world/europe/6228236.stm>; 'Migration to Europe – is North Africa Europe's border guard?', Isabel Schäfer, German Development Institute, The Current Column of 8 June 2015, at https://www.die-gdi.de/uploads/media/German_Development_Institute_Schaefer_08.06.2015.pdf; Matt Timms, 'Energy poverty stifles sub-Saharan Africa's economic development', World Finance, 3 May 2015, at <http://www.worldfinance.com/markets/energy-poverty-stifles-sub-saharan-africas-economic-development>;

⁸⁹ The region has a tremendous energy deficit that is considered by many to be one of the major elements constraining Africa's economic and social development. According to recent IEA data, less than 300 million Sub-Saharan Africans out of roughly 915 million people living in the region have access to electricity. This means that between 60-70% of Africans are disconnected. In overall terms, there are about 1.2 billion people in the world with no access to electricity, half of whom live in the African continent. See 'Africa and the Energy Charter: the bountiful continent and the energy conundrum', 2015, at

http://www.energycharter.org/fileadmin/DocumentsMedia/Infographics/2015_Energy_Charter_And_Africa.pdf; Matt Timms, 'Energy poverty stifles sub-Saharan Africa's economic development', World Finance, 3 May 2015, at <http://www.worldfinance.com/markets/energy-poverty-stifles-sub-saharan-africas-economic-development>.

⁹⁰ See Marie-Laurence Flahaux, Hein De Haas, 'African migration: trends, patterns, drivers', in 'Comparative Migration Studies', January 2016, at <https://comparativemigrationstudies.springeropen.com/articles/10.1186/s40878-015-0015-6>

⁹¹ It is interesting to note that periods of economic progress in the US and Europe have traditionally been conducive to tolerance and openness because autochthonous populations did not feel threatened by migrants for locals to progress economically. And *a contrario*, whenever economic growth was low, racism and discrimination have been on the rise, on the grounds that local populations were being pushed down economically as a results of migrants. See Friedman, B. *The Moral Consequences of Growth*, New York: Alfred A. Knopf, 2005.

In addition, migration flows into the EU have increased significantly over the past years, due to the volatile security situation in North Africa and parts of the Middle East. For example, studies conducted by the Global Migration Data Analysis Centre indicate that the number of asylum seekers has consistently grown since 2011 and is at a record high.⁹² Moreover, the UN estimates that by 2060, fertility in all regions of the world, except for Africa, will have reached the replacement rate of 2.1 children per woman or below, which is the case in many Western countries.⁹³ Africa will be at around 2.7 children per woman by 2060.⁹⁴ Between now and then, there may be many Africans who may be tempted to migrate to rich Europe so long as they continue being the victims of the consequences of climate change and energy poverty.

The growing number of refugees who are seeking asylum in the EU highlights the shortages in capacity to handle such requests, as well as the lack of resources and facilities that would permit the EU to embrace asylum seekers in line with its obligations under regional and international human rights instruments.⁹⁵ The recent readmission agreement between the EU and Turkey⁹⁶ of March 2016 further highlights these shortages in capacity, and serves to undermine the credibility of EU institutions, as it calls for the return of asylum seekers to Turkey, a state with a dubious human rights record. Many have questioned the legality of the readmission agreement, as its implementation may lead to violations of EU and international regulations on the treatment and return of refugees.⁹⁷

Regional and global cooperation on the decarbonization of the economy could help resolve some of the pressing matters that underpin the current human rights crisis. The exchange of technology and renewable energy could stimulate economic growth and alleviate energy poverty in Africa, particularly in states where it is more prevalent, such as parts of sub-Saharan Africa. Studies conducted by the International Renewable Energy Agency demonstrate that Africa's economies are currently growing at an average rate of 4% per year. In fact, six of the world's ten fastest growing economies over the last decade were found in sub-Saharan Africa.

Sustaining the same level of growth, however, will only be possible if supported by a much larger and better-performing energy sector.⁹⁸ As one of the world's major economic powers, the EU has the capacity and means to invest in research, develop new renewable energy technologies, and encourage innovation. EU states such as Germany, Sweden and

⁹² See 2015 Global Migration Trends Factsheet, at https://publications.iom.int/system/files/pdf/global_migration_trends_2015_factsheet.pdf

⁹³ Population Division of the Department of Economic and Social Affairs of the United Nations Secretariat, *World Population Prospects: The 2010 Revision*. See <https://ourworldindata.org/future-world-population-growth/#note-7>.

⁹⁴ *Ibid.*

⁹⁵ The EU is bound by the Charter of Fundamental Human Rights in the course of implementing EU legislation. In addition, EU member states are also bound by the European Convention of Human Rights and the International Covenant of Civil and Political Rights, which safeguard the basic human rights of individuals.

⁹⁶ See 'EU-Turkey Agreement: Questions and Answers', at http://europa.eu/rapid/press-release_MEMO-16-963_en.htm

⁹⁷ EU and international legislation require that there must be no risk of serious harm and no threat that those returned will be sent to another country that is deemed unsafe. See Directive 2011/95/EU of the European Parliament and of the Council of 13 December 2011; Articles 32 and 33 of the 1951 Convention Relating to the Status of Refugees.

⁹⁸ See 'Africa's Renewable Future: The Path to Sustainable Growth', International Renewable Energy Agency, at http://www.irena.org/documentdownloads/publications/africa_renewable_future.pdf

Denmark, for example, have the potential to lead the retreat from fossil fuels, and initiate the transformation of the global energy sector. Cooperation with, *inter alia*, African states on the decarbonization of the economy will:

- 1) Facilitate economic growth in the African continent and eradicate energy poverty in sub-Saharan Africa, significantly improving the living conditions of millions of people around the world, including the EU;
- 2) Reduce the number of economic migrants who travel to the EU from sub-Saharan Africa. Fewer people will feel compelled to undertake the dangerous journey from Africa to Europe; and
- 3) Ensure that the EU has the capacity to deal with refugees and asylum seekers who enter the EU to escape persecution and violence due to war and political upheaval. This will remove the current strain on national authorities, and will reduce the number of refugees that need to be sent away to third countries, such as Turkey.

Related to the notion of refugee is the concept of (economic or climate) migrant,⁹⁹ often related to energy poverty. It is demography and economic change that is pushing citizens out of poor and middle-income countries and into the rich world, which seems to dislike them so much. In the case of India and China, for instance, due to cultural beliefs, there is an excess of boys and men because of sex-selective abortions or gendercide.¹⁰⁰ Many of these young men, unable to find wives, have great incentives to migrate. The West offers great opportunities, which is what climate migrants are often looking for.

(ii) *Efforts towards decarbonization will boost the EU's economy*

Economic growth is one of the core tenets of the European Union and a powerful incentive for regional and global collaboration. Collaboration on the decarbonization of the economy will benefit individual Member States and the overall economy of the EU by proliferating the spread of renewable energy around the globe and ensuring stable and sustainable global economic growth.¹⁰¹ Enhanced cooperation also ensures that the EU will make considerable progress in attaining its objectives under the revised EU Sustainable Development Strategy (EU SDS),¹⁰² key among which is the attainment of economic

⁹⁹ On the controversial concept of 'climate migrant,' see Leal-Arcas, R. "On Climate Migration and International Trade," *Vienna Journal on International Constitutional Law*, Vol. 6, Issues 3+4, pp. 410-440, 2012.

¹⁰⁰ <https://www.newsrecord.co/answering-for-indias-missing-girls-sex-selective-abortion-in-india/>.

¹⁰¹ Already in the 1960s and 1970s there was discussion about the limits to growth and the importance of sustainable growth. See for instance Ehrlich, P. *The Population Bomb*, Sierra Club, 1968; Meadows, D. et al., *The Limits to Growth*, 1972. More recent studies include Sabin, P. *The Bet: Paul Ehrlich, Julian Simon, and our Gamble over Earth's Future*, Yale University Press, 2013; Klein, N. *This Changes Everything: Capitalism vs. the Climate*, Allen Lane, 2014; Maxton, G. and Randers, J. *Reinventing Prosperity: Managing economic growth to reduce unemployment, inequality and climate change*, Greystone Books, 2016.

¹⁰² Regional and global cooperation on decarbonization is in line with the EU's commitment to sustainable development, under the EU Sustainable Development Strategy (EU SDS). Sustainable development means that the needs of the present generation should be met without compromising the ability of future generations to meet their own needs. It is an overarching objective of the European Union set out in the Treaty, governing all the Union's policies and activities. It is about safeguarding the earth's capacity to support life in all its diversity and is based on the principles of democracy, gender equality, solidarity, the rule of law and respect for fundamental rights, including freedom and equal

prosperity through the ‘[promotion] of a prosperous, innovative, knowledge-rich, competitive and eco-efficient economy which provides high living standards and full and high-quality employment throughout the European Union.’¹⁰³ Collaboration on the establishment of a fossil-free economy will pave the way for improved trade and diplomatic relations between nations, which can, in turn:

- 1) Lead to tariff reduction for renewable energy-related goods and services in international trade agreements.¹⁰⁴ Lower tariffs will lead to lower prices for consumers and hence, increased competition. Renewable energy markets will thus soar and make way for new opportunities, increased investment and economic welfare;¹⁰⁵
- 2) Lead to the expansion of the Energy Charter’s membership to countries in the Middle East and North Africa (MENA) region and the Economic Community of West African States, attracting investment in the African continent.¹⁰⁶ Collaboration on the decarbonization of the economy, particularly with states in the MENA region and

opportunities for all. It aims at the continuous improvement of the quality of life and well-being on Earth for present and future generations. To that end it promotes a dynamic economy with full employment and a high level of education, health protection, social and territorial cohesion and environmental protection in a peaceful and secure world, respecting cultural diversity. See Council of the European Union, ‘Review of the EU Sustainable Development Strategy (EU SDS) – Renewed Strategy’, 9 June 2006 <<http://www.etuc.org/IMG/pdf/st10117.en06.pdf>>.

¹⁰³ See Council of the European Union, Review of the EU Sustainable Development Strategy (EU SDS) – Renewed Strategy, 9 June 2006, at p. 4 <<http://www.etuc.org/IMG/pdf/st10117.en06.pdf>>.

¹⁰⁴ Such an argument is in line with the 1961 book *The Theory of Economic Integration*, by Bela Balassa, who argued that a free-trade agreement is a first step towards economic integration, that harmonizing external tariffs is a step further, and yet a step even further is setting common internal regulations.

¹⁰⁵ For example, reduced costs of photovoltaics in recent years have contributed greatly to solar power becoming increasingly competitive. In particular, 2015 was a record year for renewable energy, with China, the USA, Africa, Latin America and India driving forward the global energy transition. A photovoltaics boom is also forecast for the USA. Even though China, Japan and the USA apparently dominated the photovoltaics markets in 2015, Europe was also able to reach an important expansion milestone. The total photovoltaics output in Europe reached the 100 GW mark in 2015. See ‘Solar market set to soar globally throughout 2016’ (Renewable Energy Focus, 10 May 2016) <<http://www.renewableenergyfocus.com/view/44164/solar-market-set-to-soar-globally-throughout-2016/>>.

¹⁰⁶ Efforts are already underway to encourage the accession to the Energy Charter Treaty of regional organizations such as the Economic Community of West African states, which currently holds observer status. In addition, East African Community (EAC) states such as Burundi, Tanzania and Uganda have also signed the International Energy Charter 2015, but have not yet acceded to the Energy Charter Treaty. States such as, *inter alia*, Burundi, Tanzania, Uganda, Kenya and South Sudan are facing a number of drawbacks within their energy sector, such as limited access to electricity, high costs of electricity generation, and, among others, overdependence on biomass. In relation to the MENA region, even though most MENA states already have observer status with the Energy Charter Treaty, accession has not yet taken place. Despite the potential for investment in renewable energy, many international developers, investors and companies in the supply chain are not clear as to how to enter the market. Accessing to the Energy Charter Treaty could help resolve some of these regional issues, by attracting investment, opening up energy markets, and encouraging international cooperation. However, full accession to the ECT requires that states are able to abide by universal market-based principles, which may require them to undertake further steps before proceeding. The economies of acceding states are assessed against such principles before accession can take place. See ‘Energy in the East African Community: The Role of the Energy Charter Treaty’, Energy Charter Secretariat Knowledge Centre 2016, Victoria Ritah Nalule, <http://www.energycharter.org/fileadmin/DocumentsMedia/Occasional/Energy_in_the_East_African_Community.pdf>; ‘The Future of Renewable Energy in the MENA region’, Clean Energy Pipeline <<http://www.cleanenergypipeline.com/Resources/CE/ResearchReports/The%20Future%20for%20Renewable%20Energy%20in%20the%20MENA%20Region.pdf>>

Africa at large, could lead to stabilization of the energy sectors in these regions¹⁰⁷ and, in turn, facilitate the expansion of the Energy Charter membership to them. A number of the energy-related challenges that are faced by states in sub-Saharan Africa and the MENA region could be resolved through effective collaboration on the exchange of renewable energy resources, technology and expert knowledge, ultimately enabling the expansion of the Energy Charter's membership. This expansion could create reciprocity through technology transfer, while enhancing EU energy security by creating an infrastructure that will ultimately boost international, long-distance trade in renewable energy. In addition, it will create a large global renewable energy market, where the EU can compete on a level playing field, and new producers of energy from the MENA region and sub-Saharan Africa can contribute to the energy security of the EU and the wider global community; and

- 3) Generate employment. Unemployment, and particularly youth unemployment, has been an issue of concern in the EU. Recent data indicate that 20.448 million men and women in the EU (of whom 15.908 million were in the euro area) were unemployed in October 2016. In addition, in October 2016, 4.169 million young persons (under 25) were unemployed in the EU, of whom 2.939 million were in the euro area.¹⁰⁸ Regional and global cooperation on the decarbonization of the economy could generate new opportunities for investment and expand the global renewable-energy market.¹⁰⁹ Innovation, technological advancement and research in the field of renewable energy can lead to the creation of new posts and generate employment.

(e) How can the trading system help mitigate climate change and enhance sustainable energy?

This section explores how trade can help achieve sustainable energy and mitigate climate change. We are currently experiencing a grand energy transition, where trade is critical if the international community wishes to move forward cleanly. Sustainable energy is vital for global economic and human development.¹¹⁰ In the past, efforts to achieve the different dimensions of development—economic, social, and environmental—have tended to work in silos.

Today, however, the international community is increasingly recognizing the need to take an integrated approach in addressing global development issues. Trade—an area that every country participates in and, to different degrees, benefits from—cuts across almost every aspect of development in its role of reducing poverty, creating jobs,¹¹¹ and promoting cross-border cooperation. We argue that trade can play a powerful role in achieving two

¹⁰⁷ Through the exchange of technology, technical knowledge and skills, energy-related challenges faced by many states in parts of Africa and the MENA region can be met more easily, allowing for the introduction of relevant compliance mechanisms that will enable them to abide by universal market-based principles, and thus lead to speedier accession to the Energy Charter Treaty.

¹⁰⁸ See Eurostat, 'Unemployment Statistics' http://ec.europa.eu/eurostat/statistics-explained/index.php/Unemployment_statistics#Youth_unemployment_trends

¹⁰⁹ Indeed, various kinds of innovative actions between the private and public sectors are emerging to mitigate climate change. This is the commitment of Mission 2020. See <http://www.mission2020.global/>.

¹¹⁰ Bertelsmann Foundation has analyzed how major economies are supported by trade. See <http://www.bfna.org/publication/bvisual-trade-beyond-the-tweet>.

¹¹¹ Interestingly, in the Western world, only 20% of job losses is the result of trade agreement. The remaining 80% comes from technology and innovation. See Wiseman, P. "Why robots, not trade, are behind so many factory job losses," The Boston Globe, 2 November 2016, available at <https://www.bostonglobe.com/business/2016/11/02/why-robots-not-trade-are-behind-many-factory-job-losses/bfg4Wo9hpr4A5Yc5c81GtM/story.html>.

of humanity's most urgent needs today (namely, sustainable energy and climate change mitigation) and that trade is being overlooked as a platform to address important global agendas.

Trade has caused harm to the environment because the goods that were traded were not clean goods. If we provide a system that creates incentives to trade in clean goods, we will be fighting climate change. We will be stimulating the economy by creating new jobs, innovative companies and goods that help towards a sustainable future. If all of this is positive, why are countries and people not reacting to it? Are the trade rules preventing the energy transition? What needs to be changed to make the energy transition happen faster? There is an opportunity to make a better, cleaner and richer world for all of us.

Our premise is that everyone wants a world that is clean, safe, prosperous, with no poverty. What people may not know is that the answer to many of these issues is a trading system that facilitates the movement of goods and services in a way that will help achieve a cleaner, sustainable and richer world. This is possible via the reduction or elimination of tariff and non-tariff barriers to environmental goods and services. For instance, there are countries that charge tariffs as high as 35 per cent on environmental goods.¹¹² If you eliminate or reduce technical barriers to trade in green goods and services,¹¹³ you are not only helping in the mitigation of climate change, but also providing greater access to sustainable energy and making the economy grow thanks to more trade and jobs.¹¹⁴ Doing so will be beneficial to trade, the environment and sustainable development. Equally, by making use of mega-regional trade agreements with binding provisions on environmental protection, there will be economic growth and mitigation of climate change.

This section links trade with climate change and energy security in the context of the green economy. Climate change is one of the biggest challenges humanity faces today. As a result of trade, there is increased social inequality as well as more carbon and other GHG emissions in the atmosphere. The international community should conduct more coherent regulation and policy-making where the potential for trade to positively contribute to the climate action effort is realized, making sure that that climate measures do not distort trade and instead promote an open economic system that contributes to an equitable and inclusive sustainable development. Our idea is to make an impact to this big agenda of climate change by using trade law to help decarbonize the economy. Trade law has been a very powerful instrument for change. Below are three examples:

1. poverty reduction: thanks to trade agreements, around 1 billion people have come out of poverty in the last 20 years;¹¹⁵
2. access to medicines: thanks to trade agreements, more people have access to medicines;¹¹⁶ and

¹¹² <https://ustr.gov/trade-agreements/other-initiatives/environmental-goods-agreement>.

¹¹³ For a list of 54 environmental goods where leaders of the Asia-Pacific Economic Cooperation (APEC) have committed to reduce or eliminate tariffs, see http://www.apec.org/Meeting-Papers/Leaders-Declarations/2012/2012_aelm/2012_aelm_annexC.aspx.

¹¹⁴ http://www.unep.org/PDF/UNEPGreenjobs_report08.pdf.

¹¹⁵ See "Towards the end of poverty," *The Economist*, 1 June 2013.

¹¹⁶ World Health Organization, "Access to AIDS medicines stumbles on trade rules," available at <http://www.who.int/bulletin/volumes/84/5/news10506/en/>.

3. the protection of human rights: 75% of countries use trade agreements to protect human rights.¹¹⁷

So if the trading system has been instrumental for the above issues, why not use trade law as a novel tool to mitigate climate change? This could be achieved through greater cooperation between major emitters of GHGs and more trade liberalization on environmental goods and services. Citizens could have a much greater role in renewable energy services. We assert that the trading system can be a powerful tool to fight climate change, give access to sustainable energy and make people and countries richer. Today, 80% of the global energy supply comes from fossil fuels.¹¹⁸ Fossil fuels contribute to climate change and are believed to be finite,¹¹⁹ which leads to energy insecurity.¹²⁰ Renewable energy can help here in that it is cleaner than fossil fuels. It also helps towards energy independence and therefore enhances energy security.¹²¹ Unlike what people think, trade law and policy could be used as a vehicle to achieve this goal.¹²²

We stand to achieve considerable gains when trade law becomes a tool for change. Our hypothesis is that trade law can be a tool to help mitigate climate change and enhance energy security.¹²³ And it is well known that, thanks to trade, countries grow economically. Hence, the triple benefit of trade (see Figure 3).

¹¹⁷ Aaronson, S.A. “Human Rights,” available at <http://siteresources.worldbank.org/INTRANETTRADE/Resources/C21.pdf>.

¹¹⁸ World Energy Council, “World Energy Council report confirms global abundance of energy resources and exposes myth of peak oil,” available at <https://www.worldenergy.org/news-and-media/press-releases/world-energy-council-report-confirms-global-abundance-of-energy-resources-and-exposes-myth-of-peak-oil/>.

¹¹⁹ However, see the views of Charles Mann, who says that “new technology and a little-known energy source suggest that fossil fuels may not be finite. This would be a miracle—and a nightmare.” Mann, C. “What if we never run out of oil?” *The Atlantic*, May 2013, available at <http://www.theatlantic.com/magazine/archive/2013/05/what-if-we-never-run-out-of-oil/309294/>.

¹²⁰ Julian Simon questions this statement by arguing that the quantities of natural resources are not limited in the way we think they are. New reserves of natural resources are constantly discovered; others are yet to discover; and others are not yet economically viable. See Simon, J. “When will we run out of oil? Never!” available at http://www.juliansimon.com/writings/Ultimate_Resource/TCHAR11.txt. Moreover, regarding copper, in 1972 the Club of Rome said that known copper reserves would run out in 36 years. According to that prediction, we should have no copper by now. In addition, in 1970 the prediction was that there would be reserves of about 280 million metric tons of copper. Since then, the consumption of copper has been almost 480 million metric tons and world copper reserves are now estimated to be 700 million metric tons, more than double the original estimate in 1970. See US Geological Survey, *Mineral Commodity Summaries 2015*, Washington, DC: US Geological Survey, 2015, p. 191, available at <https://minerals.usgs.gov/minerals/pubs/mcs/2015/mcs2015.pdf>

¹²¹ On the governance of renewable energy, see Leal-Arcas, R. and Minas, S. “Mapping the international and European governance of renewable energy,” *Oxford Yearbook of European Law*, Vol. 35 (1), (2016), pp. 621-666, doi:10.1093/yel/yew022.

¹²² Some proponents have going even further to suggest that ‘trade must be an engine of growth for all.’ See WTO, IMF and World Bank leaders: “Trade must be an engine of growth for all.” 7 October 2016, available at https://www.wto.org/english/news_e/news16_e/dgra_07oct16_e.htm.

¹²³ Leal-Arcas, R. “How governing international trade in energy can enhance EU energy security,” *Renewable Energy Law and Policy Review*, Vol. 6(3), pp. 202-219, 2015.

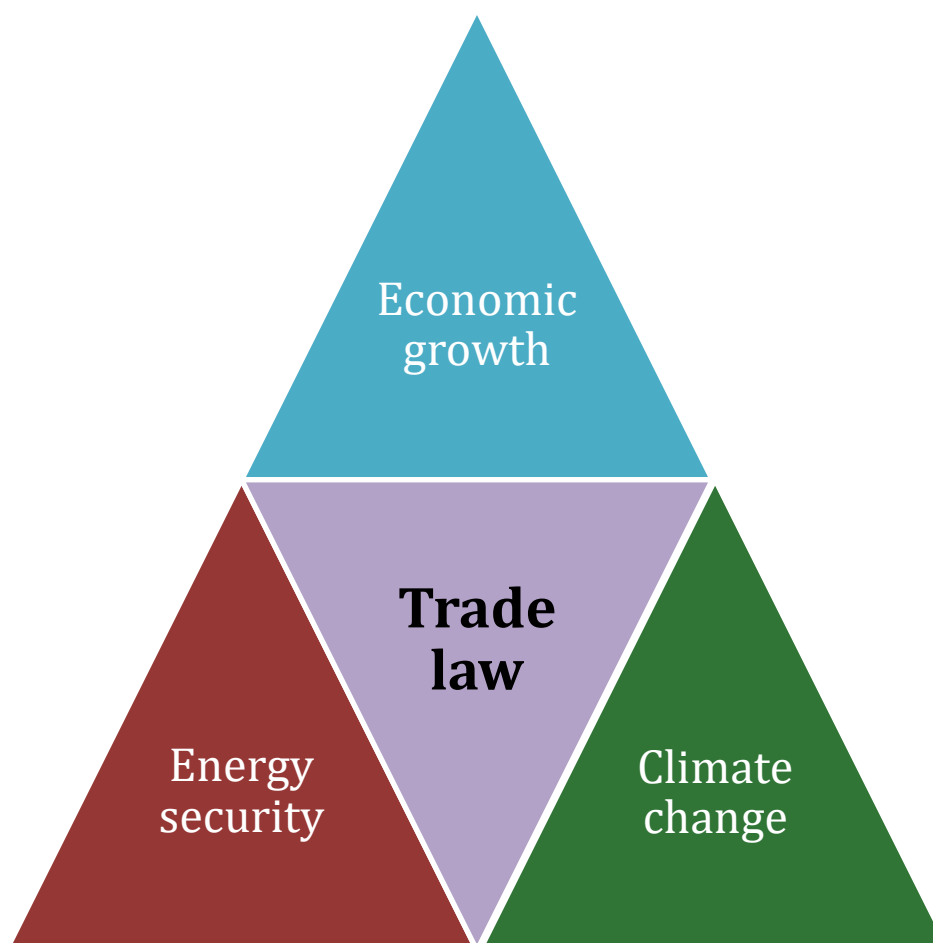


Figure 3: The triple benefit of trade

What is needed is to fill the theoretical and empirical gap for how trade law can help mitigate climate change. This gap is potentially catalytic because it paves the way to use trade to solve other sustainability challenges. As a result of this knowledge gap, we have missed crucial opportunities for cooperation between trade and climate change. It is here where greater cooperation between the secretariats of the United Nations Framework Convention on Climate Change (UNFCCC) and that of the World Trade Organization (WTO) is desired. Let me give you an example.

As Figure 4 depicts, in the 1990s, two major agreements were concluded: one on climate change—the UNFCCC—and one on international trade—the WTO Agreement. The WTO Agreement only briefly mentions in its preamble the importance of ‘sustainable development’ in the context of international trade. Although sustainable development appears in the preamble of the WTO Agreement, why is the multilateral trading system being more effective towards climate change mitigation or sustainable energy? We maintain the WTO Agreement was a missed opportunity for trade law to play a bigger role in mitigating climate change.

From 2008, so-called ‘21st century trade agreements’¹²⁴ with chapters on sustainable development started to emerge, albeit these chapters are rather weak. In 2015, a new global climate agreement came into existence—the Paris Agreement on Climate Change—which

¹²⁴ This locution refers to trade agreements that touch upon environmental and social issues.

does not even mention the term ‘trade.’¹²⁵ These are examples of missed opportunities to cooperate between the trade and climate regimes. However, in the COP 22 in Marrakesh,¹²⁶ some progress was made towards how the trading system can help achieve the SDGs. The WTO, the UN Conference on Trade and Development (UNCTAD) and the International Trade Center (ITC), in collaboration with the secretariats of the UNFCCC and the International Fund for Agricultural Development, came up with the tool box of trade measures that can help mitigate GHG emissions.¹²⁷ These are:

1. Reducing costs and deploying key climate technologies quickly to where they will have the biggest impact;
2. Stimulating investment in energy, infrastructure, transport, information technology and other key sectors of the new climate economy; and
3. Fostering the competitive markets that encourage individuals, enterprises, and entire industries to learn from past experience, innovate, and do better in the future.

Our vision is that we can use trade law as a vehicle not only for climate action and sustainable energy,¹²⁸ but for many of the SDGs. Currently, the governance of trade and renewable energy is fragmented, with many institutions and legal instruments. There is insufficient research on how the trade and renewable energy regimes can cooperate.

Figure 4: From insufficient cooperation to effective synergies



¹²⁵ http://unfccc.int/paris_agreement/items/9485.php.

¹²⁶ The Conference of the Parties (COP), described in Article 7 of the UNFCCC, is the supreme decision-making body of the UN Framework Convention on Climate Change. It comprises the 197 Parties (all the 196 states and the EU) that have ratified the Convention. It held its first session (COP-1) in Berlin in 1995 and meets on a yearly basis unless the Parties decide otherwise. The COP's role is to promote and review the implementation of the Convention. It periodically reviews existing commitments in light of the Convention's objective, new scientific findings, and the effectiveness of national climate change programs. The COP can adopt new commitments through amendments and protocols. In December 1997, at its third session (COP-3), it adopted the Kyoto Protocol, containing stronger emissions-related commitments for developed countries in the post-2000 period. In the 2015 COP-21, the Paris Agreement on Climate Change was adopted.

¹²⁷ <http://unctad.org/en/pages/newsdetails.aspx?OriginalVersionID=1379>.

¹²⁸ See for instance Leal-Arcas, R., Caruso, V. and Leupuscek, R. "Renewables, preferential trade agreements and EU energy security," *Laws*, Vol. 4, Issue 3, pp. 472-514.

We argue that greater cooperation will lead to climate change mitigation and energy security. For instance, India plans to reduce its GHG emissions relative to its GDP by 33 to 35% by 2030 from the 2005 level.¹²⁹ It intends to do so through policies on the promotion of clean energy, enhancement of energy efficiency, development of less carbon-intensive and more resilient urban centers, as well as the promotion of a sustainable green transportation network.¹³⁰ India also pledged to achieve around 40% of its electric power from non-fossil fuel based energy resources by 2030 with the help of technology transfer and low-cost international finance from the Green Climate Fund.¹³¹ All of this is largely possible if there is greater cooperation between the trade and climate change regimes. In this sense, identifying the gaps and opportunities for cooperation between these two regimes is crucial to have the basis for a new normative framework on how the trading system can help mitigate climate change and enhance energy security.

How can the trading system help? How should the trading system deal with climate change mitigation? There are very few trade agreements with sustainable development chapters. Moreover, there is a lack of scholarship that can inform practice. We contend that trade agreements can be a vehicle to address common concerns.

(i) *Major emitters and mega-regional trade agreements*

This section brings forward the novel idea of using mega-regional trade agreements (RTAs) to mitigate climate change and enhance sustainable energy. We argue that only a few major GHG emitters and just three mega-RTAs can make a great contribution towards climate change mitigation and the enhancement of sustainable energy (see Table 4 below). The evidence for this claim is that RTAs have often served as laboratories for covering new disciplines that do not exist in the WTO context.¹³² Moreover, RTAs today cover many topics well beyond trade: competition, investment, environmental protection, natural resources, intellectual property rights, labor rights, *et cetera*.¹³³ This section makes the claim that since most of the Contracting Parties to these three mega-regionals are also the main GHG emitters, and since RTAs have provisions that bind countries to mitigate climate change, then RTAs may potentially become a very effective and promising solution to climate change mitigation.¹³⁴ A way to approach this idea is by looking at the landscape of the trade and climate change governance to see who the main emitters of GHGs are and who the Contracting Parties to the three mega-RTAs *par excellence* are.

¹²⁹ <http://pib.nic.in/newsite/PrintRelease.aspx?relid=128403>.

¹³⁰ *Ibid.*

¹³¹

<http://www4.unfccc.int/submissions/INDC/Published%20Documents/India/1/INDIA%20INDC%20TO%20UNFCCC.pdf>, at p. 29.

¹³² For an analysis of the link between RTAs and the WTO, see Leal-Arcas, R. "Proliferation of Regional Trade Agreements: Complementing or Supplanting Multilateralism?" *Chicago Journal of International Law*, Vol. 11, No. 2, pp. 597-629, 2011.

¹³³ Leal-Arcas, R. "Climate Change Mitigation from the Bottom Up: Using Preferential Trade Agreements to Promote Climate Change Mitigation," *Carbon and Climate Law Rev*, Vol. 7(1), pp. 34-42, 2013.

¹³⁴ The same argument applies to sustainable energy. See for instance R. Leal-Arcas, Valentina Caruso and Raphaela Leupuscek, "Renewables, preferential trade agreements and EU energy security," *Laws*, Vol. 4, Issue 3, pp. 472-514, 2015.

The three concluded or ongoing negotiations for mega-regional trade agreements *par excellence* based on their percentage of global GDP are:

1. The Regional Comprehensive Economic Partnership (RCEP), which is a free-trade agreement (FTA) negotiation that has been developed among 16 countries in Asia and Oceania: the 10 members of ASEAN (Brunei, Cambodia, Indonesia, Laos, Malaysia, Myanmar, The Philippines, Singapore, Thailand, and Vietnam) and the six countries with which ASEAN has existing FTAs – Australia, China, India, Japan, South Korea, and New Zealand. In relation to RCEP, these six non-ASEAN countries are known as the ASEAN Free Trade Partners. RCEP countries have a population of more than three billion and a total GDP of around \$US23 trillion, which is about 30% of global GDP;¹³⁵
2. The Trans-Pacific Partnership (TPP), which is an almost 6,000-page long free trade agreement concluded amongst 12 Asia-Pacific nations, namely the United States, Japan, Mexico, Canada, Australia, Malaysia, Chile, Singapore, Peru, Vietnam, New Zealand and Brunei. It was concluded on 5 October 2015, after several years of secretive negotiations. In fact, the TPP negotiations were conducted with a level of secrecy not witnessed in any previous trade agreement.¹³⁶ Even US Congress was critical about the opaqueness surrounding it.¹³⁷ Only 600 ‘cleared advisors’ representing corporations and trade blocs are privy to the negotiating process at the expense of the general public and civil society;¹³⁸ The TPP represents 11% of world population,¹³⁹ 26% of world trade,¹⁴⁰ and nearly 40% of global GDP.¹⁴¹ In January 2017, President Trump of the US signed an executive order for the US to withdraw from the TPP.¹⁴² For the purposes of our argument, the US withdrawal makes only a minor difference since the TPP will go ahead without the US. Moreover, the US has never been a party to the TPP. The treaty never entered into force;¹⁴³ and
3. The Trans-Atlantic Trade and Investment Partnership (TTIP), which is a proposed RTA between the United States and the European Union and its Member States. The TTIP was first conceived in November 2011, following a US–EU Summit and the sixth meeting of the Transatlantic Economic Council.¹⁴⁴ Leaders requested that the US–EU High Level Working Group on Jobs and Growth identify ‘policies and

¹³⁵ <https://www.mfat.govt.nz/en/trade/free-trade-agreements/agreements-under-negotiation/rcep/>.

¹³⁶ WikiLeaks, “Secret Trans-Pacific Partnership Agreement (TPP) - IP Chapter,” available at <https://wikileaks.org/tpp/pressrelease.html>.

¹³⁷ Public Citizen, ‘Congressional Democrats Escalate Criticism of Substance, Process of Obama’s First Trade Pact – the Trans-Pacific Partnership,’ (27 June 2012), available at <http://www.citizen.org/documents/release-congressional-democrats-escalate-criticism-6-27-12.pdf>.

¹³⁸ William Mauldin, “U.S Says Not ‘Rushing’ Asia-Pacific Trade Deal,” *The Wall Street Journal*, 26 September 2013, available at <http://online.wsj.com/news/articles/SB10001424052702303796404579099632713091994>.

¹³⁹ <http://dfat.gov.au/trade/agreements/tpp/Pages/trans-pacific-partnership-agreement-tpp.aspx>.

¹⁴⁰ Ibid.

¹⁴¹ This figure is prior to the US withdrawal from the TPP. See <https://ustr.gov/tpp/overview-of-the-TPP>.

¹⁴² BBC, “Trump executive order pulls out of TPP trade deal,” 24 January 2017, available at <http://www.bbc.co.uk/news/world-us-canada-38721056>.

¹⁴³ The US President’s authority to withdraw from an international agreement on his own authority is summarized in section 339 of the Restatement (Third) Foreign Relations Law of the United States. The question has been litigated in the context of withdrawal from a treaty, in particular the case of *Goldwater v. Carter*, which concerned termination of the US-Taiwan Mutual Defense Treaty.

¹⁴⁴ ‘Fact Sheet: United States to Negotiate Transatlantic Trade and Investment Partnership with the European Union’ (Office of the United States Trade Representative, 13 February 2013) <www.ustr.gov/about-us/press-office/fact-sheets/2013/february/US-EU-TTIP>.

measures to increase US–EU trade and investment to support mutually beneficial job creation, economic growth, and international competitiveness.¹⁴⁵ The High Level Working Group concluded that the development of a comprehensive bilateral trade and investment agreement would provide the most benefits for the parties.¹⁴⁶ The TTIP represents nearly 50% of global GDP.¹⁴⁷

If we leave aside the overlapping membership in these three mega-RTAs (Malaysia, Vietnam, Brunei, Japan, Singapore, Australia and New Zealand are parties to both RCEP and TPP), the total aggregate of global GDP that the three mega-RTAs represent is probably around 80-85%.¹⁴⁸ This means that most of the global GDP is represented by these three mega-regionals. Equally, the 10 major emitters of GHGs are responsible for about 70% of global GHG emissions out of 196 countries (see Table 4).¹⁴⁹

Table 4: List of major GHG emitters and Contracting Parties to the three mega-regionals

Top 10 GHG emitters ¹⁵⁰ (≈70% of global GHG emissions)	RCEP (ASEAN + 6) (≈30% of global GDP)	TPP (≈40% of global GDP)	TTIP (≈50% of global GDP)
China	✓		
USA			✓
EU of 28 countries			✓ ¹⁵¹
India	✓		
Russia			
Indonesia	✓		
Brazil			
Japan	✓	✓	
Canada		✓	
Mexico		✓	
	<i>RCEP parties that are not top 10 GHG emitters: Australia, New Zealand, South Korea, Singapore, Thailand, Brunei, Malaysia, Vietnam, Myanmar, Laos, Philippines, Cambodia</i>	<i>TPP parties that are not top 10 GHG emitters: Australia, New Zealand, Peru, Chile, Malaysia, Singapore, Brunei, Vietnam</i>	

If one analyzes the table above by considering the EU as a single economic entity and discounts the EU Member States that are among the 10 major economies in the world (i.e., Germany, the UK, France and Italy), it is interesting to note that Indonesia and Mexico are the only two emitters in the top 10 that are not among the 10 major economies.¹⁵²

¹⁴⁵ ‘Final Report: High Level Working Group on Jobs and Growth’ 1, (United States-European Union High Level Working Group on Jobs and Growth, 11 February 2013) www.ustr.gov/sites/default/files/02132013%20FINAL%20HLWG%20REPORT.pdf (citations omitted) (hereinafter Final Report: High Level Working Group on Jobs and Growth)

¹⁴⁶ *ibid.*

¹⁴⁷ <https://www.eaccny.com/international-business-resources/what-you-need-to-know-about-ttip/>.

¹⁴⁸ Author’s estimate. This figure is prior to the US withdrawal from the TPP.

¹⁴⁹ http://www.wri.org/sites/default/files/uploads/top_10_emitters.png.

¹⁵⁰ The list takes into account emissions deriving from land use change and forestry.

¹⁵¹ The EU Members States will most likely be part of TTIP.

¹⁵² According to the International Monetary Fund, these are the 10 major economies, excluding any EU Members State and including the EU as a single entity: US, the EU, China, Japan, India, Brazil, Canada, South Korea, Russia, and Australia. See <http://bit.ly/2dQKeno>.

Indonesia is the one country in the top 10 emitters which is not among the top world economies. This means that its levels of GHG emissions are disproportionately high.

In addition to those three mega-RTAs, there are three concluded or ongoing trade initiatives that are worth mentioning regarding the role of international trade in climate change mitigation and sustainable energy. The first, also a mega-RTA, is the Comprehensive Economic and Trade Agreement between Canada and the EU and its Member States (CETA).¹⁵³ Since both Canada and the EU are parties to some of the three mega-RTAs mentioned above (Canada is a party to the TPP and the EU to the TTIP), we have omitted CETA from the table above to avoid repetition of the participation of the top GHG emitters in mega-RTAs.¹⁵⁴ The second trade agreement is the Environmental Goods Agreement, currently under negotiation. The third agreement is the Information Technology Agreement, which is relevant for trade in clean energy technologies.

1. The Comprehensive Economic and Trade Agreement (CETA) was signed in October 2016. CETA has two chapters relevant to our premise: Chapter 22 (on trade and sustainable development) and Chapter 24 (on trade and environment).¹⁵⁵ Both Canada and the EU are in the top 10 GHG emitters and are among the major economies of the world, therefore key actors for our premise. CETA's Chapter 22 recognizes that economic growth, social development and environmental protection are interconnected. The parties to CETA agree that economic growth supports their social and environmental goals. Chapter 24 commits the parties to putting into practice international environmental agreements. More specifically, it:
 - a. Protects the right of the parties to regulate on environmental matters;
 - b. Requires the parties to enforce its domestic environmental laws; and
 - c. Prevents the parties from relaxing their laws to boost trade.¹⁵⁶
2. The Environmental Goods Agreement (EGA) is a plurilateral¹⁵⁷ trade agreement currently under negotiation between the following 18 WTO Members: Australia, Canada, China, Costa Rica, the European Union,¹⁵⁸ Hong Kong, Iceland, Israel, Japan, South Korea, New Zealand, Norway, Singapore, Switzerland, Liechtenstein, Chinese Taipei (Taiwan), Turkey, and the United States. Five of the 10 major GHG emitters listed in the table above are participating in the EGA. This agreement aims to encourage green growth and sustainable development by liberalizing trade in environmental goods by reducing or eliminating tariffs in green goods,¹⁵⁹ such as

¹⁵³ <http://data.consilium.europa.eu/doc/document/ST-10973-2016-INIT/en/pdf>.

¹⁵⁴ Within the three chosen mega-RTAs, there is repetition in membership. For instance, there are seven TPP signatories that are included in the RCEP negotiations: Australia, New Zealand, Japan, Brunei, Malaysia, Singapore, and Vietnam. Moreover, the US is a Party to both the TPP and TTIP.

¹⁵⁵ Article 24.9 of CETA specifically refers to 'Trade favouring environmental protection.'

¹⁵⁶ <http://ec.europa.eu/trade/policy/in-focus/ceta/ceta-chapter-by-chapter/>.

¹⁵⁷ A plurilateral approach to trade agreements means that the agreements are optional and not binding on those WTO Members who do not engage in them. In the WTO context, multilateral negotiations, as opposed to plurilateral negotiations, imply the participation of all WTO members. The nature of the consequent multilateral agreements from these multilateral negotiations implies that commitments are taken by all the WTO Members. The idea behind plurilateral negotiations is to make the WTO deliver again on progressive liberalization.

¹⁵⁸ All the EU Member States are represented by the EU in the negotiations, which means that there is a total of 46 WTO Member States represented in the EGA.

¹⁵⁹ 'Joint statement regarding the launch of the Environmental Goods Agreement negotiations', available at http://eeas.europa.eu/delegations/wto/documents/press_corner/final_joint_statement_green_goods_8_july_2014.pdf.

the promotion of renewable and clean energy technology.¹⁶⁰ Arguably, a broad liberalization of services could also be beneficial for sustainable development; so an expansion of the EGA to services trade would also be beneficial.¹⁶¹ Moreover, a great added-value of the EGA is that the ‘benefits of this new agreement will be extended to the entire WTO membership, meaning all WTO members will enjoy improved conditions in the markets of the participants to the EGA.’¹⁶² Doing so will multilateralize this plurilateral agreement. This agreement is an example of the relevant intersection between international economic law and the SDGs. Such plurilateral agreement could have the potential of MFN application and therefore serve as a platform for climate change mitigation worldwide.¹⁶³ In sum, once the EGA is in place, one could add traditional products (not just environmental goods), more WTO Members, and non-technical barriers to trade in environmental services.

3. The Information Technology Agreement (ITA), concluded by 29 Parties at the Singapore Ministerial Conference in December 1996. Today, there are 82 Parties to the ITA, which represents 97% of international trade in IT products. In December 2015, over 50 Parties to the Agreement concluded an expansion of the ITA, which covers an additional 201 products.¹⁶⁴

(ii) *Regionalism over multilateralism in trade and climate change*

Multilateralism is personified in international trade agreements. International trade and the rapidly proliferating network of trade agreements have aroused passions for decades. While some blame trade agreements for exporting jobs, sowing poverty, furthering illegal migration, and stealing national sovereignty, others praise them as lynchpins of growth, pillars of peace, guarantors of security, and engines of globalization. Still others view them as useful instruments for fostering global trade and investment. Arguably, multilateralism is in crisis, whether in the field of trade, investment,¹⁶⁵ energy governance¹⁶⁶ or climate change mitigation.¹⁶⁷ In the case of trade negotiations, the Doha Round¹⁶⁸ of trade

¹⁶⁰ On the link between renewables and the trading system, see Leal-Arcas, R. and Filis, A. ‘Legal Aspects of the Promotion of Renewable Energy Within the EU and in Relation to the EU’s Obligations in the WTO’, (2014) 5(1) *Renewable Energy Law and Policy Review* 3–25; Leal-Arcas, R. and Filis, A. ‘Certain Legal Aspects of the Multilateral Trade System and the Promotion of Renewable Energy’, in Lim, C.L. and Mercurio, B. (eds.) *International Economic Law after the Global Crisis: A Tale of Fragmented Disciplines*, Cambridge University Press, pp. 482-518, 2015.

¹⁶¹ For instance, clean water filtration services and the movement of people via the General Agreement on Trade in Services’ mode 4.

¹⁶² https://www.wto.org/english/tratop_e/envir_e/ega_e.htm.

¹⁶³ Baschuk, B. “Environmental Goods Negotiators Make Incremental Progress,” *International Trade Daily*, 26 September 2016.

¹⁶⁴ World Trade Organization, ‘Information Technology Agreement,’ available at https://www.wto.org/english/tratop_e/inftec_e/inftec_e.htm.

¹⁶⁵ See for instance Leal-Arcas, R., *International Trade and Investment Law: Multilateral, Regional and Bilateral Governance*, Edward Elgar, 2010.

¹⁶⁶ See for instance Leal-Arcas, R., Filis, A. and Abu Gosh, E. *International Energy Governance: Selected Legal Issues*, Edward Elgar, 2014.

¹⁶⁷ See for instance Leal-Arcas, R., *Climate Change and International Trade*, Edward Elgar, 2013.

¹⁶⁸ If ultimately successful, the Doha Round, as of January 2017 with more than 164 countries at the negotiating table, would be the ninth Round since the World War II. The previous rounds were, in chronological order: Geneva Round (1948), with 23 countries; Annecy Round (1949), with 13 countries; Torquay Round (1951), with 38 countries; Fourth Round (1956), with 26 countries; Dillon Round (1962), with 26 countries; Kennedy Round (1967), with 62 countries; Tokyo Round (1979), with 102 countries;

negotiations at the WTO has clearly reached an impasse. We argue the reason for this crisis is that citizens were absent from the process of decision-making. So in addition to the top-down process, we propose a bottom-up process, with greater citizen participation.

Another method of governance is regionalism, which is a method of economic integration. While multilateralism has its advantages, regionalism is an alternative to multilateral governance that has not been fully explored and appropriately tapped so far when it comes to climate change mitigation and the enhancement of sustainable energy. Regionalism is this form that perhaps best describes the supranationalism of the integration of European States into a Community and Union:¹⁶⁹ sovereign States binding themselves both legally and politically into a single entity in which national and supranational institutions share governance and answer to a court that protects not only the institutions of the system, but also the rights of the individual citizens.¹⁷⁰ Specifically to regional trade, there are at least four main trends identified in RTAs as a reaction to the impasse in multilateral trade:

- a) from most-favored nation¹⁷¹ (MFN) liberalization to RTAs;¹⁷²
- b) a geographical shift to the Asia-Pacific region;
- c) cross-regional RTAs, and
- d) mega-RTAs.¹⁷³

For our purposes, we will focus on how mega-RTAs can serve as a platform for climate change mitigation and sustainable energy enhancement. While the multilateral trade system has the potential to help mitigate climate change, amending the WTO rules requires consensus among the WTO members. This section aims at testing an alternative means to multilateral trade by which regional trade can facilitate climate change mitigation, namely through mega-regionals such as the TPP.

From a climate change point of view, we argue that it is easier and more manageable to negotiate amongst a small number of large players than it is amongst a large number of small players, which explains the creation of climate change clubs.¹⁷⁴ The same argument

and Uruguay Round (1994), with 123 countries. See Leal-Arcas, R. (2008a) *Theory and Practice of EC External Trade Law and Policy*, London: Cameron May, pp. 486–7.

¹⁶⁹ Börzel, T. “Europeanization: How the European Union Interacts with its Member States,” in Bulmer, S. and Lesquene, C. (eds.), *The Member States of the European Union*, Oxford: Oxford University Press, pp. 45-76, 2005; Sedelmeier, U. “Europeanisation in New Member and Candidate States,” *Living Reviews in European Governance* 1(3), 2006, available at <http://www.livingreviews.org/lreg-2006-3>.

¹⁷⁰ On supranationalism in the EU, see Leal-Arcas, R. “Theories of Supranationalism in the EU,” *Journal of Law in Society*, Vol. 8.1, 2007, pp. 88-113.

¹⁷¹ The most-favored-nation treatment (GATT Article I, GATS Article II, and TRIPs Article 4), is the principle of not discriminating between one’s trading partners.

¹⁷² According to GATT Article XXIV, it is possible to deviate from GATT Article I, and therefore give preferential treatment to parties to an RTA, provided it does not raise barriers to trade for third countries. GATT Article XXIV requires that duties be eliminated on “substantially all the trade” between the parties of a customs union or free-trade area, or at least with respect to substantially all the trade in products originating in such territories. Regarding the locution “substantially all the trade,” there is neither an agreed definition of the percentage of trade to be covered by a WTO-consistent agreement nor common criteria against which the exclusion of a particular sector from the agreement could be assessed. For more information, see submissions by Australia (TN/RL/W/173/Rev.1 and TN/RL/W/180), European Communities (TN/RL/W/179), China (TN/RL/W/185), and Japan (TN/RL/W/190).

¹⁷³ For an analysis of the main trends and characteristics of regional trade agreements, in force and under negotiation, see R. Fiorentino, L. Verdeja and C. Toqueboeuf, “The Changing Landscape of Regional Trade Agreements: 2006 Update” WTO Discussion Paper No. 12 (2007).

¹⁷⁴ Leal-Arcas, R. “Top-down versus Bottom-up Approaches for Climate Change Negotiations: An Analysis,” *The IUP Journal of Governance and Public Policy*, Vol. 6, No. 4, pp. 7-52, December 2011.

holds true for trade negotiations. The thesis of this section is that the multilateral trading system's single undertaking¹⁷⁵ is no longer feasible because the WTO has more Members than ever (and WTO membership is an ongoing process, with more Members to come in the near future) and covers increasingly more topics, which, in turn, are more complex than ever, namely trade and climate change or trade-related energy issues. This explains RTA proliferation as the *modus operandi* for trade liberalization. Trade liberalization means more trade, trade means economic growth, and economic growth means that every country is better off.

When merging the membership of mega-RTAs with the major GHG emitters in Table 4 above, we see that eight out of the 10 major GHG emitters are Contracting Parties to at least one of the three mega-regionals (namely, Japan is a party to the TPP and RCEP; the US to the TPP and TTIP). The only two major emitters which are not Parties to any of the three mega-regionals are Brazil and Russia. Two other major GHG emitters (Australia and South Korea), which are not in the top 10 major GHG emitters, are Contracting Parties to at least one or two of the three mega-regionals (namely RCEP and TPP).

Therefore, by having these three mega-RTAs with legally binding provisions on climate change mitigation/low-emissions economy, we could have eight of the 10 major GHG emitters effectively solve most of the climate change problem. Although climate change is a global problem of collective action, mega-RTAs could potentially be an effective way to tackle climate change.

Why do we argue that RTAs, and regionalism at large, are a more effective way to combat climate change than multilateralism via the Paris Agreement on Climate Change? Because the nationally determined contributions to the global response to climate change (Article 3 of the Paris Agreement on Climate Change) are not legally binding under the Paris Agreement,¹⁷⁶ whereas, at the regional level, the TPP—the only of the three mega-RTAs *par excellence* concluded to date—makes climate action legally binding in the form of a commitment to a low-emissions economy.¹⁷⁷ So one option would be for the trading system to help mitigate climate change via mega-regionals such as the TPP, and not necessarily via the multilateral (trading/climate change) system. Considering that the US (which is the only country that has not ratified the Kyoto Protocol)¹⁷⁸ is a party to the TPP, it is significant that the TPP recognizes climate change (albeit not expressly) as a global concern and that transition to a low-emissions economy requires collective action. The US counterproposal of 2014 removed the term 'climate change,' substituting it with the locution 'low-emissions economy' in the final version.¹⁷⁹ Moreover, it removed any reference to the UNFCCC.

¹⁷⁵ Single undertaking is a provision that requires countries to accept all the agreements reached during a round of multilateral trade negotiations as a single package, as opposed to on a case-by-case basis. It basically means that nothing is agreed until everything is agreed by everyone.

¹⁷⁶ Article 4.2 of the Paris Agreement on Climate Change reads:

'Each Party shall prepare, communicate and maintain successive nationally determined contributions that it intends to achieve.'

Such weak wording does not imply that the NDCs are legally binding on the Parties.

¹⁷⁷ Articles 20.15(1) and (2) of the TPP.

¹⁷⁸ On the position of the US regarding the Kyoto Protocol, see generally Leal-Arcas, R. *Climate Change and International Trade*, Edward Elgar, Chapter 5, 2013.

¹⁷⁹ See US counterproposal to the TPP Environment Chapter (14 February, 2014), available at <http://www.redge.org.pe/sites/default/files/20140218%20biodiversity%20climate%20change%20TPP.pdf>.

Furthermore, we question the assumption that only (or mainly) multilateralism will solve collective action problems such as climate change. In fact, we argue that the proliferation of mega-RTAs can lead to economic growth, climate change mitigation and the enhancement of sustainable energy. We have made the case above of how this can be achieved. Furthermore, regionalism has proven to be more effective than multilateralism at liberalizing trade (and arguably can do the same for climate change mitigation and sustainable energy enhancement) and therefore there is no imperative need for a universal treaty that aims to liberalize trade, mitigate climate change, and enhance sustainable energy.

Thus, variable geometry,¹⁸⁰ as opposed to a single undertaking approach, seems to me a plausible way to move forward the multilateral trade agenda, since the single undertaking approach seems too ambitious. The variable-geometry approach has the advantage of removing the current frustration at the WTO negotiating table—and sometimes violent protests organized by civil society—with its slow negotiating pace.

Finally, it seems that trade agreements are stricter on environmental protection (see for instance the TPP's chapter on environment in relation to a low-emissions economy) than climate change agreements, such as the Paris Agreement. This is so because the Paris Agreement is not legally binding on the reduction of GHG emissions, whereas the TPP is. We also conclude that even if the Trump administration in the US would like to withdraw from the Paris Agreement on Climate Change, it will take four years to do so, in accordance with Articles 28(1) and (2) of the Paris Agreement on Climate Change.

(iii) *Coherence between trade and climate change actions*

Two fora seem the most appropriate when it comes to aiming at coherence between trade and climate change policies. First, the establishment of the WTO incorporated the creation of its Committee on Trade and Environment (CTE).¹⁸¹ The goal of the CTE is to identify and understand the relationship between trade and the environment in order to promote “sustainable development.”¹⁸² The other forum for discussion of trade measures and their links with climate change is the UNFCCC's response measures forum.¹⁸³ To avoid the proliferation of climate measures impacting adversely on international production and trade, Article 3.5 of the UNFCCC states explicitly that: “Measures taken to combat climate change, including unilateral ones, should not constitute a means of arbitrary or unjustifiable discrimination or a disguised restriction on international trade.”

Moreover, some of the WTO agreements under Annex 1 contain provisions that recognize the right of WTO Members to regulate the protection of human, animal, and plant life or health, or the environment.¹⁸⁴ In addition, the Doha Round encompasses specific

¹⁸⁰ Variable geometry refers to a situation where some but not all WTO Members would conclude trade agreements. The benefit of this concept is that those WTO Members who wish to undertake deeper integration or trade liberalization may do so irrespective of the unwillingness of other WTO Members to go along.

¹⁸¹ See the Committee on Trade and Environment (CTE), available at http://www.wto.org/english/tratop_e/envir_e/wrk_committee_e.htm.

¹⁸² *Idem*.

¹⁸³ http://unfccc.int/cooperation_support/response_measures/items/4908.php.

¹⁸⁴ See the Agreement of the Application of Sanitary and Phytosanitary Measures, 15 April 1994; The Agreement on Technical Barriers to Trade, 15 April 1994; and General Agreement on Trade in Services,

negotiations concerning various aspects of trade and the environment which emphasize the increase in environmental values in the trade sphere.¹⁸⁵ Overall, the WTO seeks to ensure that environmental policies are not barriers to trade liberalization and that trade policies are not an obstruction to environmental protection. However, all these changes that have occurred during the WTO era have not substantially influenced the ongoing interaction between trade and climate change.

The concept of using the trading system to mitigate climate change and enhance energy security will transform our understanding of trade in the context of environmental protection. It will shift the current paradigm to conceiving trade as a tool for environmental protection.

Reducing CO₂ without reducing economic growth or energy security is therefore possible thanks to coherence between trade and climate change regulation and policy. For instance, as Johan Norberg points out, we could have more efficient production processes, construction that is less energy-consuming, and new sources of energy that are cleaner.¹⁸⁶ Despite the high levels of CO₂ in the US, thanks to technology, the US has been able to emit three times less CO₂ than it would have if its technology had been kept at the 1900 level.¹⁸⁷

(iv) *A General Agreement to Reduce Emissions*¹⁸⁸

In addition to the regional approach to trade and climate change proposed above, this study suggests the creation of a new mechanism similar to the WTO Trade Policy Review Mechanism that would monitor national commitments to cut GHG emissions, even if it is acknowledged that multilateralism is not doing so well these days.¹⁸⁹

Using the WTO monitoring system as a model would be perfectly feasible so long as the monitoring is carried out by an international body with environmental expertise. There may well be lessons to be learned from the GATT techniques as regards compensatory adjustments for violations. Clearly, it would not be acceptable for country A to feel free to disregard its own GHG emission commitments because country B has – in the opinion of country A – already disregarded its commitments. The monitoring problem arises only once the commitments are made, even if sometimes States are reluctant to undertake commitments because they believe that others will cheat and not be caught out.¹⁹⁰ It would

15 April 1994, Marrakesh Agreement Establishing the World Trade Organization (WTO Agreement), Annex 1B, 1869 UNTS. 183.

¹⁸⁵ For further explanation regarding negotiations on trade and environment under the Doha Round, see http://www.wto.org/english/tratop_e/envir_e/envt_intro_e.htm.

¹⁸⁶ Norberg, J. *Progress: Ten Reasons to Look Forward to the Future*, Oneworld Publications, 2016, p. 123.

¹⁸⁷ *Idem*.

¹⁸⁸ These ideas draw from Leal-Arcas, R. *Climate Change and International Trade*, Edward Elgar, 2013, chapter 6.

¹⁸⁹ On the link between trade and climate in a post 2012 climate policy system, see Whalley, J. (2011) “What Role for Trade in a Post 2012 Global Climate Policy Regime,” NBER *Working Paper* No. 17498.

¹⁹⁰ For an analysis of the problem of enforcement of obligations, see Ulfstein, G. (ed.) (2007) *Making Treaties Work: Human Rights, Environment and Arms Embargo*, Cambridge: Cambridge University Press.

be useful to see how the WTO Trade Policy Review Mechanism worked in trade policy for a possible replica in the case of climate change.¹⁹¹

So how would a new mechanism modeled on the WTO Trade Policy Review Mechanism monitor national commitments to cut GHG emissions? Unlike the Kyoto Protocol, which would have subordinated a State's policies to the decisions of an international organization, a future General Agreement to Reduce Emissions (GARE) would perform in the same manner as the GATT 1947 in terms of setting rules, non-binding dispute settlement, and creating incentives (such as financial incentives for environmental technology transfer) for countries to coordinate their efforts in reducing GHG emissions.¹⁹² Just as was the case in the GATT, the advantage of the proposed GARE is that it would not have to be established or enforced by a legally binding treaty.¹⁹³ Countries could join the GARE by adopting their own ambitious and verifiable reductions targets based on domestic legislation.¹⁹⁴ So although the international dimension of the GARE would be politically binding, the GARE would be based on legally binding national obligations.¹⁹⁵

Parties to the GARE would cooperate with each other to make sure that all of them have reliable reporting, monitoring and enforcement mechanisms. Once the laws of the various participating countries are sufficiently ambitious in reducing GHG emissions, and once they have confidence in one another's compliance with their own targets, international emissions trading would be the logical next step.¹⁹⁶ A single set of rules would presumably

¹⁹¹ See for instance Levi, M. (2009) "Creating a Climate Policy Review Mechanism," *Harvard Project on International Climate Agreements*, available at <http://belfercenter.ksg.harvard.edu/files/levi.pdf>; Collins-Williams, T. and Wolfe, R. (2010) "Transparency as a Trade Policy Tool: The WTO's Cloudy Windows," *World T.R.* 9(4), pp. 551–81; Charnovitz, S. (2010) "Trade and Climate Change: A Report by the United Nations Environment Programme and the World Trade Organization," *World T.R.* 9(1), pp. 273–81; Tamiotti, L. (2010) "Trade and the Environment: Fundamental Issues in International Law, WTO Law and Legal Theory," *World T.R.* 9(1), pp. 285–8.

¹⁹² William Antholis and Strobe Talbott have studied the possibility of creating an international mechanism modelled on the GATT that would monitor national commitments and create incentives for other countries to coordinate their efforts to cut GHG emissions. See Antholis, W. and Talbott, S. (2010) *Fast Forward: Ethics and Politics in the Age of Global Warming*, Washington, D.C.: Brookings Institution Press.

¹⁹³ There is a difference between a treaty and an (executive) agreement. A treaty is an agreement formally signed, ratified, or adhered to between two or more nations or sovereigns and governed by international law. "The legal terminology used by the United States to describe international agreements is markedly different from that employed elsewhere. Under the U.S. Constitution, the term 'treaty' has a particular meaning – an agreement made by the President with the advice and consent of the Senate." See Bederman, D. (2001) *International Law Frameworks*, 158. An executive agreement, however, is an international agreement entered into by the President, without approval by the Senate, and usually involving routine diplomatic or military matters. See Garner, B. (2009) *Black's Law Dictionary*, 9th ed., West, p. 651.

¹⁹⁴ For further discussion on this point, see Wiener, J. (2007) "Incentives and Meta-Architecture," in Aldy, J. and Stavins, R. (eds.) *Architectures for Agreement: Addressing Global Climate Change in a Post-Kyoto World*, Cambridge University Press.

¹⁹⁵ On the domestic political and economic constraints that nations face in moving toward a globally integrated goal, see Ruggie, J. (1983) "International Regimes, Transactions, and Change: Embedded Liberalism in the Postwar Economic Order," in Krasner, S. (ed.) *International Regimes*, Cornell University Press.

¹⁹⁶ For an examination of whether international emissions trading falls within the scope of WTO Agreements, whether it might violate substantive WTO rules and, if so, whether it could be covered by exemption clauses, see Voigt, C. (2008) "WTO Law and International Emissions Trading: Is there Potential for Conflict?" *Carbon and Climate Law Review*, Vol. 2, No. 1, pp. 52–64.

lower the transaction costs for participants; and investors would be inclined to fund projects¹⁹⁷ in countries with the most cost-effective emissions reduction policies.¹⁹⁸

The GARE would effectively link domestic action with an international agreement.¹⁹⁹ It would also avoid moving too quickly to a full-blown international institution.²⁰⁰ A GARE system could be built on the G-8 or major emitters' group.²⁰¹ A core set of the most important countries could start the process, and this ultimately would be compatible with regional and bilateral agreements. On an annual basis, leaders of this group could meet at the summit level to evaluate progress and to help give a boost to the ongoing negotiations.²⁰² Countries could choose domestically to cut their GHG emissions in the way that makes most sense, given their domestic constraints. Rather than prioritize a treaty as a goal in and of itself, a GARE would start with domestic legislation and help nations strengthen – that is, gear up – their ambition.²⁰³

With the high barriers to legislative approval in the U.S.,²⁰⁴ the GARE would be a major incentive for the U.S. because it would not be a treaty but an agreement. The practical implication of this distinction between a treaty and an agreement is that the GARE would require a 60-vote majority in the U.S. Senate, instead of the 67 votes necessary for treaty ratification. Moreover, current U.S. legislation already authorizes the United States Environmental Protection Agency (EPA) to trade GHG emissions permits with any “national or supranational foreign government”²⁰⁵ that imposes a mandatory cap on GHG emissions. Furthermore, the current legislation also requires the EPA to determine that the foreign country's program is “at least as stringent as the program established by this title [Title VII], including provisions to ensure at least comparable monitoring, compliance, enforcement [...]”²⁰⁶ In other words, countries could legislate nationally and coordinate globally. Furthermore, countries should be encouraged to join the GARE by providing

¹⁹⁷ Already in the 2009 COP-15 in Copenhagen, consensus was emerging amongst the Parties to the UNFCCC that a new international climate fund should be established, a fund which would dwarf all existing funds dedicated to supporting climate change activities in developing countries. At the same time, there is a growing realization that the current relationship providing guidance and ensuring accountability between the UNFCCC's Conference of Parties and the existing operating entity, is in need of reform. For an analysis of how such a reform could be carried out and how it could be used in providing a legitimate and effective process to set up the new fund, see Müller, B. (2010) “Why Reinvent the Wheel?: on establishing new funds whilst guiding and holding accountable operating entities of the UNFCCC financial mechanism,” *Oxford Energy and Environment Comment*, October. See also Müller, B. and Chandani, A. (2010) “What Expertise? On who should be drafting the framework documents for a new Global Climate Fund,” *Oxford Energy and Environment Comment*, November.

¹⁹⁸ For more details on the GARE proposal, see Stern, T. and Antholis, W. (2007/2008) “A Changing Climate: The Road Ahead for the United States,” *Washington Quarterly*, 31, Winter, pp. 175–88; see also Petsonk, A. (2007) “Testimony before the Subcommittee on Energy and Air Quality,” Committee on Energy and Commerce, 27 March; Purvis, N. (2008) “Trading Approaches on Climate: The Case for Climate Protection Authority,” *Resources*, Summer.

¹⁹⁹ Antholis, W. (2008/2009) “Five ‘Gs’: Lessons from World Trade for Governing Global Climate Change,” *Brookings Trade Forum*, 2008/2009, pp. 121–38, at p. 126.

²⁰⁰ *Ibid.*, at p. 126.

²⁰¹ *Idem.*

²⁰² *Idem.*

²⁰³ *Ibid.*, at p. 128.

²⁰⁴ According to the U.S. Constitution, for a treaty to enter into force, two-thirds of the U.S. Senate has to ratify it. See Article II, Section 2, of the U.S. Constitution.

²⁰⁵ The conditions for trading are set out in U.S. House of Representatives, “American Clean Energy and Security Act of 2009,” 111th Congress, 1st sess., HR 2454, Title VII, Part C, Section 728, International Emissions Allowances, p. 774.

²⁰⁶ *Ibid.*

them with a competitive standing. Those who eventually refuse to join should be penalized with sanctions.

To conclude this section on the links between trade, climate change and sustainable energy, it is important to recognize that, in the relationship between WTO rules and multilateral environmental rules, environmental rules should be drafted in a manner that is not in conflict with WTO law. Whenever a conflict between the two disciplines arises, clarification of WTO rules should be done in a manner that puts the environment first.

IV. Innovation, research, technology and spirituality

Businesses have taken on a leadership role in climate change mitigation, and cities all over the world are showing innovative strategies for advancing solutions to climate change. In this section, we explore the various challenges and opportunities in sustainability, the options for a cleaner future, the remarkable potential contribution of sustainable companies, and the links between sustainability and spirituality.

(a) *Challenges ahead, but the future is bright*²⁰⁷

Technologies, research and innovation are anticipated to have a growing importance in Europe's pursuit of energy security. Horizon 2020 will be the EU's principal financial means of promoting energy research and innovation in the coming years.²⁰⁸ Measures in this particular aspect of EU energy policy will revolve around the Strategic Energy Technology (SET) Plan.²⁰⁹ The SET Plan aims to foster research and development in both existing and new generations of low-carbon technologies. The EU remains a global leader in terms of innovation and renewable energy,²¹⁰ but this status will be at risk unless the role of technologies, research and innovation is increased.²¹¹

The main challenge in the field of innovation lies in the necessity to fuse the EU and its Member States' research programs. An integrated approach is required to complement efforts and reinforce ties between research and industry, thereby easing the emergence of new technologies in the European internal market.²¹² The promotion of new technologies should underlie the Energy Union's governance. Technological innovation will continue to sway our societies. Shared networks are expected to hasten and intensify the interplay of information between individuals and companies across the globe.

²⁰⁷ Some of these ideas draw from Leal-Arcas, R. *The European Energy Union: The quest for secure, affordable and sustainable energy*, Claeys & Casteels Publishing, 2016, Chapter 3.

²⁰⁸ Horizon 2020 is the largest EU research and innovation program to date. The scheme holds €80 billion to deploy over the period 2014-2020, of which €6.6 billion will be specifically devoted to energy. See European Commission, "What is Horizon 2020?" <<https://ec.europa.eu/programmes/horizon2020/en/what-horizon-2020>>.

²⁰⁹ The SET Plan will sustain the Energy Union's pillar on technologies, research and innovation. It outlines the long-term energy research and innovation agenda for Europe by setting strategic objectives for the future. See European Commission, "The European Strategic Energy Technology Plan (SET-Plan)" <http://ec.europa.eu/research/energy/eu/index_en.cfm?pg=policy-set-plan>.

²¹⁰ See Leal-Arcas, R. and Minas, S. "Mapping the international and European governance of renewable energy," *Oxford Yearbook of European Law*, Vol. 35, No. 1, pp. 621-666, 2016.

²¹¹ Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee, the Committee of the Regions and the European Investment Bank, "A Framework Strategy for a Resilient Energy Union with a Forward-Looking Climate Change Policy", at p. 3, COM(2015) 80 final (25 February 2015).

²¹² *Ibid*, p. 16.

The increasing importance of digital energy will require an equivalent innovation impulsion in the field of cyber security to protect the system from cyber-attacks. Indeed, an unbounded revolution in the digital exchange of information would make the cyber systems worldwide prone to new threats as digital instruments and shared networks ease intrusions to private life.²¹³ Therefore, the pace of innovation should be rationalized to ensure the effective safeguard of private life.

To start with, the Energy Union promises an updated SET Plan and a strategic transport research and innovation agenda, thereby expediting energy system transformation.²¹⁴ The Energy Union's proposal charts four objectives to press for in the area of innovation:

- 1) Making the EU the world leader in developing the next generation of renewable-energy technologies;²¹⁵
- 2) Easing the participation of consumers in the energy transition;²¹⁶
- 3) Ensuring effective energy systems;²¹⁷ and
- 4) Developing more sustainable transport systems that employ large scale innovative technologies.²¹⁸

Another promising advancement is the Energy Union's commitment to phase out environmentally harmful subsidies altogether.²¹⁹ Continuing to fund fossil fuels within Europe would be counterproductive, not only in the light of the EU's ambitious energy and climate goals,²²⁰ but also in that it would delay the arrival of new technologies. Therefore, redirecting these subsidies to support low-carbon technologies and digital energy innovation represents a sensible change of course.

Beyond the EU context, there is a new initiative of visionary billionaires determined to provide energy that is reliable, affordable and carbon-less. The initiative is called "Breakthrough Energy Coalition."²²¹ The Energy Union could and should join forces with this coalition that is currently working with a growing group of visionary countries towards joint research to make sure that this project becomes a reality. Another way to help mitigate climate change is through energy storage, which offers many benefits such as reduced costs and increased profits. Moreover, yet another initiative called Mission Innovation²²² brings together a group of 20 countries²²³ that aim to reinvigorate and accelerate clean energy

²¹³ Andoura, S. and Vinois, J.-A. "From the European Energy Community to the Energy Union: A Policy proposal for the short and the long term" *Notre Europe*, pp. 125 and 136, 2015.

²¹⁴ Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee, the Committee of the Regions and the European Investment Bank, "A Framework Strategy for a Resilient Energy Union with a Forward-Looking Climate Change Policy", at p. 16, COM(2015) 80 final (25 February 2015).

²¹⁵ *Ibid.*

²¹⁶ *Ibid.*

²¹⁷ *Ibid.*

²¹⁸ *Ibid.*

²¹⁹ *Ibid.*, p. 10.

²²⁰ The leaders of the G7 (Canada, US, UK, France, Italy, Germany, and Japan) have the ambition to phase out fossil fuel emissions in the 21st century. See Clark, P. and Wagstyl, S. "G7 leaders agree to phase out fossil fuels," *Financial Times*, 8 June 2015.

²²¹ To access their principles, see <http://www.breakthroughenergycoalition.com/en/index.html>.

²²² <http://mission-innovation.net/>.

²²³ <http://mission-innovation.net/countries/>.

innovation throughout the world to make clean energy affordable for all. The Energy Union should also join forces with this initiative.²²⁴

There are reasons to be optimistic because the options for the future are abundant. Wind turbines and solar panels are proliferating across Europe, India,²²⁵ China and the US, albeit they are barely restraining CO₂ emissions. Wind power projects on a massive scale are underway in the North Sea and so are projects to bring solar energy produced in the Saharan desert to southern Europe.²²⁶ An increasing number of developing countries is investing in renewable energy out of their own initiative, not because they are legally bound to do so. There are positive examples of countries that have climate change laws in place (on GHG emissions reduction) even if they are not a party to the UN Framework Convention on Climate Change (e.g., Taiwan) or an Annex I country²²⁷ (e.g., Mexico).

It is a fact that life expectancy at birth between 1770 and the end of the 19th century was only around 30 years,²²⁸ that world GDP per capita until 1900 was just around \$1,000 based on the value of the US dollar in 1990,²²⁹ and that the level of illiteracy in the early 19th century was around 85% of the world population.²³⁰ As a result, we did not have the incentive or ability to deal with environmental protection effectively. However, the good news is that today world GDP per capita has risen to about \$8,000, the levels of undernourishment between 1945 and 2015 have drastically decreased from 50% of the world population to just above 10% in 2015,²³¹ life expectancy at birth is 70 years and, in some developed countries, it is rising to 85 years,²³² illiteracy has gone down to just 10% of the world population, and poor countries today have lower poverty rates than the richest countries did in the early 19th century.²³³ This is all excellent news and great achievements. And the prognosis is equally excellent: in 2107, being over 100 years of age will no longer be rare; rather, it will be the norm.²³⁴

We now know that technology and wealth are compatible with a green future. In fact, they are a precondition to environmental sustainability. As Johan Norberg notes, we also know that the alarmist rhetoric of the 1960s and 1970s that envisaged a catastrophic future was

²²⁴ Efforts to do so on the part of the EU and other OECD partners are already visible. See European Commission, “The EU and other OECD partners agree on trade measures supporting cleaner energy,” 18 November 2015, available at <http://trade.ec.europa.eu/doclib/press/index.cfm?id=1401>.

²²⁵ See for instance Sivaram, V. *et al.*, “Research for the Sun: How India’s Audacious Solar Ambitions Could Make or Break its Climate Commitments,” *Stanford Steyer-Taylor Center for Energy Policy and Finance*, available at <https://www-cdn.law.stanford.edu/wp-content/uploads/2015/12/Reach-for-the-Sun-High-Resolution-Version.pdf>.

²²⁶ Morocco is currently building one of the largest solar plants in the world and hopes to export power to Europe in the future. See “Nuclear power in the Middle East: Wasting energy,” *The Economist*, 28 November 2015, p. 57.

²²⁷ Annex I countries are developed countries and those countries in transition to a market economy. According to the Kyoto Protocol, they are legally bound to reduce their emissions of greenhouse gases.

²²⁸ Roser, M. “Life Expectancy,” 2016, available at <https://ourworldindata.org/life-expectancy/>

²²⁹ Madison, A. *The World Economy: Historical Statistics*, Paris: OECD, 2003, p. 262.

²³⁰ OECD, “World development of literacy and attainment of at least basic education, 1820-2010,” statistical appendix to Zanden *et al.*, 2014.

²³¹ FAO, *The State of Food and Agriculture 1947*, Geneva: FAO, 1947; FAO, *The State of Food Insecurity in the World 2015*, Rome: FAO, 2015.

²³² World Health Organization.

²³³ Ravallion, M. “Poverty in the rich world when it was not nearly so rich,” 2014, *Center for Global Development*, available at <http://www.cgdev.org/blog/poverty-rich-world-when-it-was-not-nearly-so-rich>.

²³⁴ Human mortality database, University of California, Berkeley and Max Planck Institute for Demographic Research, available at www.mortality.org.

not scientifically sound and turned out to be factually wrong when predicting a world without forests, with acid rain, and where people had to use surgical masks to protect themselves from pollution.²³⁵ In the words of the 2014 Environmental Performance Index, “wealth emerges as a major determinant of environmental performance.”²³⁶ In other words, the richer the country, the more it had done to clean the environment, largely due to its economic might and technological progress.

An extraordinary example of how technological progress is contributing to environmental protection is the fact that a modern car in motion emits less CO₂ than a 1970s car did by just being parked, as a result of gasoline vapor leakage.²³⁷ Therefore, it is the lack of technology and affluence in poor countries that is creating their worst environmental problems. So the solution is to keep investing in a cleaner future, aiming at developing alternative and cheaper energy.

(b) *Betting on a cleaner future*²³⁸

Moving forward, we need to create a new energy future, accepting the fact that we may never run out of fossil fuels (otherwise, there would be no life on Earth).²³⁹ To get there, we will need to change our energy supply and control CO₂ emissions.²⁴⁰ It is a well-known fact that the use of energy impacts the environment. Both energy and the environment are global issues. As stated by T. Meyer, we may not speak the same language or share the same culture, but we breathe the same air.²⁴¹

It will be necessary to utilize all energy options: clean coal, oil shale combined with CO₂ sequestration, nuclear energy, hydrogen and fuel cells, renewable energy (whether wind, solar, geothermal or biomass), *inter alia*. In this respect, President Barack Obama said in 2010: “An America run solely on fossil fuels should not be the vision we have for our children and grandchildren.”²⁴² He then added that “the only way the transition to clean energy will ultimately succeed is if the private sector is fully invested in this future -- if capital comes off the sidelines and the ingenuity of our entrepreneurs is unleashed. And

²³⁵ Norberg, J. *Progress: Ten Reasons to Look Forward to the Future*, Oneworld Publications, 2016, p. 109.

²³⁶ Hsu, A., Emerson, J., Levy, M., de Sherbinin, A., Johnson, L., Malik, O., Schwartz, J., and Jaiteh, M. *The 2014 Environmental Performance Index*, New Haven, CT: Yale Center for Environmental Law & Policy, 2014.

²³⁷ Ealey, L. and Mercer, G. “Tomorrow’s cars, today’s engines,” *McKinsey Quarterly*, No. 3, 2002.

²³⁸ See Brudvig, G. “Spurring Innovation,” lecture given at the Yale sustainability leadership forum, 22 September 2016, Yale University, New Haven, USA.

²³⁹ On that note, former US Secretary of Energy Steven Chu once famously said that “the Stone Age did not end because we ran out of stones; we transitioned to better solutions.” By the same token, we should not need to wait until we run out of fossil fuels to make the transition to sustainable energy. See Energy.gov, “Letter from Secretary Steven Chu to Energy Department Employees,” 1 February 2013, available at <http://energy.gov/articles/letter-secretary-steven-chu-energy-department-employees>.

²⁴⁰ See, for instance, the views of Ron Oxburgh in 2004, chairman of Shell: “Sequestration is difficult, but if we don’t have sequestration then I see very little hope for the world.” He then added: “No one can be comfortable at the prospect of continuing to pump out the amounts of carbon dioxide that we are pumping out at present with consequences that we really can’t predict but are probably not good.” 17 June 2004, available at <http://news.bbc.co.uk/1/hi/uk/3814607.stm>

²⁴¹ Meyer, T. “Our energy future. What are the technology challenges of the 21st century?” lecture at the University of North Carolina, 2 March 2006.

²⁴² See remarks by President Barack Obama on the economy at Carnegie Mellon University, 2 June 2010, available at <https://www.whitehouse.gov/the-press-office/remarks-president-economy-carnegie-mellon-university>.

the only way to do that is by finally putting a price on carbon pollution.”²⁴³ However, putting a price on carbon, so that people pay for their CO₂ emissions, will affect the poor negatively the most, and not the rich who, incidentally and unlike the poor, are the ones to blame the most for the causes of climate change.

Renewable energy can contribute meaningfully. For instance, solar energy could become cheaper thanks to new materials and assembly technologies.²⁴⁴ At present, solar power remains expensive vis-à-vis fossil fuels as a source of energy. For example, if you were to invest US \$10 billion in burning gas to power a region, you could help lift 90 million people out of poverty and darkness. If, however, you were to spend the same amount on renewable energy, you could only help 20 to 30 million people. This means that, in our hypothetical, 60 million people would remain in poverty and darkness.²⁴⁵ But the potential of solar energy is phenomenal: solar energy today is only 1% of global energy;²⁴⁶ moreover, one hour of sun can generate energy for the whole Earth for an entire year;²⁴⁷ furthermore, “we could power the entire world if we covered less than 3 percent of the Sahara Desert with solar panels.”²⁴⁸

New developments regarding solar energy are showing a promising future. Graphene,²⁴⁹ a new material created in 2004 at the University of Manchester, is very thin and flexible (only one carbon atom thick). It is also very strong and conducts electricity and heat very efficiently. Graphene could radically change the economics of solar power because most solar cells today utilize expensive indium,²⁵⁰ whereas carbon atoms are abundant. If graphene takes off, we could envisage a future where anything is turned into a solar power station.

There are also interesting developments on how to make our appliances more intelligent. A pan-European project called WiseGRID²⁵¹ is working on how to effectively place citizens at the center of the transformation of the grid by allowing greater citizen participation and, by doing so, moving towards a transition to energy democracy. Others are contemplating solar power in space,²⁵² where nothing blocks the sun. A microwave transmitter would send energy to areas on Earth that need it. The energy internet,²⁵³ where producers and consumers can place information and power into the network, could help solve the renewable-energy storage issue for wind and solar power because non-used

²⁴³ *Idem*.

²⁴⁴ “Clear thinking needed,” *The Economist*, 28 November 2015, pp. 13-14.

²⁴⁵ Moss, T. and Leo, B. “Maximizing access to energy: Estimates of access and generation for the overseas private investment corporation’s portfolio,” *Center for Global Development*, January 2014, available at http://www.cgdev.org/sites/default/files/maximizing-access-energy-opic_1.pdf.

²⁴⁶ “Solar Frontiers,” *The Economist*, <http://films.economist.com/>.

²⁴⁷ *Ibid*.

²⁴⁸ See Zakaria, F. “The GPS Road Map for Powering America,” *CNN*, Aired on 21 October 2012, available at <http://transcripts.cnn.com/TRANSCRIPTS/1210/21/cp.01.html>.

²⁴⁹ “In simple terms, graphene, is a thin layer of pure carbon; it is a single, tightly packed layer of carbon atoms that are bonded together in a hexagonal honeycomb lattice.” See Graphenea, “Graphene – What Is It?” available at <http://www.graphenea.com/pages/graphene#.WFxPSIOLQ2w>.

²⁵⁰ Indium is ‘a silvery malleable fusible chiefly trivalent metallic element that occurs especially in sphalerite ores and is used especially as a plating material, in alloys, and in electronics.’ See <https://www.merriam-webster.com/dictionary/indium>.

²⁵¹ <http://www.wisegrid.eu/>.

²⁵² <http://www.nss.org/settlement/ssp/>.

²⁵³ An internet for energy interconnects the energy network with the internet, allowing units of energy (locally generated, stored, and forwarded) to be dispatched when and where it is needed. See <http://www.artemis-ioe.eu/>.

energy could be stored in cars and homes. There are scientists trying to remove CO₂ from the air, which is what trees do after all.²⁵⁴ This process has the potential to reverse global warming and is part of the broader notion of geoengineering.²⁵⁵

The advantages of solar energy are that it is abundant,²⁵⁶ essentially free (albeit not its technology) and limitless, widely dispersed and with a low environmental impact. One great disadvantage, however, is that it is not a constant supply of energy, since the sun does not always shine. So countries will need better ways of storing and trading renewable energy via large, mega-grids, which is the key issue in solar energy implementation. Hence the importance of international cooperation. Equally, carbon sequestration is important because countries are not going to stop burning carbon in the near future. Geoengineering could be further developed to mitigate climate change.²⁵⁷ The greatest result of investing in low-carbon technologies will be becoming increasingly energy independent. Therefore, more R&D spending on energy technologies would be necessary to decarbonize the economy.

Shifting subsidies from fossil fuels to renewable energy is a promising policy towards clean energy support. States could provide incentives to move to renewable energy, especially in warm countries. However, there needs to be public support in the transition to a clean economy: if cleaning the environment comes at the cost of higher unemployment, no democracy will accept that. Moreover, most people are interested in short-term local issues and solutions, not long-term global problems. However, it is in everyone's interest to provide the developing world with the best technology so that dirty carbon technology can be minimized.

The bottom line is to make sure that future climate policies do not obstruct our ability to wealth creation and technology innovation, which can then be transferred to poor countries to improve their quality of life and their environment.

(c) *Sustainable companies*²⁵⁸

Three factors are necessary to reach sustainability: investors, technology and policy.²⁵⁹ Moreover, transportation, energy and agriculture are crucial industries to build a sustainable future since they represent around 60% of greenhouse gas emissions.²⁶⁰ Yet,

²⁵⁴ <http://www.arboreenvironmentalalliance.com/carbon-tree-facts.asp>.

²⁵⁵ Leal-Arcas, R. and Filis-Yeloghotis, A. "Geoengineering a Future for Humankind: Some Technical and Ethical Considerations," *Carbon and Climate Law Rev*, Vol. 6(2), pp. 128-148, 2012.

²⁵⁶ For an overview of the world's total primary solar energy supply, see http://www.ez2c.de/ml/solar_land_area/.

²⁵⁷ Leal-Arcas, R. and Filis-Yeloghotis, A. "Geoengineering a Future for Humankind: Some Technical and Ethical Considerations," *Carbon and Climate Law Rev*, Vol. 6(2), pp. 128-148, 2012.

²⁵⁸ See Pfund, N. "Creating the sustainable companies of the 21st century," lecture given at the Yale sustainability leadership forum, September 2016, Yale University, New Haven, USA.

²⁵⁹ For further details on sustainable companies, see Esty, D. and Winston, A. *Green to Gold: How smart companies use environmental strategy to innovate, create value, and build competitive advantage*, John Wiley & Sons, Inc., 2009.

²⁶⁰ See US Environmental Protection Agency, "Sources of Greenhouse Gas Emissions," available at <https://www.epa.gov/ghgemissions/sources-greenhouse-gas-emissions>. See also IPCC, 5th Assessment Report, Working Group III, Cambridge University Press, 2014, available at http://www.ipcc.ch/pdf/assessment-report/ar5/wg3/ipcc_wg3_ar5_full.pdf.

the leaders of these industries²⁶¹ have been around for over 100 years, but their innovation record is irregular. In that same time period, the computer and IT industries have been remarkably innovative: computers have been transformed from being a main frame to a tablet; in telecommunications, phones have been transformed from a landline to smartphones. Soon over 3 billion people will own a smartphone. These three billion people will each have more computer power in their hands than the super computers of the 1960s, enabling them to have access to all the world's knowledge.²⁶²

And there are positive future commitments by technology companies such as Google, who plans to buy only renewable energy in 2017 'to match the entire needs of all its data centres and offices around the world.'²⁶³ In this innovation cycle, the energy, transportation and agriculture sectors are starting to catch up: in the energy sector, we see a move from centralized fossil fuel plants (such as coal plants) to fully integrated micro-grids; in transportation, we are experiencing a transformation from gas-powered cars to autonomous and connected cars; and in agriculture, from mechanized to data-driven agriculture. Equally important is the fact that renewable energy is employing many people.²⁶⁴

Interestingly, these three sectors are adopting many of the same themes of innovation as the computer and IT sectors. The principles on which 21st century companies will be built will be transparency, decentralization, reducing cost, personalization, and convenience, among others. In the case of cars, thanks to technology, they will be electrified, autonomous and the social tendency is towards ride-sharing. Customers are asking for cars that are cheaper, greener and safer.²⁶⁵ As for agriculture, there is a demand for it to be cheaper, greener, with more choice and more farmer independence. Examples of 21st century agriculture companies are Blue River Technology, Apeel Sciences, Farmers Business Network, and Planet. Regarding energy, the demand is for energy that is cheaper, greener, more reliable and more functional. There are clear market opportunities. The question is how to help build these companies of the 21st century in the transportation, energy and agricultural sectors.²⁶⁶

²⁶¹ For instance, General Motors since 1908, General Electric since 1892, Ford since 1903, John Deere since 1837.

²⁶² Norberg, J. *Progress: Ten Reasons to Look Forward to the Future*, Oneworld Publications, 2016, p. 200.

²⁶³ Waters, R. "Google to buy only renewable energy for operations in 2017," *Financial Times*, 6 December 2016, available at <https://www.ft.com/content/6794d2f0-bb6a-11e6-8b45-b8b81dd5d080?emailid=55ccb875090bff0300e78b63&segmentId=3d08be62-315f-7330-5bbd-af33de531acb>.

²⁶⁴ See for example the case of Texas, where more than 100,000 people are employed in that sector. Spindle, B. and Smith, R. "Which State is a Big Renewable Energy Pioneer? Texas," *The Wall Street Journal*, available at 29 August 2016, <http://www.wsj.com/articles/which-state-is-a-big-renewable-energy-pioneer-texas-1472414098>.

²⁶⁵ See Stewart, J. "Tesla's cars have driven 140M miles on autopilot. Here's how," *Wired*, 17 August 2016, available at <https://www.wired.com/2016/08/how-tesla-autopilot-works/>; Google self-driving car project, available at <https://www.google.com/selfdrivingcar/>; Hawkins, A. "Uber just completed its two-billionth trip," *The Verge*, 18 July 2016, available at <http://www.theverge.com/2016/7/18/12211710/uber-two-billion-trip-announced-kalanick-china-didi>.

²⁶⁶ For an overview of how to revitalize business models to win the clean-energy race, see Lovins, A. *Reinventing Fire: Bold Business Solutions for the New Energy Era*, Chelsea Green Publishing, 2013.

In 2017 a taskforce on carbon disclosure will deliver recommendations to the G20²⁶⁷ and the Financial Stability Board,²⁶⁸ a forum of global regulators. The purpose is to create a voluntary framework to allow companies to report their exposure to climate risks. By doing so, the market will be able to go green more efficiently.

(d) *Sustainability and spirituality*²⁶⁹

People's behavior and attitudes are shaped by world views, values and spirituality derived from world religions, environmental ethics, biophilia, humanitarian and secular values as well as the arts.²⁷⁰ We are the first human community to face a comprehensive crisis, threatening ecosystems and species on a global scale. To paraphrase Thomas Berry, we have ethics for homicide, suicide, and genocide, but not for biocide or geocide.²⁷¹ While this is largely true,²⁷² since 2015 the international community is officially committed to the Sustainable Development Goals as a roadmap for a sustainable future.²⁷³

Well-known reasons make sustainability a challenge: population growth, increased consumption, urbanization, alienation from land, climate change, biodiversity loss, to name but a few. Ways to reach sustainability are, among others, reverence for the Earth community, respect for species, restraint in the use of natural resources, redistribution of technology and aid, responsibility for the future of the planet, and restoration of ecosystems and the human spirit.

Two foundational principles may serve as a method to get there:

- 1) valuing nature: the idea that nature is a source, not a resource; acknowledging the intrinsic value of nature; and accepting environmental degradation as an ethical issue; and
- 2) honoring humans: being aware of environmental rights for present and future generations; and the notion of distributive justice as part of our environmental responsibilities.

Two strategies emerge to tackle the challenge of a sustainable future:

- 1) thinking consequentially, both short- and long-term; and
- 2) integrating solutions in the context of energy and technology via renewable energy and technology transfer.²⁷⁴

²⁶⁷ https://www.g20.org/Webs/G20/EN/Home/home_node.html.

²⁶⁸ <http://www.fsb.org/>.

²⁶⁹ See Tucker, M. "Sustainability and Spirituality," lecture given at the Yale sustainability leadership forum, September 2016, Yale University, New Haven, USA.

²⁷⁰ See for instance Grim, J. and Tucker, M.E. *Ecology and Religion*, Island Press, 2014; Swimme, B. and Tucker, M. *Journey of the Universe*, Yale University Press, 2011.

²⁷¹ Berry, T. "The Ecozoic Era," *Ecological Buddhism*, available at http://www.ecobuddhism.org/wisdom/psyche_and_spirit/thomas_berry/.

²⁷² One exception is that of Tajikistan, whose criminal code stipulates in Article 399 (on biocide) the following:

'Using of nuclear, neutron, chemical, biological (bacteriological), climatic or other kind of mass destruction weapons with the intent of destruction of people and environment is punishable by imprisonment for a period of 15 to 20 years, or death penalty.'

Available at <http://preventgenocide.org/law/domestic/tajikistan.htm>.

²⁷³ <http://www.un.org/sustainabledevelopment/sustainable-development-goals/>.

²⁷⁴ See TRIPs Agreement, Article 66.2.

Finally, two interrelated tactics are presented as a way forward:

- 1) ensuring restraint on global consumption and population growth; and
- 2) creating law in the context of global governance and global ethics.

V. Conclusion and a future research agenda

In the 19th century, coal was the main natural resource used for energy generation. In the 20th century, it was oil. In the 21st century, the expectation is that it will be renewable energy, although we are still using large amounts of coal for energy production and coal may remain the most used fossil fuel for years to come. It is a fact that renewable energy is currently not cost-competitive vis-à-vis fossil fuels, so much so that, economically, it makes little sense to move to, say, solar energy.

So following the title of the famous novel *What is to be done?* by Nikolai Chernyshevsky, we need to find the right economic balance between fossil fuels and renewables. A credible solution for the energy mix is combining renewable energy with natural gas. Why? Because generating energy based solely on renewables is not credible and because natural gas is the least dirty of all the fossil fuels. Moreover, decarbonization is possible not only via renewable energy—for which investing in innovation will be necessary—but also by decarbonizing fossil fuels, namely through carbon capture and storage, which will be necessary in the future. In addition, moving forward, the idea is that renewable energy will shift from being a complement to a substitute for fossil fuels because climate change does not care about renewables, but about fossil fuels.

The solution moving forward is to reduce CO₂ emissions by decarbonizing, electrifying, making use of the circular economy (i.e., recycling and reusing products), transferring funds and technology from the West to the rest of the world, shifting the economy to services that do not use products, and sharing best practices. Through effective regional and global collaboration on the decarbonization of the economy, the EU (and the rest of the world) can pave the way towards a sustainable and secure future for generations to come. Cooperating on renewable energy will enable EU member states to reduce their greenhouse gas emissions, in line with their obligations under the Paris Climate Agreement and the EU's Sustainable Development Strategy. By enhancing sustainable energy, the EU and the international community are mitigating climate change. In addition, effective cooperation will culminate in the spread of global renewable energy security, a global public good that can only be supplied through collective efforts. Among others, regional and global cooperation on decarbonization will enable the EU to tackle some of the most pressing human rights issues in the region, boost the economy by encouraging investment, and generate employment.

It is possible to achieve global renewable energy security. In 2011, the Intergovernmental Panel on Climate Change argued that "as infrastructure and energy systems develop, in spite of the complexities, there are few, if any, fundamental technological limits to integrating a portfolio of renewable energy technologies to meet a majority share of total energy demand in locations where suitable renewable resources exist or can be supplied".²⁷⁵ The IPCC has further said that if governments are supportive, and the full complement of

²⁷⁵ IPCC (2012), "Special Report on Renewable Energy Sources and Climate Change Mitigation", Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, pp. 17-18.

renewable energy technologies are deployed, renewable energy supply could account for almost 80% of the world's energy use within forty years, namely by 2050.²⁷⁶

We live in changing and challenging times. Yuval Harari states that “for the first time in history, more people die today from eating too much than from eating too little; more people die from old age than from infectious diseases; and more people commit suicide than are killed by soldiers, terrorists and criminals combined.”²⁷⁷ The challenge of the third millennium will be a sustainable future, where common people understand common concerns and public goods are taken seriously. Conservation is the biggest source of GHG emissions reduction. Our challenge is not technological (with the exception of carbon capture and storage), nor is it financial; it is political.

Moving forward, we should all build climate considerations in everything we do. We should be more serious about the transition to clean energy; a way forward would be by providing concessional financing for CO2 to incentivize countries to decarbonize their economies. Taking the Paris Agreement on Climate Change forward is imperative to make sure no one is left behind. The concept of *in dubio pro natura*, advocated by Brazil's National High Court Justice Antonio Benjamin, is the strongest legal form of environmental protection.²⁷⁸ In terms of new approaches to governance resulting from the Paris Agreement, what is emerging is the idea that mayors and citizens should be at the center of analysis for climate change mitigation and sustainable energy.

There is a knowledge gap on the links between four major global concerns: trade, energy, climate change, and sustainability. With the threat of climate change looming, and energy increasingly important to all aspects of human and economic development, learning more about these links is extremely timely. Specifically, it would be necessary to do more research taking the novel approach of using trade as a tool to achieve sustainable energy and therefore reduce poverty, while also addressing climate change. An open trading system in all its three aspects (political, legal and economic) is crucial for sustainable development to take shape. Equally important is to study the pivotal role that cities will play in being new platforms to help mitigate climate change and enhance sustainable energy more effectively. Making use of such innovative methodologies sets out to bridge an important knowledge gap and, in doing so, opens the door to an entirely new research agenda.

²⁷⁶ See generally IPCC ‘Renewable Energy Sources and Climate Change Mitigation,’ Summary for policymakers, available at https://www.ipcc.ch/pdf/special-reports/srren/SRREN_Full_Report.pdf.

²⁷⁷ Harari, Y.N. *Homo Deus: A Brief History of Tomorrow*, Harvill Secker, 2016.

²⁷⁸ REsp 883.656/RS, Rel. Herman Benjamin.