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Confronting NAFTA's Climate Paradox:

A Sustainable Energy Perspective for the Post-Kyoto Regime and Rio+20[1]

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Abstract

The USA and Canada are confronted with a climate paradox. Since their 2007 the G8-countries agreed to reduce their GHG emissions by 80% by 2050 related to 1990. They endorsed the goal of the Copenhagen Accord and of the Cancun Agreements to stabilize the increase of the global average temperature at +2°C by 2100. However, both major NAFTA countries failed to abide by their obligation under the UNFCC and the Kyoto Protocol the US signed but did not ratify. In 2010 the GHG emissions of Canada and the U.S. were above both targets. Given their implementation gap both will most likely be unable to reduce their GHG by 80% by 2050 if they continue their "business-as-usual" approach. Rather, fundamental changes in their worldview, mindset, dominant culture and governance processes are needed towards a "fourth sustainability revolution" with a decarbonization of their economies. After reviewing the European DESERTEC Industrial Initiative project for the MENA region this paper offers a conceptual proposal for NAFTA for a sustainable solar energy project (NAFSOLTEC) from the deserts of Mexico and the US for Canada, the USA and Mexico applying innovative financial tools for a sustainable energy transformation.

Keywords: climate change, implementation, NAFTA, Canada, USA, Mexico, sustainable energy transformation, solar energy, deserts, DESERTEC, NAFSOLTEC

[1] This paper reflects research in progress and emerged from the following previous chapters, where detailed references can be found in: Brauch, Hans Günter, 2009: "Securitizing Global Environmental Change", in: Brauch et al. (Eds.), 2009: *Facing Global Environmental Change: Environmental, Human, Energy, Food, Health and Water Security Concepts* (Berlin – Heidelberg – New York: Springer-Verlag): 65-102; Oswald Spring, Úrsula; Brauch, Hans Günter, 2011: "Coping with Global Environmental Change – Sustainability Revolution and Sustainable Peace", in: Brauch et al., 2011: *Coping with Global Environmental Change, Disasters and Security – Threats, Challenges, Vulnerabilities and Risks (*Berlin – Heidelberg – New York: Springer-Verlag): 1487-1504; Brauch, Hans Günter, 2012: "Policy Responses to Climate Change in the Mediterranean and MENA Region during the Anthropocene", in: Scheffran, Jürgen et al. (Eds.): *Climate Change, Human Security and Violent Conflict: Challenges for Societal Stability* (Berlin – Heidelberg – New York: Springer-Verlag, 2012): 719-796. These texts and the extensive bibliographies can be downloaded at SpringerLink: <http://www.springer.com/series/8090?detailsPage=titles>. There is a free access to the integrated bibliographies of volumes III and IV of the Hexagon Book Series in the backmatter of each book. Additional information is at my download page at: <http://www.afes-press.de/html/download_hgb.html>.

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1. Introduction

Less than two years after the *United Nations Framework Convention on Climate Change* (UNFCCC) was signed during the first Earth Summit in Rio de Janeiro in June 1992, the *North American Free Trade Organization* (NAFTA) was established by Canada, the United States of America and Mexico, between two developed countries and a threshold country, all being members of the *Organization for Economic Co-operation and Development* (OECD). While the USA and Canada – as Annex-I Countries under the UNFCCC and as Annex B-Countries under the *Kyoto Protocol* (KP) – have *quantitative emission limitation and reduction obligations* (QELROs). Mexico did not assume any legal obligation under the KP.

Both the USA and Canada had been instrumental for launching the international negotiations that resulted in UNFCCC when from 19 to 21 June 1988 the Reagan Administration put climate change on the agenda of the G-7 Conference in Toronto. As the US Congress never ratified the *Kyoto Protocol* (KP), the US government is not legally bound by its obligations under the KP. During the Clinton Administration its delegates had actively participated in negotiating (1995-1997) this Protocol. Canada unilaterally withdrew from the KP after the 17th *Conference of the Parties* (COP17) of the UNFCCC in Durban and thus the Canadian government is not bound by the KP any longer.

As a Non-Annex-I Country Mexico hosted COP16 in Cancun in November-December 2010 and negotiated the adoption of the Cancun Accords that brought the international climate diplomacy back into the UN framework with the goal to achieve a legally binding treaty that was postponed at COP17 in Durban until 2015 with the goal to enter into force by 2020, i.e. eight years after the Kyoto regime expires in December 2012.

This paper argues that both the USA and Canada face a 'climate paradox'. As countries that actively helped to launch both the UNFCCC and the KP they have become laggards. While their presidents and prime ministers have declaratorily supported the goal of the G-8 each year since 2007 to reduce their greenhouse gases (GHG) by 80% by 2050, they have both failed to stabilize their greenhouse gases by 2010 at the level of 1990 (UNFCCC) and to reduce their GHG emissions by 7% (USA) or 6% (Canada) their delegates accepted during the negotiations of the KP. Under article 25 of the KP Canada reported for 1990 GHG emissions amounting to 457,441 Gg (or 3.3% of global emissions) and the USA 4,957,022 Gg (or 36.1% of global emissions).

Two decades later, from 1990 to 2009, according to a report of the UNFCCC Secretariat (2011), the GHG emissions of Canada had increased with land use changes and forestry measures (LULUF) by 28.8% and without LULUF by 17.0 % and were thus 34.8% (with LULUF) or 23% (without LULUF) above its targets (figures 2, 3). According to Canada's 5th National Communication to the UNFCCC Secretariat (2009), in 2006 Canada was about 33.8 % above its Kyoto target (figure 5). During the same period the GHG emissions of the U.S. rose by 7.2% (without LULUF) or 5.6% (with LULUF) and were 14.2% (without LULUF) or 12.6% (with LULUF) above the targets their delegates negotiated in the KP (1997).

Given this significant implementation gap during the past two decades, how are both countries to achieve the 80% reduction goals by 2050, after they had significantly failed to achieve their reduction obligations until 2012? Thus, the governments of both Canada and the US face a 'climate paradox' making 'new' legally nonbinding policy declarations after both failed to abide by their obligations to which they consented to in negotiating the KP.

As a Non-Annex I country, Mexico has no QELROs under the KP. In 2006 its emissions in units of carbon dioxide in equivalents (CO_2 eq) were 709,005 Gg and between 1990 and 2006. Mexico's GHG rose approximately by 40% or showed an average annual growth of 2.1%. Mexico repeatedly announced unilateral voluntary GHG reduction commitments. In June 2008, Mexico's President Calderon promised to cut GHG emissions by 50 million tons by 2012 by using more efficient cars and power plants what would imply a 8-16% reduction of GHG emissions. However, by May 2011 many independent observers have doubted that these goals have been implemented as the tools for an efficient monitoring are lacking.

The 'climate paradox' refers to established practices in all three NAFTA countries to enter into declaratory commitments for which often the political will, the legal basis for implementation and the administrative mechanisms for the monitoring of these legal obligations or declaratory commitments have been lacking, while business-as-usual policies have continued.

This paper addresses the following research questions:

a. Why have the USA and Canada as pioneers of global climate change policy in the late 1980s and the early 1990s gradually turned to laggards in the late 1990s, to opponents of the Kyoto Regime in the early 21st century and why have both industrialized countries failed to implement their QELROs under Art. 4,2b of the UNFCCC to stabilize their GHG emissions to their 1990s level?

b. How likely will it be that the USA, Canada and Mexico will be able to achieve their declared policy commitments by 2050 if the present business-as-usual continues? Or will a fundamental transition of the whole economy and of those sectors that are responsible for the GHG become necessary?

Starting from the premise of the declared 80% GHG reduction goals of the governments of Canada and the USA to be achieved by 2050 and of the announced voluntary GHG reduction goal of the Mexican government, this paper argues that these goals cannot be achieved by nonbinding promises the Obama administration has made on the background of the blockade by a both the Democratic- (2009-2010) and Republican-controlled US Congress (since 2011) that failed so far to agree on any legally binding GHG reduction obligations for the US.[2]

In analogy to the *European Solar Pla*n (ESP) and the DESERTEC proposal of European companies that aims at supplying 15% of the EU's electricity needs by 2050 from renewable energy sources in North Africa and the Middle East (MENA) this paper suggests as a thought experiment a similar NAFSOLTEC project for the NAFTA countries to supply a significant part of their electricity and other energy needs from land that is unusable for agriculture and the deserts in the US, Canada and Mexico from wind power and concentrated solar power.

The UN Secretary General in his report of 11 September 2009 on climate change and security (figure 1) distinguished among five pathways, where climate change as a 'threat multiplier' may result in violent conflict and thus pose manifold security dangers and concerns. This line of reasoning has been taken up by the climate change and security discourse (Scheffran/ Brzoska/Brauch/Link/Schilling 2012).

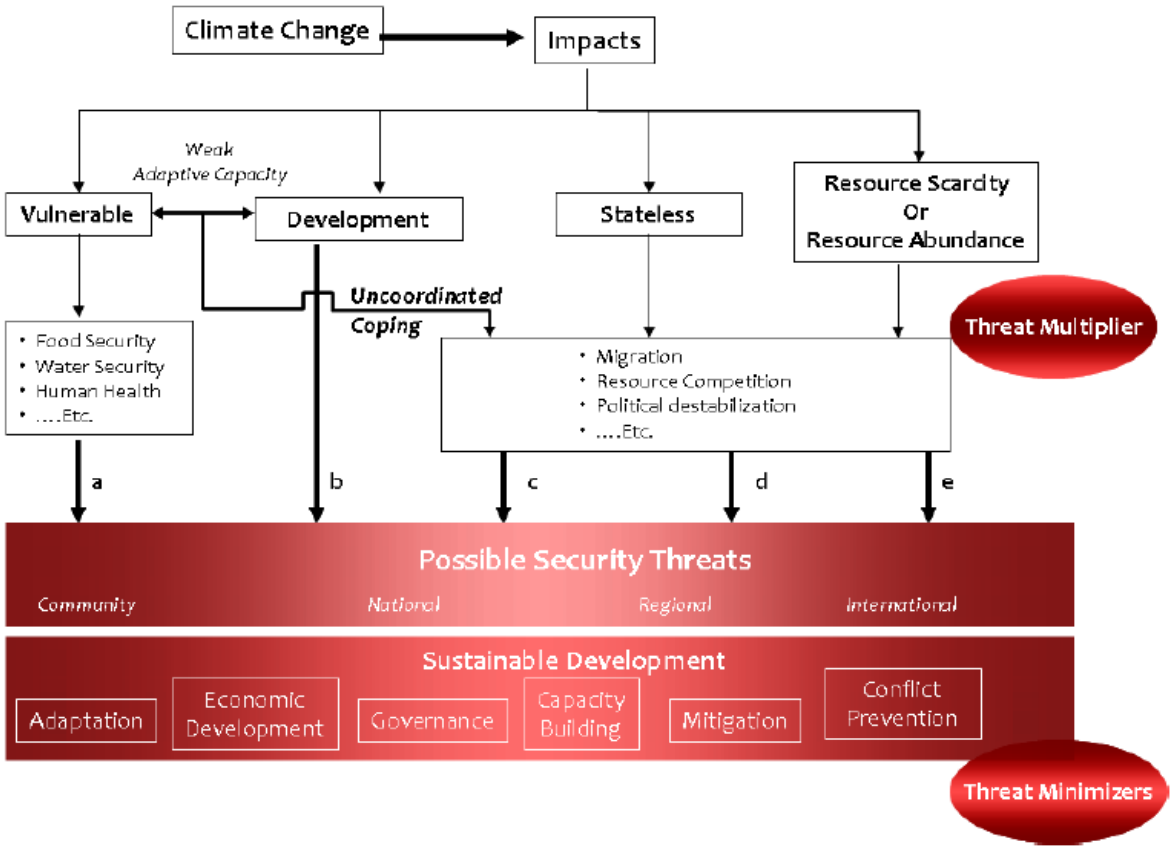
Figure 1 also refers to six components as 'threat minimizers' to achieve sustainable development by strategies, policies and measures of adaptation, economic development mitigation, governance, capacity-building, and conflict prevention. This line of reasoning refers to an alternative discourse calling for a new sustainability paradigm (Clark/Crutzen/Schellnhuber 2004), for a new social contract for sustainability (WBGU 2011), for a long-term transform-

[2] See Tänzler's (2011) brief analysis of the US quest for policy leadership on climate change and its domestic policy blockades and Klein's (2011, 2012) critical assessment of the political strategy of US climate skeptics.

ation towards sustainability (Grin/Rotmans/Schot 2010) or for a fourth sustainability revolution (Oswald Spring/Brauch 2011).

This conceptual paper for a proposed NAFSOLTEC will be used for the development of the argument that the declared goals of the G-8 – with the support of the US and Canadian governments – cannot be achieved with a continuation of policies of business-as-usual policies by calling for military adaptation strategies by a 'securitization' or even a 'militarization' of the possible security impacts of a 'dangerous climate change'. Rather, the paper argues for a major shift from a discourse focusing on climate change as a 'threat multiplier' to a discourse shifting the attention to 'threat minimizers' by a fundamental global and regional transformation and transition towards sustainable energy policies.

Figure 1: Channels of 'threat multipliers' and 'threat minimizers'. **Source:** UN (2009a: 7).



The 'climate paradox' of NAFTA countries may become a self-fulfilling prophecy resulting in a progressive securitization and even militarization as part of national adaptation strategies, policies and measures and thus climate change may become even more a 'threat multiplier' providing legitimacy for calls for new military missions, budgets and equipment to cope with this new security threat.

This paper argues for an alternative sustainability paradigm where strategies, policies and measures for a long-term transformation of the global economy moving towards policies of sustainability transition that aim at 'threat minimizers' for coping with the security consequences of global climate change.

2. The Climate Paradox: Policy Declarations without Implementation

As a result of prevailing business-as-usual policies on the impacts of anthropogenic global climate change humankind is confronted with a 'Climate Paradox'. A fundamental paradigm shift with a "transformation of global cultural, environmental, economic … and political … relations" (Oswald Spring/Brauch 2011: 1487) is needed for coping with *global environ-*

mental change (GEC) by aiming at a "sustainability revolution and sustainable peace". Both visions refer to different coping strategies with GEC:

- In the first vision of business-as-usual cornucopian perspectives prevail that suggest primarily technical fixes …, defense of economic, strategic and national interests with adaptation strategies that are in the interest of and affordable for the 'top billion' of OECD countries in a new geopolitical framework.
- In the alternative vision of a comprehensive transformation a sustainable perspective has to be developed and implemented into effective new strategies and policies with different goals and means based on global equity and social justice.

Both opposite scientific visions imply different policy consequences:

- The vision of business-as-usual with minimal reactive adaptation and mitigation strategies will most likely increase the probability of a 'dangerous climate change' … or catastrophic GEC with both linear and chaotic changes in the climate system and their socio-political consequences that represent a high-risk approach.
- To avoid these consequences the alternative vision and sustainability perspective requires a change in culture …, worldviews …, mindsets … and new forms of national and global governance. (Oswald Spring/Brauch 2011: 1487-1488)

The concept of a 'Climate Paradox' refers to a fundamental contradiction in the behavior of both developed (G8) and developing and threshold countries (G20), as reflected in their policy declarations and lack of implementation of these policy commitments.

Most government representatives confirmed the IPCC findings that climate change is increasingly being influenced by human interventions into the earth system and supported the goal to stabilize the increase of global average temperature at 2°C above the pre-industrial level by the year 2100. Since 2007, the G8 countries in their annual summit declarations, most recently in May 2011 in Deauville (France), have supported the goal

> of developed countries reducing emissions of greenhouse gases in aggregate by 80% or more by 2050, compared to 1990 or more recent years. Consistent with this ambitious long-term objective, we will undertake robust aggregate and individual mid-term reductions. Similarly, major emerging economies need to undertake quantifiable actions to reduce emissions significantly below business-as-usual by a specified year.

The G20 adopted in November 2011 in Cannes, a declaration that included a call for "financing the fight against climate change":

> 63. … In Copenhagen, developed countries have committed to the goal of mobilizing jointly USD 100 billion per year from all sources by 2020 to assist developing countries to mitigate and adapt to the impact of climate change, in the context of meaningful mitigation actions and transparency.

The G20 proposed also to foster clean energy, green grown and sustainable development:

> 59. We will promote low-carbon development strategies in order to optimize the potential for green growth and ensure sustainable development in our countries and beyond. We commit to encouraging effective policies that overcome barriers to efficiency, or otherwise spur innovation and deployment of clean and efficient energy technologies. … We welcome the assessment of the countries' current situation regarding the deployment of these technologies as well as the on-going exercise of sharing best practices, as a basis for better policy making.
>
> 60. … A green and inclusive growth will create a broad spectrum of opportunities in new industries and in areas such as environmental services, renewable energy and new ways to provide basic services to the poor.

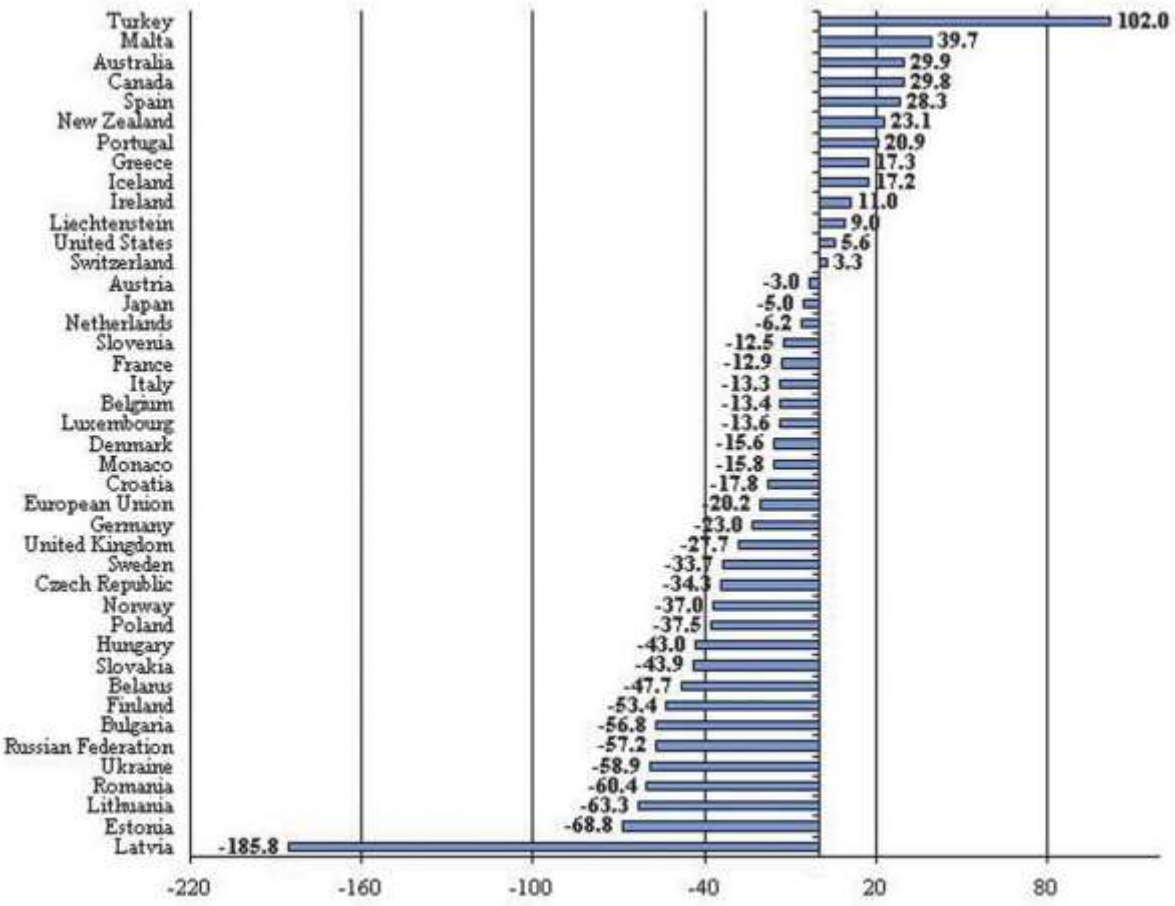
Most states have confirmed the finding of the IPCC that climate change is real and human-induced but many Annex-1 countries (UNFCCC) and Annex-B countries (KP) have failed to

fully implement their legal and declaratory obligations and to adopt legally binding commitments for major reductions in GHG emissions and they have postponed a legally binding Post-Kyoto climate change regime to enter into force by 2020 instead of 2013.

As a result of this 'Climate Paradox' of ambitious policy declarations without a sense of urgency, willingness or ability to implement, many scientists now agree that the goal of a stabilization of the increase of GHG at 2°C above the pre-industrial level by the year 2100 becomes increasingly unlikely, rather an increase between 2-4°C becomes more probable what may result in a 'catastrophic climate change' (Schellnhuber/Cramer/Nakicenovic/ Wigley/Yohe 2006).

If the business-as-usual approach continues unabated, even a catastrophic climate change with potentially catastrophic societal and international consequences may become possible. If climate change should cross a certain threshold and trigger various tipping points in the climate system (Lenton et al. 2006) serious consequences for international (EU 2008; UNSG 2009; UNSC 2007, 2011), national (CNA 2007; NSS 2010), and human security (Barnett/Adger 2007; Scheffran et al. 2012) may occur. Also several conflict constellations (WBGU 2008) may become real in environmental and climate hotspots (REC 2011).

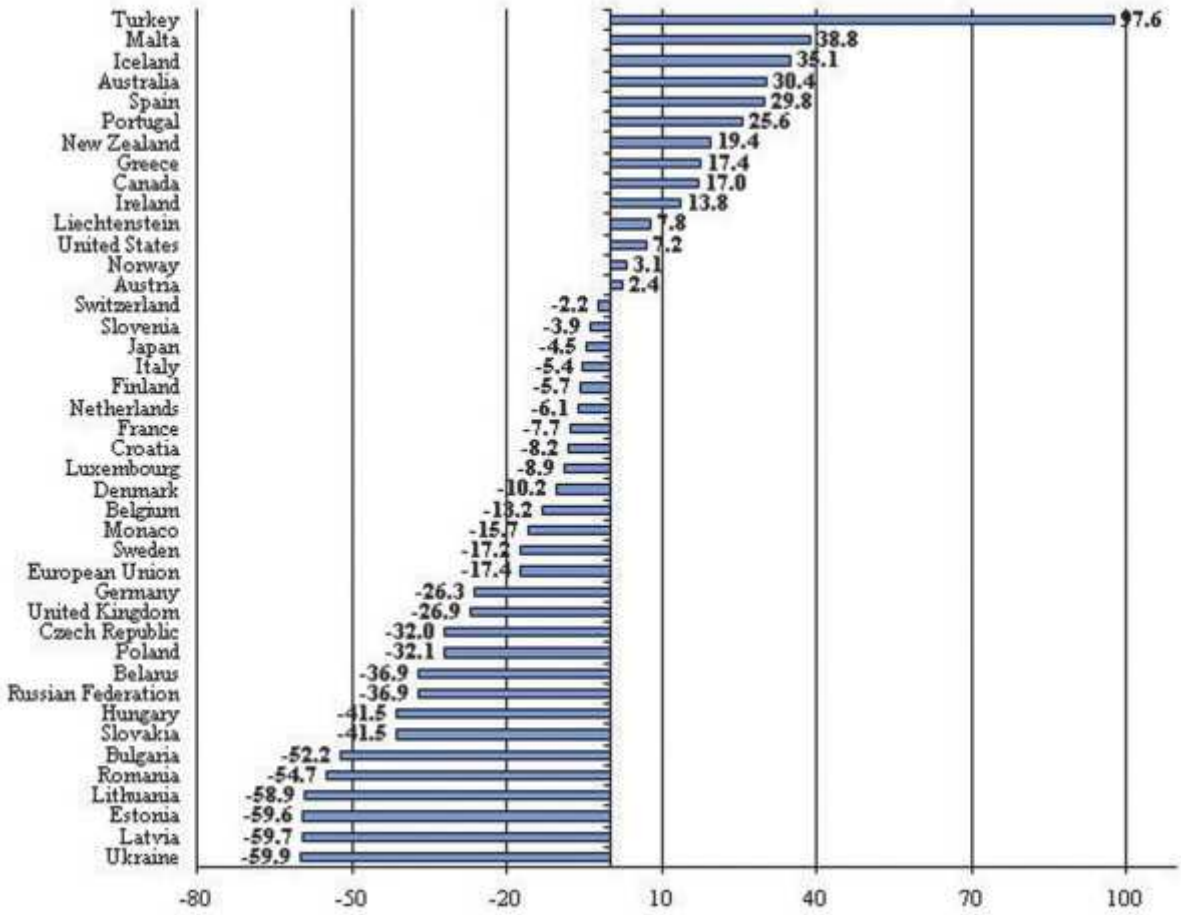
Figure 2: Total aggregate greenhouse gas emissions of individual Annex I Parties, 1990-2009 (including LULUCF). **Source:** <http://unfccc.int/files/inc/graphics/image/jpeg/changes_ including_2010.jpg>.



Thus, scientists (Steffen et al. 2004; Leemans et al. 2011; Copenhagen Conference 2009) and scientific bodies (IPCC 2007, 2007a, 2007b, 2007c, 2011, 2012; WBGU 2007/2008, 2011) have argued for a fundamental shift in the development paradigm (Clark/Crutzen/Schellnhuber 2004; WBGU 2011; Grin/Rotmans/Schot 2010; Oswald/Brauch 2011).

Many OECD countries – among them half of the G8: Canada, the US, Japan, Italy - failed to fully implement their legal obligations under the UNFCCC and the KP and to agree on a legally-binding Post-Kyoto regime. The Durban outcome "included a decision by Parties to adopt a universal legal agreement on climate change as soon as possible, and no later than 2015". Based on a proposal by the conference president, an Ad Hoc Working Group on the Durban Platform for Enhanced Action was established with the goal to "launch a process to develop a protocol, another legal instrument or a legal outcome under the Convention applicable to all Parties" that should "complete its work as early as possible but no later than 2015 in order to adopt this protocol, legal instrument or legal outcome at the twenty-first session of the Conference of the Parties and for it to come into effect and be implemented from 2020". This most recent decision reflects the dominant business-as-usual mentality among many government representatives to postpone legally binding commitments to their successors.

Figure 3: Total aggregate greenhouse gas emissions of individual Annex I Parties, 1990-2009 (excluding LULUCF). **Source:** <http://unfccc.int/files/inc/graphics/image/jpeg/changes_excluding_2010.jpg>.



This 'climate paradox' is the result of a manifold failure of the member states of the UNFCCC (Annex 1 countries) and of the KP: (i) to implement the nonbinding goals of the UNFCCC; (ii) to implement the legally binding obligations under the KP for Annex B countries; (iii) to approve a Post-Kyoto treaty with GHG reduction obligations for all countries; and (iv) the political inability and unwillingness of OECD and major threshold countries to implement both their legal obligations and abide by their policy declarations.

This 'climate paradox' is an illustration of the prevailing business-as-usual paradigm in a Hobbesian world that has been projected to result during the 21st century: (1) in major temperature increases, precipitation changes, sea-level rises and more extreme weather events

(IPCCC 2012); (ii) possible non-linear and chaotic tipping points in the climate system (Lenton et al 2006); (iii) their societal outcomes may result in severe human security dangers due to forced migration and increase in several conflict constellations in environmental and climate hotspots; and (iv) these societal outcomes as 'threat multipliers' (EU 2008, UN 2009) may trigger internal climate-induced crises, conflicts and force people to leave their homes and livelihoods (BMU 2002; WBGU 2008; Lee 2008; UN 2007, 2009, 2011; Scheffran et al. 2012) and possibly even become threats to international peace and security.

Therefore the adherents of the alternative paradigm have argued for a shift towards a fourth sustainability revolution with a (i) fundamental transformation of the Western mass culture and 'way of life'; (ii) a long-term transformative change in worldviews towards sustainability; (iii) a transformation of the prevailing mindset in politics and the business community toward decarbonized and dematerialized productive processes and consumptive patterns; and (iv) a new social contract for sustainability (between state and civil society) with new forms of governance.

3. Climate Policies of NAFTA Countries With and Without QELROs

As a basis for the assessment of past performance this brief analysis will be based only on the most recent National Communications (NC) to the UNFCC Secretariat of the USA (CAR 2010), Canada (2010) and Mexico (2009).

3.1 United States' Climate Policy

> The threat from climate change is serious, it is urgent, and it is growing. Our generation's response to this challenge will be judged by history, for if we fail to meet it—boldly, swiftly, and together—we risk consigning future generations to an irreversible catastrophe.[3]

In the Fifth NC to the UNFCCC and the *U.S. Climate Action Report 2010* (CAR 2010) the Obama Administration offered a first review of its activities on the implementation of the President's declared policy goals. This report summarized major climate change-related developments in the US between 1990 and 2007:

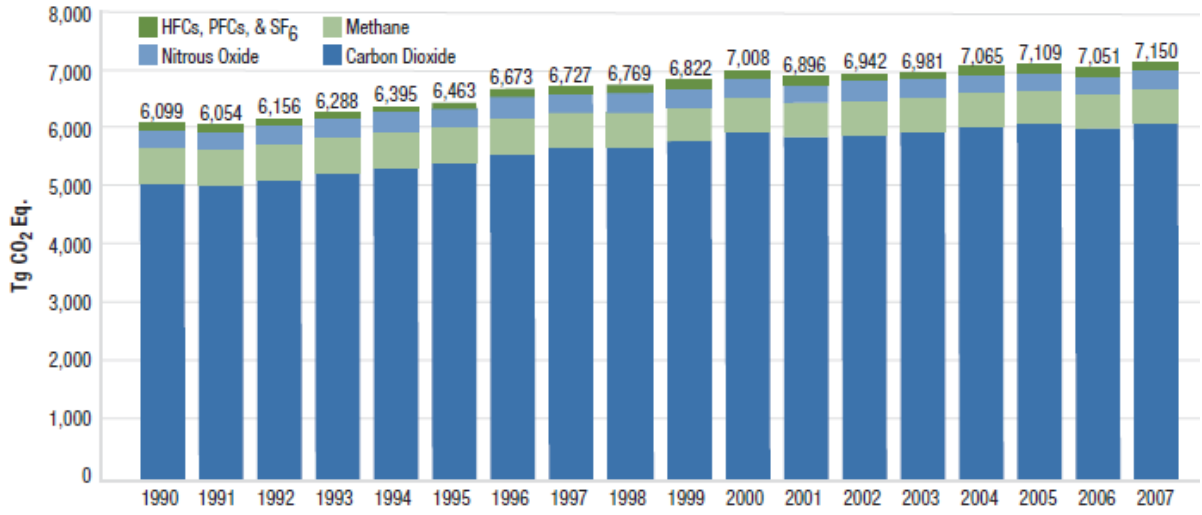
- Between 1990 and 2008, U.S. GDP grew by over $5.78 trillion (in constant 2008 dollars) or 66.9 percent, to reach $14.4 trillion (2008 dollars) [CAR 2010: 4].
- Total U.S. emissions rose by 17 percent from 1990 through 2007. The U.S. GDP increased by 65 percent and population increased by 21 percent. CO_2 accounted for approximately 85 percent of total U.S. GHG emissions in 2007 [CAR 2010: 5].
- CO_2 from fossil fuel combustion has accounted for approximately 79 percent of global warming potential-weighted emissions since 1990. Emissions of CO_2 from fossil fuel combustion increased at an average annual rate of 1.3 percent from 1990 through 2007. The … factors influencing this trend include general domestic economic growth, and significant growth in emissions from transportation activities and electricity generation.
- CO_2 emissions from fossil fuel combustion increased from 4,708.9 Tg CO2 Eq. to 5,735.8 Tg CO2 Eq., a 21.8 percent total increase. Historically, changes in emissions from fossil fuel combustion have been the dominant factor affecting U.S. emission trends.
- U.S. emissions of CH_4 declined by 5 percent, mostly due to increased collection and combustion of landfill gas, as well as improvements in technology and management practices at natural gas plants.
- Nitrous oxide (N_2O) accounted for approximately 4.4 percent of total U.S. GHG emissions in 2007. ... Overall, U.S. emissions of N_2O declined by 1 percent.
- Fluorinated substances—hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), and sulfur hexafluoride (SF6)—accounted for 2 percent of total U.S. GHG emissions in 2007. The increasing use of these compounds since 1995 as substitutes for ozone-depleting substances has been largely responsible for their upward emission trends.

[3] President Barack Obama, 22 September 2009, United Nations Summit on Climate Change, cited in the Fifth National Communications of the USA (June 2010: 1) to the UNFCCC Secretariat.

On the policies and measures the 5th US NC (CAR 2010) noted by using the year 2005 as the base year – instead of the year 1990 agreed to in the UNFCCC and in the KP:

- In June 2009, the U.S. House of Representatives passed the landmark American Clean Energy and Security Act, which includes economy-wide GHG reduction goals of 3 percent below 2005 levels in 2012, 17 percent below 2005 levels in 2020, and 83 percent below 2005 levels in 2050 [p. 6]. …
  - With additional mitigation measures, … the United States would have a GHG reduction goal of 17 percent by 2020 [CAR 2010: 6].
- From 2005 through 2020, total GHG emissions are projected to rise by 4 percent under a "with measures" scenario, from 7,109 Tg CO_2 Eq. to 7,416 Tg CO2 Eq., while the U.S. GDP is projected to grow by 40 percent. Over that period, CO_2 emissions in the baseline projection are estimated to increase by 1.5 percent, although CH_4, N_2O, and PFC emissions are expected to grow more rapidly by 8 percent, 5 percent, and 4 percent, respectively. A large portion of emissions growth is driven by HFCs, which are projected to more than double between 2005 and 2020 … The relatively slow growth forecast for CO_2 emissions is attributable to increasing use of renewable energy and policies implemented to increase efficiency [CAR 2010: 6].
- Renewable energy … currently accounting for 3 percent of U.S. electric generation excluding conventional hydro, or 9 percent including conventional hydro [CAR 2010: 13].
- Petroleum remains the largest single source of U.S. primary energy consumption; in 2008 it accounted for 37.7 percent of total U.S. energy demand, down from 41 percent in 2005. Natural gas accounts for 24.4 percent, coal for 22.4 percent, nuclear for 8.1 percent, conventional hydro for 2 percent, and other renewables for 3 percent.

Figure 4: Growth in US Greenhouse Gas Emissions by Gas. **Source:** US (CAR 2010: 25).



The above citations and figures 4 and 5 from the 5th US NC to the UNFCCC document the assessment of the Obama Administration and clearly show that both the goal of a stabilization of GHG under the UNFCCC and the 7% reduction goal under the KP have not been met. Looking back at the US climate policy during 2011, Kevin Kennedy of the World Resources Institute noted on 21 December 201:

> Our assessment is that the administration is making progress to keep the 17 percent target [below 2005 levels by 2020] within sight, but it will require a sustained effort in 2012 and beyond to reach the goal. … While the House repeatedly approved anti-environment and anti-climate measures, those efforts did not make it through the Senate. … [Regarding] President Obama's call … for a clean energy standard that would set a goal of generating 80 percent of the country's electricity from clean energy sources by 2035 … the Senate Energy and Natural Resources Committee issued a white paper for comment, no further action was taken. … In September [2011], the International Energy Agency reported that 2010 was a record year for emissions globally. … New climate and

energy legislation would make the target easier to reach, but even without legislation, we believe this is still possible with sustained effort.

Table 1: Recent Trends in US GHG Emissions and Sinks. **Source:** US NC (CAR 2010: 26-27).

Gas/Source	1990	1995	2000	2005	2006	2007
Carbon Dioxide (CO_2)	**5,076.7**	**5,407.9**	**5,955.2**	**6,090.8**	**6,014.9**	**6,103.4**
Fossil Fuel Combustion	4,708.9	5,013.9	5,561.5	5,723.5	5,635.4	5,735.8
Electricity Generation	1,809.7	1,938.9	2,283.2	2,381.0	2,327.3	2,397.2
Transportation	1,484.5	1,598.7	1,800.3	1,881.5	1,880.9	1,887.4
Industrial	834.2	862.6	844.6	828.0	844.5	845.4
Residential	337.7	354.4	370.4	358.0	321.9	340.6
Commercial	214.5	224.4	226.9	221.8	206.0	214.4
U.S. Territories	28.3	35.0	36.2	53.2	54.8	50.8
Total	**6,098.7**	**6,463.3**	**7,008.2**	**7,108.6**	**7,051.1**	**7,150.1**
Net Emissions (Sources and Sinks)	**5,257.3**	**5,612.3**	**6,290.7**	**5,985.9**	**6,000.6**	**6,087.5**

While the US failed to meet its commitments since 1990, given the political blockade, especially in the US Senate, it is unclear how the Obama Administration may achieve its 17% reduction goal by 2020 based on the year 2005 what represents a 5% reduction based on 1990 as the base year and would be below the goals of the KP until 2012. It becomes even more difficult to foresee as to how the US will achieve its 80% reduction goal by 2050 as both Presidents George W. Bush and Barack H. Obama had consented to at all G-8 summits since 2007.

3.2 Canada's Climate Policy

In its 5th NC to the UNFCCC of 12 February 2010 the Government of Canada referred to its commitment "to reduce GHG emissions to 6% below 1990 levels during the commitment period" until end of 2012 and it described its performance between 1990 and 2007 as follows:

- Canada's 2007 GHG emissions from all sources, excluding LULUCF, were 747 Mt of CO_2 eq, a 26% increase from 1990 levels of 592 Mt.
- The Canadian economy grew by almost 60% from 1990 to 2007. However, the GHG intensity of Canada's economy has progressively decreased, particularly since 1996. As a result, in 2007, the GHG intensity of Canada's economy was 21% lower than in 1990. Canada's national population also grew by 18%, largely through immigration.

Table 2: Canada's GHG Emissions by Gas and Sector. **Source:** 5th NC (Canada 2010: 22).

	CO_2 eq.			CO_2			CH_4			N_2O		
	1990	2007	change	1990	2007	change	1990	2007	change	1990	2007	change
	Gg		%	Gg		%	Gg		%	Gg		%
Energy	**469,000**	**614,000**	**+31**	**424,000**	**550,000**	**+30**	**1,740**	**2,560**	**+47**	**27.3**	**33.2**	**+22**
Fuel Combustion Activities	427,000	549,000	+29	414,000	534,000	+29	212	238	+12	27.2	33.1	+22
Energy Industries	147,000	196,000	+34	144,000	193,000	+33	77.5	111	+43	2.84	3.71	+31
Manufacturing and Construction	63,100	72,500	+15	62,500	71,800	+15	2.78	3.35	+20	1.72	2.15	+25
Transport	145,000	200,000	+37	138,000	192,000	+38	31	30.1	-3	20.4	24.7	+21
Other Sectors	71,600	81,000	+13	68,800	78,200	+14	101	93.8	-7	2.26	2.52	+11
Fugitive Emissions from Fuels	42,700	64,800	+52	10,600	15,900	+51	1,530	2,330	+52	0.101	0.122	+21
Solid Fuels	1,910	764	-60	-	-	-	91.2	36.4	-60	-	-	-
Oil and Natural Gas	40,700	64,100	+57	10,600	15,900	+51	1,440	2,290	+60	0.101	0.122	+21
Total, excluding LULUCF	592,000	747,000	+26	456,000	590,000	+29	3,520	4,760	+35	162	155	-4
Land Use Change & Forestry	**-51,600**	**45,500**	**+188**	**-57,600**	**35,400**	**+161**	**178**	**295**	**+65**	**7.48**	**12.4**	**+66**
Forest Land	-78,700	38,300	+149	-84,100	28,700	+134	160	283	+77	6.69	11.9	+78
Cropland	12,700	-3,390	-127	12,200	-3,640	-130	13.5	7.17	-47	0.608	0.334	-45
Wetlands	4,960	2,650	-46	4,950	2,650	-46	0.303	-	-100	0.013	-	-100
Settlements	9,510	7,840	-18	9,360	7,690	-18	4.91	4.88	-1	0.168	0.163	-3
Total, including LULUCF	540,000	792,000	+47	398,000	626,000	+57	3,690	5,060	+37	169	167	-1

To achieve its GHG emission reduction goals the Canadian government has adopted several national policies and measures, such as clean electricity, energy efficiency improvements, *carbon capture and storage* (CCS), reduction of vehicle emissions and renewable fuels. In its 5th NC to the UNFCCC Secretariat the Canadian government admitted that in 2007 Canada's GHG emissions were 33.8% above its Kyoto target (figure 5).

Figure 5: Canadian GHG Emissions Trends and Targets. **Source:** 5th NC (Canada 2010: 21).

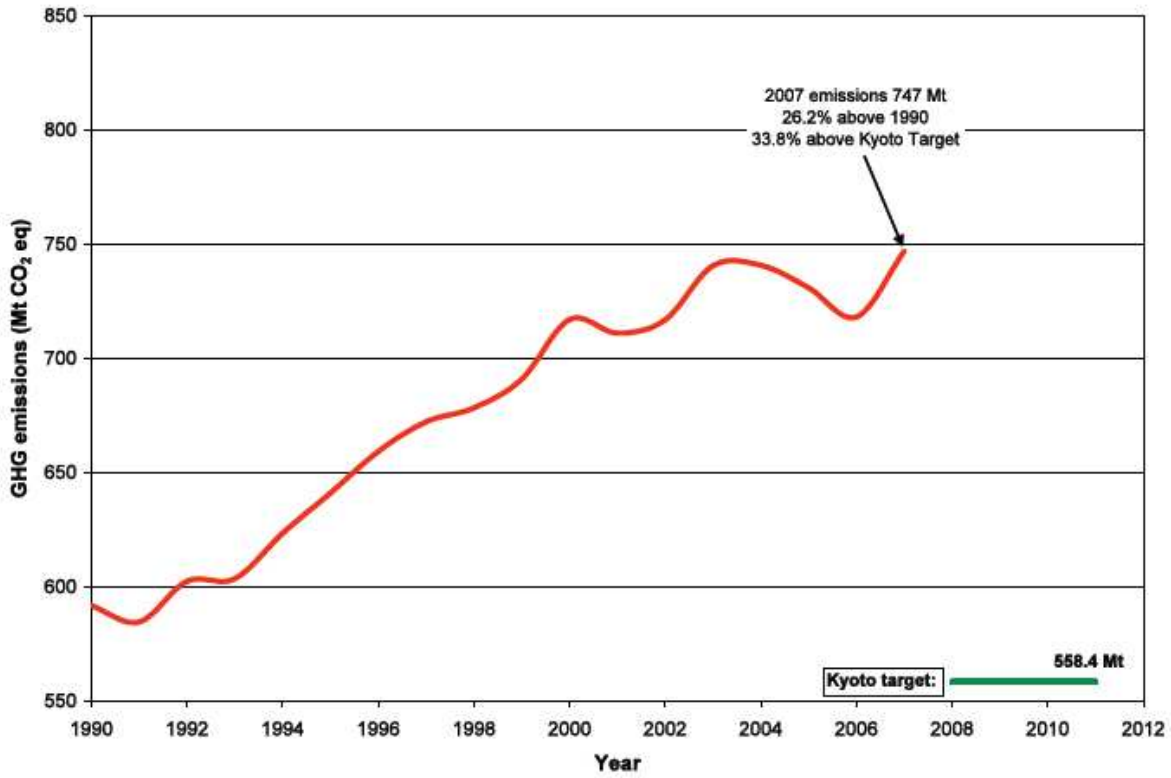
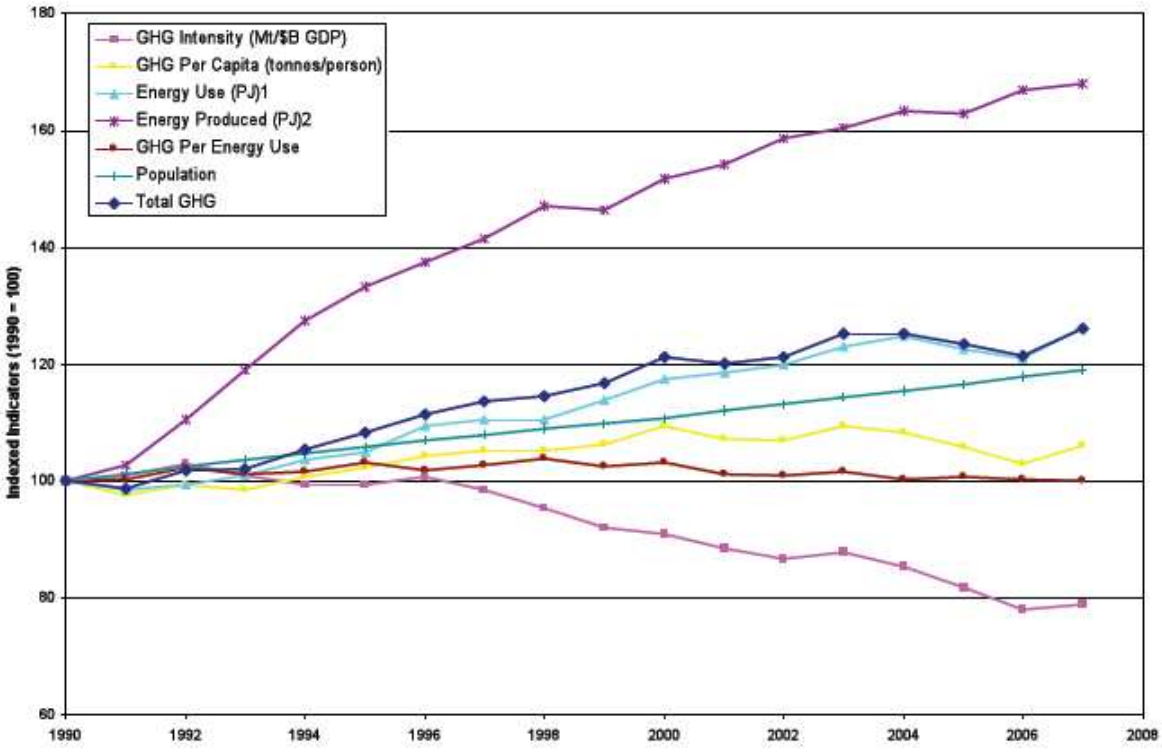


Figure 6: Trends in Energy, Population and GHG Emission indicators for Canada. **Source:** 5th NC (Canada 2010: 21).



Between 1990 and 2007, the total energy produced increased significantly and the energy use as well as the GHG emissions increased faster than the high population growth, only the GHG per capita and per energy use and the GHG intensity declined (figure 6). Emissions increased in all sectors, except for landuse change and forestry (table 2). Table 3 offers an overview of the growing GHG emissions for the energy sector especially for electricity generation.

Table 3: GHG Contribution of Energy Industries. **Source:** 5th NC (Canada 2010: 24).

	1990	2004	2005	2006	2007
	Mt CO_2 eq				
Public Electricity and Heat Production	95.5	126.8	124.7	117	126
Electricity Generation	95	125	123	116	125
Heat Generation	0.7	2.03	1.4	1.37	1.4
Petroleum Refining	16	18	17	16	18
Manufacture of Solid Fuels and Other Energy Industries	36	53	49	50	52
Energy Industries Total	147.5	197.8	190.7	183	196

In chapter 4, the Canadian government listed the many policies and measures it had undertaken by the national and the provincial governments to change the GHG trends it listed in its official assessment. With the Kyoto Protocol Implementation Act (KPIA) of 22 June 2007 the government adopted a legal framework that aimed to achieve minor reductions in GHG emissions between 2008 and 2012 with additional measures (table 4).

Table 4: Canada's projected emission level under the KPIA (2007). **Source:** 5th NC (Canada 2010: 65).

	2008	2009	2010	2011	2012
	Mt				
Projected emissions excluding Government Measures	749	739	743	766	790
Expected emissions including Government Measures	748	737	691	702	716
Expected emissions reductions	1	2	52	64	74

On 11 December 2011, as the first country Environment Minister Kent announced Canada's unilateral withdrawal from the KP arguing that this would save Canada $14 billion in penalties. Canada would join a new global commitment with the two biggest GHG emitters, China and the US.[4] Canada's Conservative Prime Minister Harper claimed that the KP hurt the competitiveness of the Canadian economy. Although Canada had noted in its 5th NC of 2012 its high vulnerability to the of climate change impacts, Environment Minister Kent prioritized creating new jobs and supporting the economy to purchasing carbon credits.

3.3 Mexico's Climate Policy

Mexico's National Development Plan (2007-2012) addressed actions for CC mitigation and adaptation. The Environment and Natural Resources Sector Program (2007-2012) developed a National Strategy of Climate. A Special Program on CC (2009-2012) committed unilateral voluntary emissions reductions of 50% by 2050 compared to a baseline year of 2000; research results in the medium and long run and a study on the Economics of CC for Mexico. Since 2005, the Interministerial Commission on CC has coordinated the national policies for prevention and mitigation of GHG emissions, and for adaptation to CC impacts. In 2010,

[4] See many press reports including: *The Star*, 12 December 2011; Bill Curry and Shawn Mccarthy: "Canada formally abandons Kyoto Protocol on climate change", in: *Globe and Mail*, 12 December 2011; Ian Austin: "Canada Announces Exit from Kyoto Climate Treaty", in: *New York Times*, 12 December 2011.

Mexico hosted COP-16 of the UNFCCC in Cancun which resulted in the Cancun Agreements. According to Mexico's 4th NC (2009: 26), from 1990-2006, Mexico's GHG emissions increased by "approximately 40%, [with] an average annual growth of 2.1%". In 2006,

- GHG emissions in units of … CO_2 eq for Mexico were 709,005 Gg. The contribution by category in terms of CO_2 eq is as follows: energy uses: 60.7% (430,097 Gg); waste: 14.1% (99,627.5 Gg); land use, land-use change and forestry: 9.9% (70,202.8 Gg); industrial processes: 9% (3,526 Gg); and agriculture: 6.4% (45,552.1 Gg).
- GHG emissions by sector: Energy industry: 35% (49,137 Gg); followed by transportation: 34% (144,691 Gg); manufacturing and construction industry: 13% (56,832 Gg); fugitive emissions: 11% (47,395 Gg); and other sectors (residential, commercial and agricultural): 7% (32,042 Gg).
- GHG emissions by gas, measured in CO_2 eq are: CO_2, 492,862.2 Gg (69.5%); CH_4, 185,390.9 Gg (26.1%); N_2O, 20,511.7 Gg (2.9%), and the remaining 1.4% is made up of 9,586.4 Gg of HFCs, and 654.1 Gg of SF6.

Regarding future GHG projections INE (2009) coordinated a *Study on the Impact of Renewable Energy Sources of GHG Emissions in Mexico in the Medium and Long Term*s, that was carried out by the Electric Power Research Institute and a study on *GHG Emissions Scenarios in the Medium and Long Terms, 2020, 2050 and 2070*, prepared by the Mexican Institute of Petroleum.

Based on official data supplied by the three governments to the UNFCCC Secretariat a clear trend emerges: In all three countries GHG emissions increased significantly since 1990: for Mexico until 2006 by 40, for Canada until 2007 33,8% above its target under the KP and for the USA until 2009 by about 5.6% to 7.2% above the level of 1990. Given the present policy framework, it is highly unlikely that Mexico will meet its 50% GHG reduction goal by 2050 (with the base year of 2000) and the US of 80% (with the base year 2005). A continuation of the past business-as-usual policies on climate change may result in significant physical and societal effects of climate change that cannot be prevented with military means.

4. European Proposal for a Sustainability Transition in the Energy Sector

What has been the performance of EU member states – based on the UNFCCC assessment (figure 2 and 3) – what have been the adapted policies of the 27 EU member countries and what are the long-term conceptual goals of the European Commission to meet the goals expressed in the declarations of the G-8 – with the presence of the EU - since 2007.

4.1. Performance of EU Member Countries

According to the assessment of the UNFCCC Secretariat on the "total aggregate greenhouse gas emissions of individual Annex I Parties, 1990-2009 (including LULUCF)" the overall GHG emissions of the 27 EU member countries declined by 20.2%, only four Mediterranean countries had increased their emissions above the targets of the KP: Malta (+39.7%; KP: no target), Spain (+28.3%; KP: -8%; EU goal: +15%), Portugal (+20.9%; KP: -8%; EU:+27%), Greece (+17.2%; KP: -8%; EU:+25%) and in addition Ireland (+ 11.0% KP: -8%; EU:+13%), while among the initial 15 EU countries that were part of a EU's burden sharing agreement of 1998: Germany (-23.0%; KP: -8%; EU: -21%), UK (-27.7%; KP: -8%; EU: -12,5%), and Sweden (-33.7%; KP: -8%; EU: +4%) were both above their national targets under the KP and the EU's internal targets that reflect different stages of development. These figures show that the goals of the KP were achievable if the people were convinced of the urgency and the governments took the courage to implement their commitments nationally and in the case of the EU the European Commission independently monitored their actual implementation.

4.2 The EU Energy Roadmap of a 80-95% Reduction of GHG Emissions by 2050

While Canada withdrew by end of 2011 from the Kyoto Protocol, on 15 December 2011 the European Commission (2011) released its *Energy Roadmap 2050* (Communication from the

Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions, COM(2011) 885/2), according to which:

> The EU is committed to reducing greenhouse gas emissions to 80-95% below 1990 levels by 2050 in the context of necessary reductions by developed countries as a group. The Commission analyzed the implications of this in its 'Roadmap for moving to a competitive low-carbon economy in 2050'. The 'Roadmap to a Single European Transport Area' focused on solutions for the transport sector and on creating a Single European Transport Area. In this Energy Roadmap 2050 the Commission explores the challenges posed by delivering the EU's decarburization objective while at the same time ensuring security of energy supply and competitiveness. It responds to a request from the European Council.

Prior to COP 15 in Copenhagen, in March 2007 the European Council had adopted the triple goal:

> by 2020, at least 20% reduction in greenhouse gas emissions compared to 1990 (30% if international conditions are right, European Council, 10-11 December 2009); saving of 20% of EU energy consumption compared to projections for 2020; 20% share of renewable energies in EU energy consumption, 10% share in transport.

Figure 7: EU Decarbonization scenarios - 2030 and 2050 range of fuel shares in primary energy consumption compared with 2005 outcome (in %). **Source:** EU Commission (2011: 5).

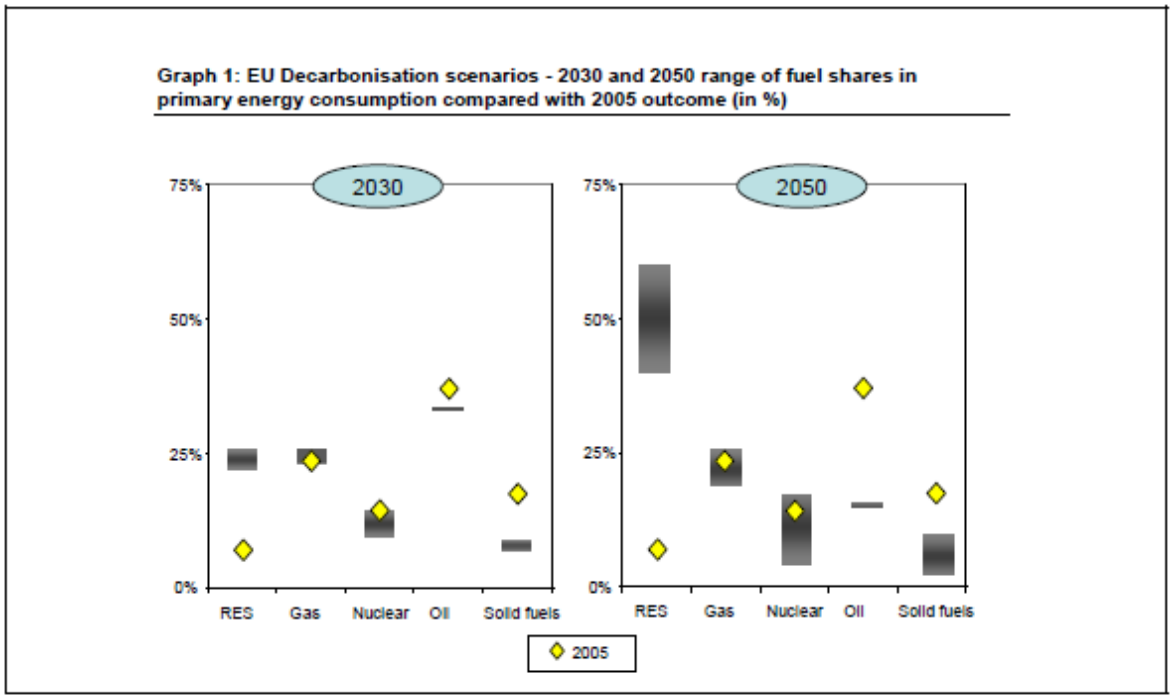


Figure 7 illustrates the share of the individual energy sources for the year 2005 and their projected share for 2030 and 2050 for the 27 EU member countries by end of 2011. The share of renewables is projected to increase to 20% by 2020, 25% by 2030 and 40 to 60% by 2050.

The EU's Energy Roadmap 2050 relied on several *Current trend scenarios*: a) Reference scenario (growth 1.7% pa) that includes the 2020 targets for RES and the *Emissions Trading Scheme* (ETS) Directive; b) *Current Policy Initiatives* (CPI) that includes proposed actions concerning the 'Energy Efficiency Plan' and the new 'Energy Taxation Directive'.

The *Decarbonization scenarios* include: a) High Energy Efficiency scenario calls for a decrease in energy demand of 41% by 2050 as compared to the peaks in 2005-2006; b) Diversified supply technologies that are driven by carbon pricing assuming public acceptance of both nuclear and *Carbon Capture & Storage* (CCS): c) High *renewable energy sources* (RES) aiming at 75% in 2050 and a share of RES in electricity consumption reaching 97%; d) *Delayed CCS* with higher shares for nuclear energy, where decarbonization is driven by

carbon prices rather than technology push; and e) Low nuclear assuming that no new nuclear reactors are being built resulting in a higher penetration of CCS (32% in power generation).

The EU Energy Roadmap 2050 argues that "in combination, the scenarios make it possible to extract some conclusions which can help shape decarbonization strategies today which will deliver their full effects by 2020, 2030 and beyond". The Roadmap relies on 10 components:

1. Decarbonization is possible – and can be less costly than current policies in the long-run;
2. Higher capital expenditure and lower fuel costs;
3. Electricity plays an increasing role;
4. Electricity prices rise until 2030 and then decline;
5. Household expenditure will increase;
6. Energy savings throughout the system are crucial;
7. *Renewables rise substantially;*
8. Carbon capture and storage has to play a pivotal role in system transformation
9. Nuclear energy provides an important contribution
10. Decentralization and centralized systems increasingly interact.

The EU Energy Roadmap 2050 stated that

> The analysis of all scenarios shows that the biggest share of energy supply technologies in 2050 comes from renewables. Thus, the *second major pre-requisite* for a more sustainable and secure energy system is a *higher share of renewable energy* beyond 2020. In 2030, all the decarbonization scenarios suggest growing shares of renewables of around 30% in gross final energy consumption. The challenge for Europe is to enable market actors to drive down the costs of renewable energy through improved research, industrialization of the supply chain and more efficient policies and support schemes. …

According to the *EU Energy Roadmap 2050*:

> Renewables will move to the centre of the energy mix in Europe, from technology development to mass production and deployment, from small-scale to larger-scale, integrating local and more remote sources, from subsidized to competitive. This changing nature of renewables requires changes in policy parallel to their further development. Incentives in the future, with increasing shares of renewables, have to become more efficient, create economies of scale, *lead to more market integration and as a consequence to a more European approach*. This has to build on using the full potential of the existing legislation, on the common principles of cooperation among Member States and with neighboring countries, and possible further measures. …

The *EU Energy Roadmap 2050*: argued that

> In the near future, wind energy from the Northern Seas and the Atlantic sea basin can supply substantial quantities of electricity with declining costs. By 2050 wind power provides more electricity than any other technology in the High Renewables scenario. … Wind and solar power from the Mediterranean countries could deliver substantial quantities of electricity. The opportunity to import electricity produced from renewable sources from neighboring regions is already complemented by strategies to use the comparative advantage of Member States. … The EU will continue encouraging and facilitating the development of renewable and low-emission sources of energy in the Southern Mediterranean and interconnections with European distribution networks.

EU Energy Roadmap 2050 projects that

> The share of renewable energy (RES) rises substantially in all scenarios, achieving at least 55% in gross final energy consumption in 2050, up 45 percentage points from today's level at around 10%. The share of RES in electricity consumption reaches 64% in a High Energy Efficiency scenario and 97% in a High Renewables Scenario that includes significant electricity storage to accommodate varying RES supply even at times of low demand.

In moving from 2020 to 2050 the EU Energy Roadmap 2050 suggested a fundamental transformation of the energy system including the following measures:

a) Energy saving and managing demand: a responsibility for all;
b) Switching to renewable energy sources;
c) Gas plays a key role in the transition;
d) Transforming other fossil fuels;
e) Nuclear energy as an important contributor;
f) Smart technology, storage and alternative fuels

It also suggested a "rethinking energy markets" by new ways to manage electricity and integrating local resources and centralized systems, as well as "mobilizing investors" and "engaging the public" and "driving change at the international level" by developing cooperation to build international partnerships on a broader basis. To achieve "this new energy system" by 2050 the EU Energy Roadmap 2050 stated that ten conditions must be met:

1. The immediate priority is to implement fully the EU's Energy 2020 strategy. All existing legislation needs to be applied, and the proposals currently in discussion, notably on energy efficiency, infrastructure, safety and international cooperation, need to be adopted swiftly. The path towards a new energy system also has a social dimension. ...
2. The energy system and society as a whole need to be dramatically more energy efficient. The co-benefits of achieving energy efficiency in a wider resource efficiency agenda should contribute to meeting the goals in a faster and cost-efficient manner.
3. Particular attention should continue to be given to the development of renewable energy. Their rate of development, impact in the market and rapidly growing share in energy demand call for a modernization of the policy framework. The EU's 20% renewable energy target has so far proven an efficient driver in development of the renewable energy in the EU and timely consideration should be given to options for 2030 milestones.
4. Higher public and private investments in R&D and technological innovation are crucial in speeding-up the commercialization of all low-carbon solutions.
5. The EU is committed to a fully integrated market by 2014. … New ways of cooperation are required for the internal energy market to deliver its full potential as new investments are coming into the energy market and the energy mix is changing.
6. Energy prices need to better reflect costs, notably of the new investments needed throughout the energy system. The earlier prices reflect costs, the easier the transformation will be in the long run. Special attention should be paid for the most vulnerable groups, for which coping with the energy system transformation will be challenging. Specific measures should be defined at national and local levels to avoid energy poverty.
7. A new sense of urgency and collective responsibility must be brought to bear on the development of new energy infrastructure and storage capacities across Europe and with neighbors.
8. There will be no compromise on safety and security for either traditional or new energy sources. The EU must continue to strengthen the safety and security framework and lead international efforts in this field.
9. A broader and more coordinated EU approach to international energy relations must become the norm, including redoubling work to strengthen international climate action.
10. Member States and investors need concrete milestones. The Low carbon economy roadmap has already indicated greenhouse gas emission milestones. The next step is to define the 2030 policy framework, reasonably foreseeable and the focus of most current investors.

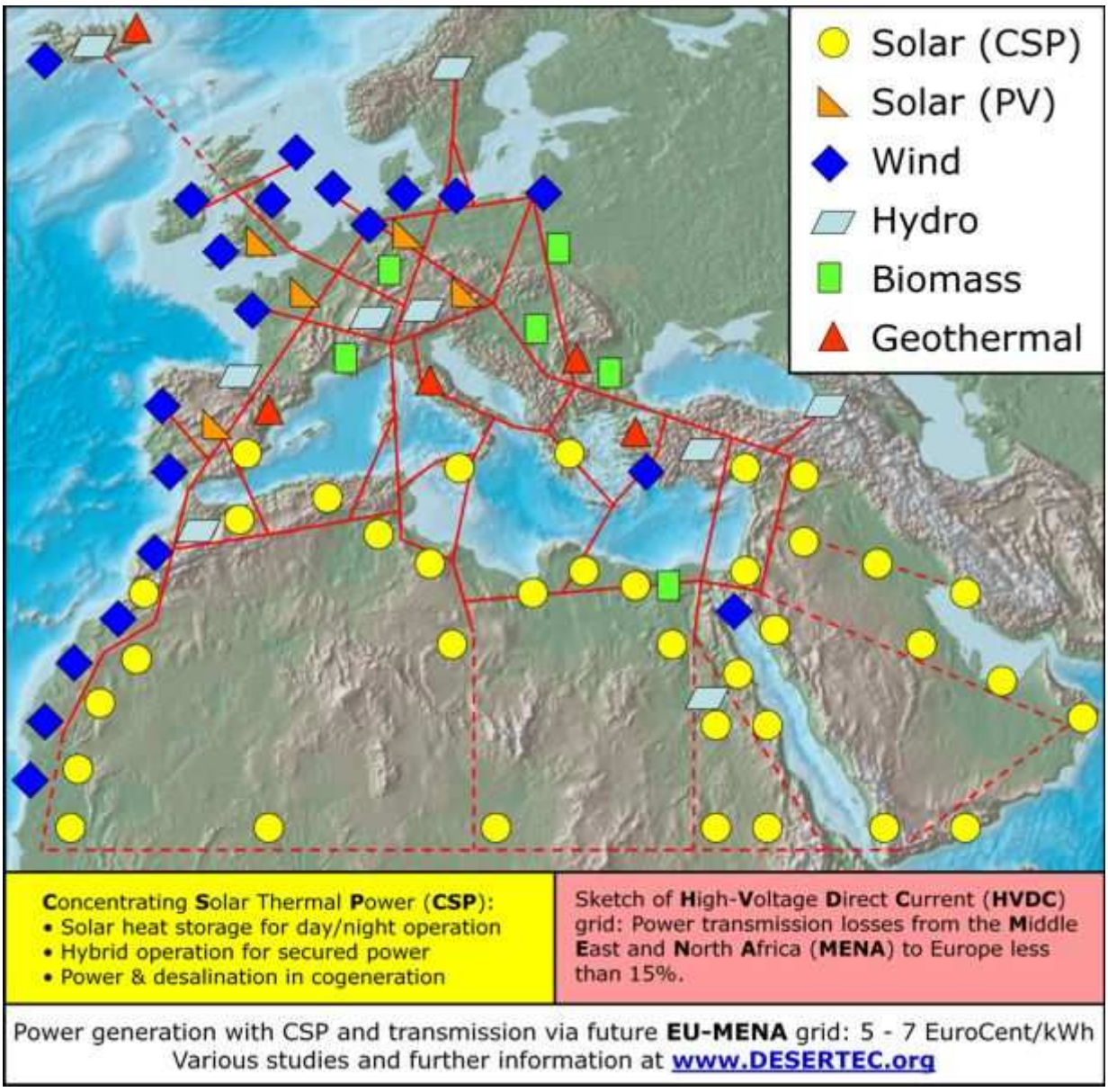
With this energy roadmap 2050, the European Commission offered a policy perspective based on the assumption that the goals proclaimed by the heads of states and governments at the G-8 level every year since 2007 are technically feasible but that the gradual transformation would require a strong political will and a sense of urgency among policy makers.

4.3. DESERTEC: Importing solar energy for electricity from the Sahara Desert

One of the options to import electricity from *concentrated solar power* (CSP) from the MENA region is presently being examined in the context of the EU's *European Solar Plan* (ESP) that was launched in 2008 in the framework of the *Union for the Mediterranean* (UfM). In July 2009 the *Desertec Industrial Initiative* (dii) was formed.

Initial conceptual and technical ideas for using the physical energy potential of the deserts resulted in the *Trans-Mediterranean Renewable Energy Cooperation* (TREC) concept. Several experts involved in the TREC project have developed since 2003 the DESERTEC concept, since 2009 in the framework of the Desertec Foundation (figure 8).

Figure 8: Conceptual development of a Trans-European and EU-MENA renewable energy network: From the TREC to the DESERTEC concept. **Source:** Desertec Foundation



As a result of 30 years of cooperation between CIEMAT and DLR, solar thermal electricity generating plants have been built since 2006 in Andalucia (e.g. Andasol I, II and III). The technology is being introduced into the market and with improvements in technology, an economy of scale is gradually emerging, and prices are falling. These new technologies will gradually become competitive during the next decade.

On 13 July 2008, with the establishment of the UfM, the ESP of the EU was chosen as one of six key projects, and it was developed further during the meeting of the foreign ministers of the 43 participating countries in November 2008.[5] Work on a *Master Plan Study* (MPS) started in early 2009 that is to outline "concrete steps for the development of: a) solar thermal

[5] This section is based on Brauch (1999, 2010, 2012); most sources are based on developments until July 2011.

power plants, b) solar photovoltaic, c) other renewable energy installations, d) export of electricity to the EU along with local energy needs, e.g. for water desalination". This MPS is to develop a roadmap detailing the phases, activities, and precise timeline for the implementation of the MSP. In February 2010, a strategy paper suggesting two targets was examined by the MSP Expert Group: (i) developing 20 GW of new renewable energy production capacities, and (ii) achieving significant energy savings around the Mediterranean by 2020, thus addressing both supply and demand. The goal was to develop the MSP by 2011 and to implement it during the planned deployment phase (2011-2020), reaching the 20 GW target by 2020. In May 2010, the European Commission stated that the development of the MPS was to take place in close collaboration with a team from the technical assistance project *Paving the Way to the Mediterranean Solar Plan*, and with other EU cooperation initiatives. The MSP complements the work funded under the *European Neighborhood and Partnership Instrument* (ENPI):

The *European Investment Bank* (EIB) has also played a key role in implementing the MSP by dedicating more than €3.6 billion to energy projects between October 2002 and 2010 through its *Facility for Euro-Mediterranean Investment and Partnership* (FEMIP), representing almost 40 per cent of its total financing over the period. On 2-3 June 2010, the Sixth Euro-Mediterranean Ministerial Conference on Energy & Renewable Energy in Cairo noted the important role of financial institutions, such as

> The World Bank through the *Clean Technology Fund* (CTF) approved financing of $750 million on December 2, 2009, which will mobilize an additional $4.85 billion from other sources, to accelerate global deployment of *Concentrated Solar Power* (CSP). It will do so by investing in the CSP programs of five countries in the Middle East and North Africa (Algeria, Egypt, Jordan, Morocco, and Tunisia). In addition, The *European Investment Bank* (EIB), the KfW Development Bank, and the *Agence Française de Développement* (AFD) decided to jointly earmark 5 billion Euros, for the 5 coming years dedicated to renewable energy and energetic efficiency.[6]

However, due to the unresolved Israeli-Arab conflict, the UfM remained divided and partly paralyzed. On 5-6 July 2011, the 1st Joint Committee of National Experts for the MSP of Algeria, Austria, Croatia, Cyprus, Egypt, Finland, France, Germany, Greece, Israel, Italy, Jordan, Malta, Morocco, the Palestinian Authority, Spain, Sweden, Tunisia, Turkey, and the United Kingdom met in Barcelona with representatives of the European Commission, the League of Arab States, the EIB, the KfW, and of the *Paving the Way to the MSP technical assistance project*.

The *DESERTEC Industrial Initiative* (Dii) was launched on 13 July 2009 in Munich with the goal: "to analyze and develop the technical, economic, political, social and ecological framework for carbon-free power generation in the deserts of North Africa". Its planning entity includes the DESERTEC Foundation, which is to contribute to the realization of this concept, and which works "for creating a global alliance to ensure security of energy supplies, to promote economic development, and to stabilize the world's climate". Among the Dii's main goals are the drafting of concrete business plans and associated financing concepts, and the initiating of industrial preparations for building many networked solar thermal power plants distributed throughout the MENA region. The initiative's clear focus on implementation is set out in the Dii Principles for all future Dii shareholders. Besides the business opportunities for the companies, there are other economic, ecological, and social potentials:

- greater energy security in the EU-MENA countries;
- growth and development opportunities for the MENA region as a result of substantial private investment;

[6] See: Council of the EU, (7 May 2010), Document 9558/10, ENER 141, MED 35; at: <http://register.consilium.europa.eu/pdf/en/10/st09/st09558.en10.pdf > (28 November 2010).

- safeguarding the future water supply in the MENA countries by utilizing excess energy in seawater desalination plants; and
- reducing carbon dioxide emissions and thus making a significant contribution to achieving the climate change targets of the European Union and the German Federal Government.

On 31 October 2009, the Desertec limited liability company was established with the goal "to satisfy a substantial part of the energy needs of the MENA countries and meet as much as 15 per cent of Europe's electricity demand by 2050". By November 2010, Dii had grown to 18 shareholders and 33 associate partners in North Africa and the Middle East, and representing a network of companies in 13 countries worldwide. Dii's first Annual Conference on "Energy from the deserts" in Barcelona on 26-27 October 2010 included high-profile stakeholders, from Algeria, Egypt, Libya, Morocco, and Tunisia, and wind and solar energy companies.

On 3 November 2010, the DESERTEC Foundation, together with 18 universities and research facilities, launched the *Desertec University Network* (DUN). During the first DUN Workshop at the Wuppertal Institute on 28 June 2011, various proposals were made for launching a *DESERTEC employment/industrialization-policy institute* (DEPI), for setting up an *Academic-Industrial Think Tank* (AITT), for initiating an internship program for expatriate engineers, for introducing a *revenue optimized market introductions strategy* (ROMIS), and for realizing a dry-oasis recovery project.

Dii will not make any investments itself, nor will it build or operate any power plants. During the planning phase (until late 2012) a suitable framework for the long-term development of renewable energies will be set up to invest in generation plants and power grids. Dii will launch several reference projects to demonstrate the fundamental viability of the Desertec vision. In spring 2011, the *Moroccan Agency for Solar Energy* (Masen) and Dii signed a *Memorandum of Understanding* (MoU) about a reference project and they jointly plan:

- installed capacity: 400 MW solar thermal power station, 100 MW photovoltaic plant;
- output: approximately 1.4 – 1.6 TWh of renewable energy;
- export: 80 per cent to Europe, of which approximately 1 TWh of energy to Germany;
- percentage of energy supplied locally: 20 per cent;
- a contribution towards achieving the 2020 environmental protection objectives.

The amount of investment required by this project is estimated at between €1.7 billion and €2 billion. Also in spring 2011, Dii and STEG Energies Renouvables initiated a feasibility study for solar and wind energy projects in Tunisia. In Egypt, an intensive debate is focusing on nuclear vs. solar energy. At an energy seminar on 9 June 2011 in Cairo, analysts argued that

> Egypt could generate more power through solar energy than through a multi-billion-dollar nuclear program. Speakers referred to the European Union, members of which were abandoning nuclear reactors in wake of the recent disaster in Japan. … The analysts said Egypt could exploit winds that blow along the Gulf of Suez to generate 20,000 megawatts of electricity. Egypt's nuclear program has envisioned the acquisition of 1,000 megawatt reactors.

The Desertec project triggered a policy debate that addressed political, economic, and security considerations, considerations that since spring 2011 had been increasingly influenced by the political changes in North Africa with the ousting of the regimes in Tunisia and in Egypt.

According to Mouldi Miled (Tunisia), executive director of the DUN, Europe could "gain 10 to 15 years in the fight against climate change" by importing solar energy from North Africa, as well as meeting its renewable energy commitments. For supporters from the MENA, Desertec is seen "as a boon both for their nations' development and for their science, engineering and manufacturing communities".

According to the *New York Times*, for many scientists from North Africa, Desertec could help "to build bridges between the north and south" and they argued that the Arab spring "will

yield to strong democracies that will better enable projects like Desertec". At a conference in Hamburg in mid-June 2011, Egyptian participants argued that the components for these solar energy projects should at least be 80 per cent locally produced and one participant

> proposed the development of an EUMENA solar energy center of excellence to exchange research. He recommended developing a blueprint of priorities that benefit both European and North African countries such as Egypt, which boasts the world's first solar thermal power plant and has attracted billions in solar and wind development in the past decade.

However, according to a World Bank study "by 2030, the [MENA] region would see a mix of pure local production and local production with international firms. The region could create about 80,000 jobs in construction services and manufacturing if it can produce between 5 and 7 gigawatts of electricity". In 1999, a report recommended a set of policy measures in support of a development partnership on renewables in the Mediterranean for NGOs, universities and research institutes, the German federal and the state governments, the European Union, and industry (Brauch 1999).

Prior to the Arab spring of 2011, several analysts were skeptical about the Desertec scheme, mentioning the authoritarian regimes in MENA countries, the high degree of instability, and the danger of Islamist regimes that could threaten this region with additional energy dependence in the electricity sector. Others mentioned structural financial and commercial barriers due to the costs of the power plants and the electricity network, and conflicts of interests.

Since the Arab revolutions in 2011, several analysts have become more favorable, pointing to the potential of sustainable co-development between the EU and MENA regions, while others called for a Euro-Mediterranean geostrategic interest policy as part of a strategy of capacity development in the framework of a forward-looking European Neighborhood Policy. A special issue of *Energy Policy* (2011) reviewed the *Energy Futures of North Africa* in detail, and a Special Report of Working Group III of the IPCC (2011) assessed the *Renewable Energy Sources and Climate Change Mitigation* (SRREN).

5. NAFTA Proposals for a Sustainability Transition in the Energy Sector

May the 'approach' taken by the European Commission in its *Energy Roadmap 2050* that calls for a major transformation of the energy system of the EU's member countries also be relevant for the NAFTA region? May these strategy and policy goals of the *Desertec Industrial Initiativ*e (Dii) be also relevant for North America assisting the USA, Canada and Mexico to overcome the 'climate paradox' and to achieve the goals of a 80% reduction of GHG by 2050 that were endorsed by President Obama and Prime Minister Harper most recently during the G-8 summit in Deauville (France) in May 2011.

5.1 Lack of Political Vision, Will, Ability and Policy Support

A major obstacle has been a lack of political vision, of a sense of political urgency, political will and capability of the political leadership to lead and persuade and to overcome both powerful lobby groups, rightwing ideologues and climate skeptics in the US. A major force to delegitimize the scientific consensus reflected in the first four IPCC assessments reports (1990, 1995, 2001, 2007) in the US has been the Heartland Institute in Chicago with its campaign against any implementing laws on climate change and it argued on its website:

> While the likelihood that global warming would be a crisis was never large and is getting even smaller as new research is reported, we know the cost of reducing man-made greenhouse gas emissions would be high. An analysis of a carbon "cap-and-trade" proposal considered by the U.S. Senate in 2008 – the Lieberman-Warner Act – found it would destroy between 1.2 and 1.8 million jobs in 2020 and between 3 and 4 million jobs in 2030; impose a financial cost on U.S. households

> of $739 to $2,927 per year by 2020, rising to $4,022 to $6,752 by 2030; and would increase the price of gasoline between 60 percent and 144 percent by 2030 and the price of electricity by 77 percent to 129 percent (National Association of Manufacturers/ACCF 2008). States that try to reduce emissions on their own are likely to incur costs 10 times greater than a national program because businesses and residents would find it easier to move to nearby states with lower energy costs or less-burdensome regulations and because states would have to rely on more costly command-and control regulatory approaches (Bast/Taylor/Lehr 2003).
>
> The record of existing emissions trading programs gives little basis for supposing a massively bigger regime would work. … European emissions trading programs have been characterized by low trading volumes, high price volatility, and mostly paper transactions that do not result in actual reductions in emissions. Most European countries are far behind schedule in meeting their emission reduction goals under the Kyoto Protocol.

Their claim on the performance of most EU countries on the KP is incorrect (see figures 2, 3), But the well-financed campaign of the climate skeptics in the US and Canada and their allies in the media have succeeded since 2007 to partly discredit the IPCCC and to downgrade the political urgency of national action to cope with the impacts of climate change (Klein 2012). The Heartland Institute claimed that the US government

> is spending billions of dollars every year on research. State and federal governments are massively subsidizing ethanol producers and wind and solar power generators in the name of "reducing carbon emissions." Billions of dollars more are being spent by businesses and consumers complying with regulations that are said to be justified by concern over global warming. In light of the compelling scientific evidence that global warming is not a crisis, policymakers should consider reducing current spending on climate change and repealing regulations and mandates that were previously justified by fear of global warming. More specifically, they should consider the following policies:
>
> - Oppose higher energy taxes or carbon 'cap-and-trade' programs.
> - Repeal renewable energy mandates that require utilities and their customers to buy high-priced electricity from solar and wind companies.
> - Support research independent from government research programs that are biased toward alarmism.
> - Remove barriers to energy conservation embedded in state and local laws and regulations, such as restrictive building codes and zoning ordinances.
> - Support research and, if appropriate, capital investments in adapting to climate change rather than trying to prevent it.[7]
> - Pursue win-win strategies that produce enough benefits to pay their way apart from their possible effect on climate
> - Oppose planned increases in Corporate Average Fuel Economy (CAFE) standards that would reduce car and truck emissions by small amounts while dramatically increasing prices and reducing consumer choices and safety.

Besides many scientists, the distinguished journalist Naomi Klein analyzed the shift in public opinion in the US between 2007, when climate change was an accepted message and 2011, when lobbyists, climate skeptics and ideologues and the Tea Party within the Republicans had succeeded to block the reporting of any climate change implementation law in US Congress:

> This shift has occurred almost entirely at one end of the political spectrum. As recently as 2008 the issue still had a veneer of bipartisan support in the United States. Those days are decidedly over. Today, 70–75 percent of self-identified Democrats and liberals believe humans are changing the climate—a level that has remained stable or risen slightly over the past decade. In sharp contrast, Republicans, particularly Tea Party members, have overwhelmingly chosen to reject the scientific consensus. In some regions, only about 20 percent of self-identified Republicans accept the science. Equally significant has been a shift in emotional intensity. Climate change used to be something most everyone said they cared about—just not all that much. When Americans were asked to rank their political concerns in order of priority, climate change would reliably come in

[7] See the cover page at: <http://heartland.org/ideas/global-warming-not-crisis> (21 March 2012).

> last. But now there is a significant cohort of Republicans who care passionately, even obsessively, about climate change—though what they care about is exposing it as a 'hoax' being perpetrated by liberals to force them to change their light bulbs, live in Soviet-style tenements and surrender their SUVs. For these right-wingers, opposition to climate change has become as central to their worldview as low taxes, gun ownership and opposition to abortion. Many climate scientists report receiving death threats, as do authors of articles on subjects as seemingly innocuous as energy conservation.
>
> This culture-war intensity is the worst news of all, because when you challenge a person's position on an issue core to his or her identity, facts and arguments are seen as little more than further attacks, easily deflected. (The deniers have even found a way to dismiss a new study confirming the reality of global warming that was partially funded by the Koch brothers, and led by a scientist sympathetic to the "skeptic" position.) The effects of this emotional intensity have been on full display in the race to lead the Republican Party. … And part of what has rescued Mitt Romney's campaign has been his flight from earlier statements supporting the scientific consensus on climate change. But the effects of the right-wing climate conspiracies reach far beyond the Republican Party. The Democrats have mostly gone mute on the subject, not wanting to alienate independents. And the media and culture industries have followed suit. [8]

This impressionist journalist snapshot indicates that not peer-reviewed scientific literature but a well-financed campaign based on mediocre and partly falsified scientific arguments succeeded – at least in the US – to discredit both the messenger and the message as well by portraying it as a threat to the 'US way of life' and as a 'job killer'. Since 1988 and 2012 obviously a major 'cultural revolution' occurred within the Republican Party, since the times of President Reagan who put climate change on the agenda of the G-8 in June 1988 and President George Bush who signed the UNFCCC in June 1992 in Rio de Janeiro.

Two decades later in June 2012 at Rio II, the prospects that decisions of Rio+20 (focusing at 20329 will be implemented in the US at least at present seem to be doubtful as long as this mindset of the rightwing ideologues are not successfully countered and until the people experience and understand that climate change has an impact on their life, by destroying their food, houses, infrastructure due to more intense natural hazards, such as hurricanes, floods, heat waves, drought, forest fires etc. (IPCC 2012).

Thus, the challenge for supporters of an alternative paradigm of a sustainability transition – at least in the USA and Canada - is to counter this anti-scientific, cultural and ideological backlash that has been instrumental in blocking climate legislation and taking the world hostage since the failure of COP 15 in Copenhagen. The alternative paradigm can be implemented unilaterally as the European example indicates and as the proposals of the European Commission for an Energy Roadmap 2050 have illustrated. Most likely the EU climate change policy will result in more energy efficient products, making European companies and their products more competitive on the world market.

5.2 Proposal of a NAFSOLTEC Industrial Initiative

During the 20th century the United States has often been the frontrunner in the great transformation during the second industrial revolution (until 1920) and the third energy, communication, transportation and IT revolution often in response to a perceived threat during World War II (Manhattan District Project) and during the Cold War (in response to the Sputnik shock of 1957) due to the successful mobilization of its great scientific and economic potential since the end of the Civil War (1860-1865) when the US emerged from a peripheral country until the eve of World War I as one of the leading economic powers (Kennedy 1987) that influenced international politics during the 20th 'American' century.

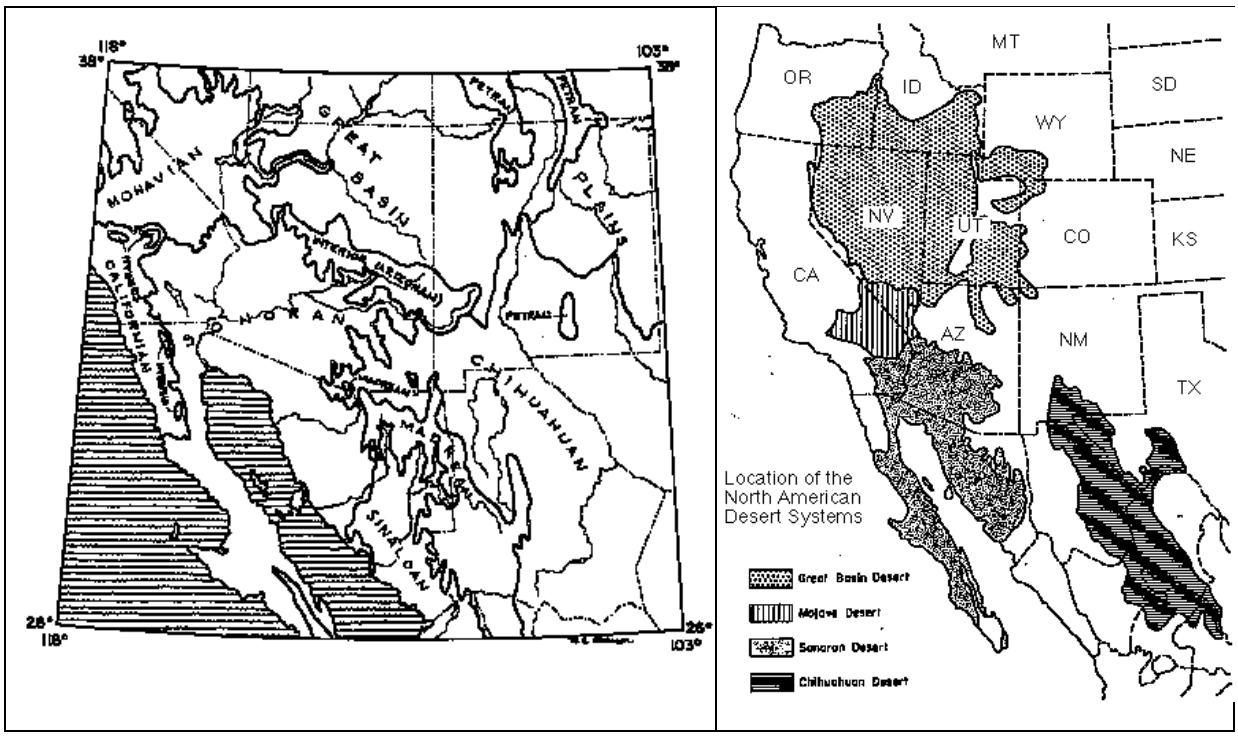
[8] Naomi Klein: "Capitalism vs. the Climate", in: *The Nation*, 28 November 2011; at: <http://www.thenation.com/article/164497/capitalism-vs-climate>.

Since the early 1990s, stimulated by energy experts (Nitsch/Voigt 1986), Brauch (1994, 2000) suggested a *Solar Development Initiative* (SDI) – thus changing the content of President Reagan's SDI that never materialized - as a *partnership building measure* (PBM) for conflict prevention in the Western Mediterranean. Later he used this term to illustrate this conceptual idea as a key element of a 'survival pact' across the Mediterranean where two regions linked 'virtual water' through food exports from EU countries to the MENA region with 'virtual sun' via the export of solar energy from North Africa to Europe and in the framework of a co-development strategy prior and after the Arab spring, he suggested the new DESERTEC project as a tool for a closer interregional economic and energy cooperation (Brauch 2010, 2012).

Conceptually there are many parallels between the EU-MENA and the NAFTA region. Both have several deserts. In the MENA region there is the desert belt from the Sahara, to the deserts in Sinai/Negev, the deserts in Israel, Syria, Jordan, Iraq, Kuwait and along the Arab/Persian Gulf. In North America in the USA and Mexico the four major deserts offer unique physical solar potentials (figure 9):

- *Chihuahua* (in North Central Mexico and Southwestern USA in Arizona, New Mexico, Texas, 455,000 km^2, with a high plateau covered by stony areas and sandy soil with many mountains and mesas);
- *Great Basin* (in the Western United States in Idaho, Nevada, Oregon, Utah, 411,000 km^2, mountains, ranges basins, salt flats, Great Salt Lake);
- *Sonora* (Southwestern USA in Arizona and California and parts of Mexico in Baja California, Sonora, 312,000 km^2, covered sand, soil, gravel)
- *Mojave* (Southwestern USA in Arizona. California and Nevada, 65,000 km^2)

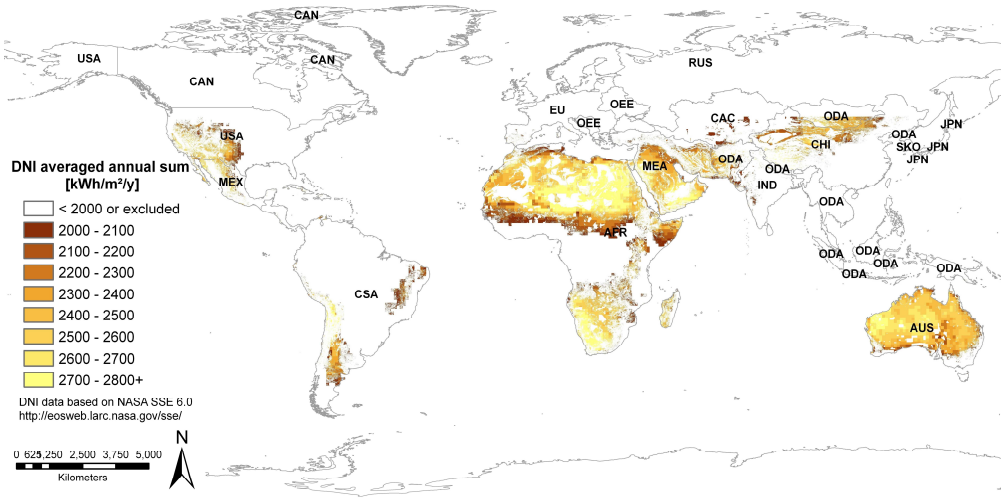
Figure 9: Deserts of North America. **Source:** "deserts of North America"; at: <http:// instruct.uwo.ca/biology/320y/ namdes.html>.



After the Arab oil shocks (1974, 1980) in the aftermath of the October War (1973) in the Near East and stimulated by President Carter's project Independence, the first solar thermal electricity plant was established in the Mohave desert that has produced electricity since 1985, although the company repeatedly had financial difficulties.

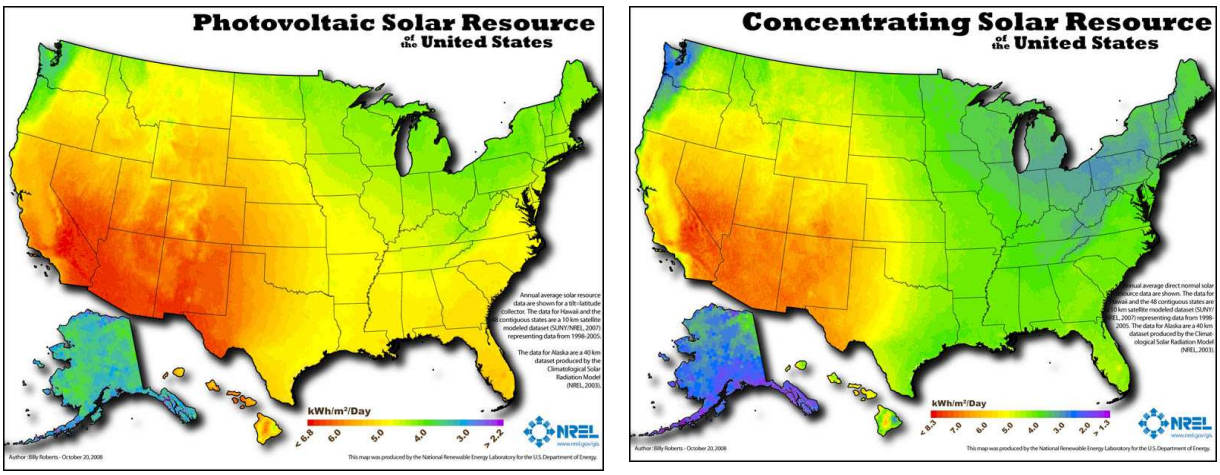
At selective and suitable sites within these four North American Deserts the most modern solar technologies for electricity generation may be used: a) *Concentrating Solar Power Technologies*; b) *Fresnel concentrators*, d) *Parabolic trough* (400-600 °C), c) *Solar tower concept* with surrounding heliostat field (1200 °C, up to 50 MW), d) *Solar dish* (for small applications up to 50 kW), and e) *Concentrated solar PV* technologies that have been employed with major backup systems that already operate in Andalucía.

Figure 10: World potential of solar power plants. **Source:** Franz Trieb (2005), presentation in Stuttgart, 24 July 2009; at: < http://www.afes-press-books.de/pdf/Hexagon_4/Trieb_Wuestenstrom-schmal_Stuttgart_090724.pdf >



While the physical solar potential is much higher in the Saharan desert (figure 10), the geopolitical situation for a suggested NAFSOLTEC project is less complicated than that in the Western and Eastern Mediterranean due to many unresolved conflicts (Pfetsch 2003) because only two or three countries would cooperate in the NAFTA framework. Figure 11 offers data on the photovoltaic and concentrating solar resources of the United States that overlap with the deserts in the Southwestern part of the US.

Figure 11: Photovoltaic and concentrating solar resources in the USA. **Source:** NREL (2012); at: <http://www.nrel.gov/gis/solar.html>.



In addition, the US also has very good wind power conditions in the great plains and in the Mid West and offshore on both the Atlantic and the Pacific Coast (figure 12), There are superb, outstanding and excellent conditions along both coasts and good and fair conditions in the Great Plains (figure 13).

Figure 12: Wind power potential of the USA: annual average wind speed at 80m. **Source:** <http://www.nrel.gov/gis/images/80m_wind/USwind300dpe4-11.jpg>

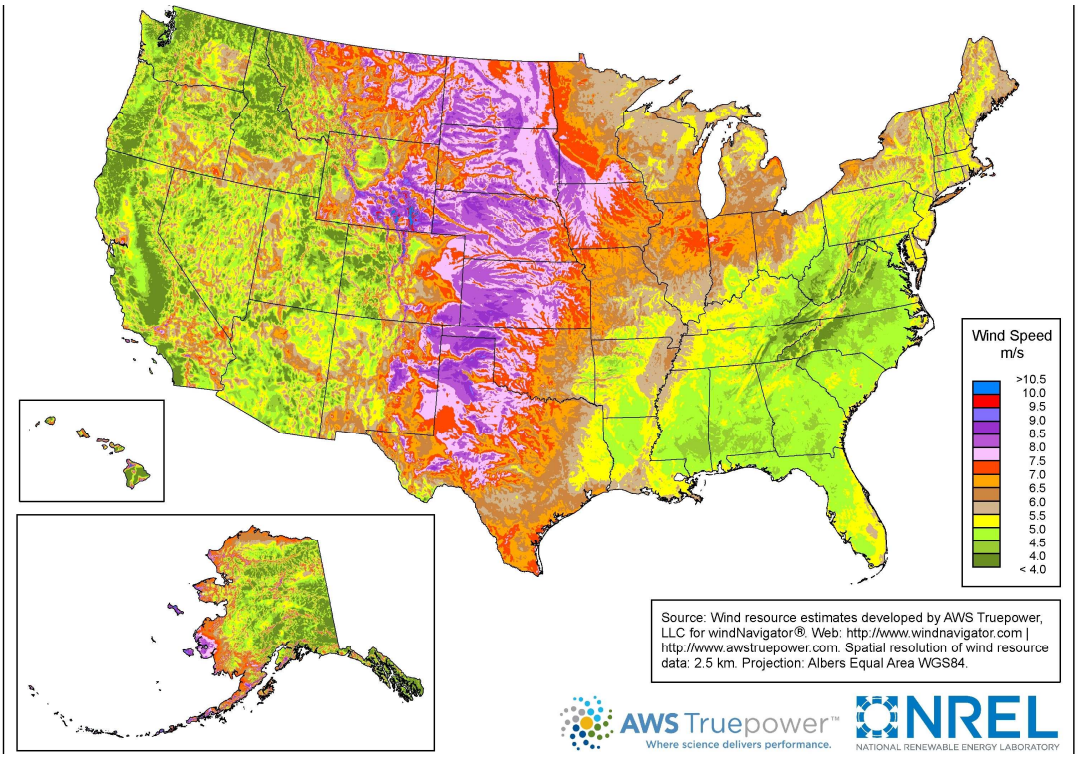
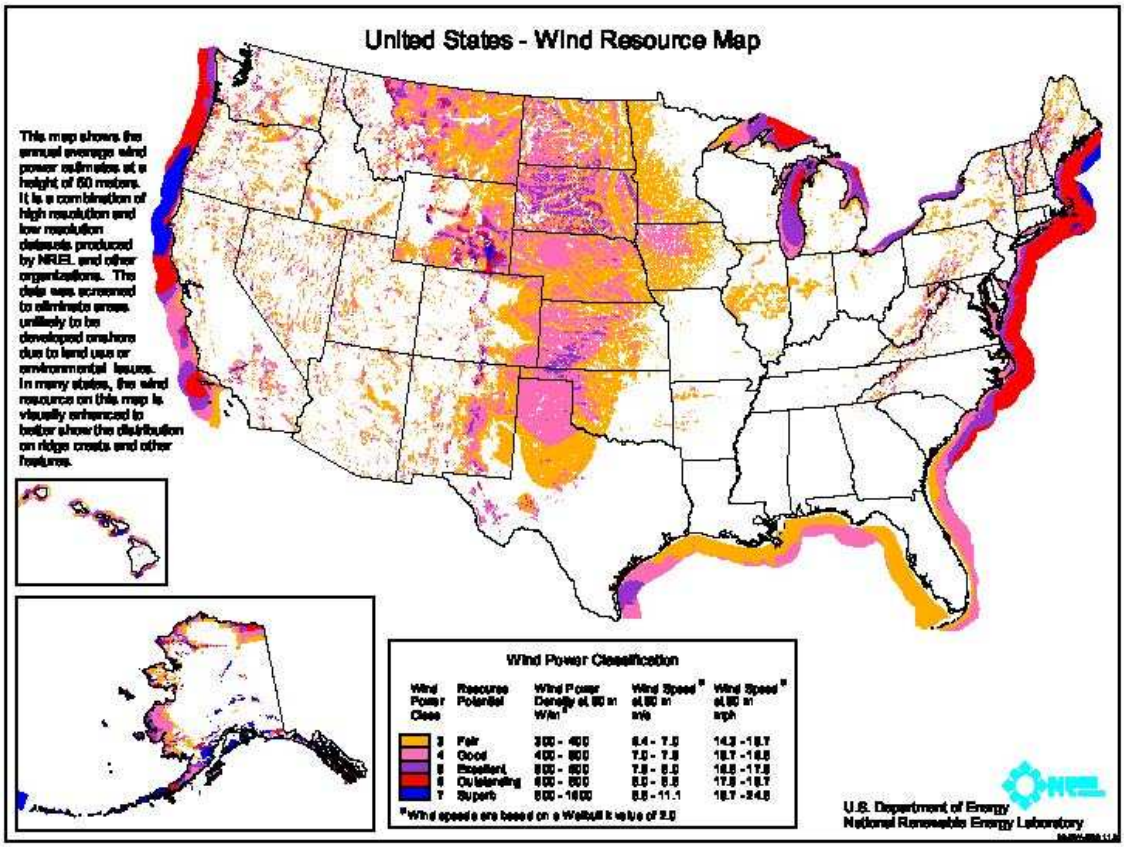


Figure 13: Wind Resource Map for the US. **Source:** < http://www.nrel.gov/gis/images/US-50m-wind-power-map.jpg>.



A potential NAFSOLTEC project would require:

- Major improvements of energy efficiency across all sectors in North America to reduce the energy demand to be increasingly satisfied by renewables.
- A determined decision of the governments of the USA, Mexico and Canada to shift towards a sustainable energy policy and to gradually replace coal, gas and oil as a source of electricity generation with gradually declining subsidies that guarantee investors a calculable rate of return;
- To require renewable energy sources for both cooling (air conditioning) and heating;
- To move from a petrol based transportation system to alternative renewable fuels what would require the buildup of a new infrastructure within the continental USA, Canada and Mexico;
- To develop new tools of financing that make it attractive for investors to enter the field
- To develop a redundant infrastructure for energy distribution systems that enable the feed-in of renewable energy components taking the demand and demand peaks into account.

Environmental advantages:

- It would reduce the reliance on new fossil fuel sources from offshore oil platforms in the Gulf of Mexico, from ecologically sensitive regions in Alaska and from oil sands from Alberta in Canada;
- It would permit the USA, Canada and Mexico to significantly replace the fossil component in the energy balance and thus enable all three countries to drastically reduce their emissions of CO_2, the major source of GHG emissions.

Security advantages:

- Such a NAFSOLTEC project would reduce the import dependence of the US on fossil fuels – from conflict areas, as the Middle East – that will intensify in the future due to the growing energy demand on the world market (e.g. by China, India and many other threshold and developing countries, and the gradually declining supply (peak oil);
- Such a project would also reduce the military resources needed to guarantee the access to fossil fuels in major conflict areas, e.g. in the Middle East, where the US has been involved in costly wars since the end of the Cold War (Kuwait 1991, Iraq, 2003-2011);

Economic advantage:

- The development of the technical components, their production, installation as well as the needed new infrastructure for energy distribution systems will create millions of new and permanent jobs

Counter the ideologues and shift of the political awareness raising:

- The climate skeptics supported by the Heartland Institute, the Tea Party and many rightwing or conservative media (e.g. Fox News) have argued that climate change destroys 100.000s of American jobs and threatens the US (or Canadian) economic competitiveness.
- The message of the promoters of a sustainable energy transition should be that NAFSOL-TEC will create millions of new highly competitive jobs.
- The establishment of a NAFSOLTEC project would create an economy of scale that will bring the prices down and create a new export market for North American products and thus would necessarily compete with European, Chinese and Indian exports in the renewable energy sector.

6. Sustainable Energy Perspective for the Post-Kyoto Regime and Rio+20

The gradual transition towards a low carbon energy future will require in the three NAFTA countries not only scientific and technical solutions but first of all major changes in the mindset of policymakers, business leaders, of societal opinion leaders but also in the media to overcome he basic culture change Klein (2011, 2012) has ably sketched for the shift in the climate change discourse in the USA.

Oswald Spring and Brauch (2011) in: "Coping with Global Environmental Change – Sustainability Revolution and Sustainable Peace" argued that:

- The vision of *business-as-usual* with minimal reactive adaptation and mitigation strategies will most likely increase the probability of a 'dangerous climate change' (Schellnhuber/ Cramer/Nakicenovic/Wigley/Yohe 2006) or catastrophic GEC with both linear and chaotic changes in the climate system and their socio-political consequences that represent a high-risk approach.
- To avoid these consequences the alternative vision and sustainability perspective requires a change in *culture* (thinking on the human-nature interface), *worldviews* (thinking on the systems of rule, e.g. democracy vs. autocracy and on domestic priorities and policies as well as on interstate relations in the world), *mindsets* (strategic perspectives of policy-makers) and new forms of national and global *governance*.

The four key concepts in this alternative vision of a new fourth 'sustainability revolution' are a radical change in *culture*, *worldview*, *mindset* and *participative governance* in the thinking and action on sustainability laying out an alternative development path with a total transformation of productive and consumptive processes aiming at equity, social justice, and solidarity with the most vulnerable and marginal people and the poorest countries.

Culture is a globally organized way of life based on values, norms, beliefs, institutions and productive processes including the development of science and technology. Culture is a learning process which includes acculturation and enculturation processes. Cultural products are shared by the members of a society and they link people together who live and think in ways that can bring about identity patterns and social representations. As a constant practice that is culturally and mutually constructed and transformed through social interaction, language, thought and beliefs are creating symbols and symbolic meanings. Culture is therefore not based on natural laws but socially constructed, where interests are able to maintain and reinforce structures of power and mechanisms of control. Finally, culture is so deeply internalized that it is perceived by the people as natural. Culture can be understood as the sum of learned behaviour and a collective programming of the mind, where the present globalization is widening the number of people belonging to the dominant culture.

Culture represents the accumulation of material and immaterial processes humankind has been able to create. It includes systems of knowledge and understanding, experiences, attitudes, social representations, identities and meanings. Within the communication process culture has been changing and thus the suggested 'Fourth Sustainability Revolution' (FSR) responds to established hierarchies, beliefs, values, notions of importance, space and time, division of labour, and to the establishment of new roles. This alternative model must also alter social and spatial relations, the concept of universe and nature, the material possessions of objects and acquired knowledge. In a broader sense, cultivated behaviour that is socially transmitted and controlled must be changed into care for nature and humans. This FSR conveys also the symbolic communication of this paradigm shift, where the *anthropos* is no longer in the centre of the universe but the dynamic interrelationship between humans and nature is. As a collective memory of the mind, a sustainable culture may also transform worldviews and mindsets along with deeply rooted habits, social representations, behaviour and beliefs.

Worldview refers to a wide world perception and to a framework of ideas and beliefs through which an individual interprets the world and interacts with it. A comprehensive worldview includes the fundamental cognitive orientation of a society, its values, emotions, and ethics through which a society or a group interprets the world in which it interacts. Hiebert (2008) suggested that worldview is the fundamental cognitive, affective, and evaluative presupposition a group of people makes about the nature of things, and which they use to order their lives. The 'construction of integrating worldviews' begins from fragments of worldviews offered to us by different scientific disciplines and various systems of knowledge to which different perspectives contribute in the world's cultures. According to Aerts et al. (1994) a worldview should comprise seven elements: 1) an *ontology* (descriptive world model); 2) an *explanation*; 3) a *futurology*; 4) *values*; 5) a *praxeology* or a theory of action on how we should attain our goals; 6) an *epistemology*, or a theory of knowledge on what is true and false; and 7) an *etiology* or a constructed worldview with an account of its own building blocks, origins and construction. Krell ([4]2009) used this concept for distinguishing among several macro-theoretical approaches in international relations.

The concept of *mindset* includes a fixed mental attitude or disposition that predetermines a person's responses to and interpretations of situations by referring to different patterns of perceiving and reasoning. Fisher ([2]1997) used it as 'cultural lenses' that filter our view of and reaction to the world. With regard to the 'Fourth sustainability Revolution' this concept refers to a discussion of a post-carbon society, where solidarity, equity, and social justice are the key drivers instead of the maximization of profits and the destruction of the Earth without thinking of the next generations or of the collapse of ecosystems.

Weiss and Thakur (2010), defined global governance as "the complex of formal and informal institutions, mechanisms, relationships, and processes between and among states, markets, citizens and organizations, both inter- and non-governmental, through which collective interests on the global plane are articulated, rights and obligations are established, and differences are mediated". The concept has been widely used in international relations and in international environment policy since the 1990's, and several specific research centres, projects, and programmes were set up. In the context of the 'Fourth Sustainability Revolution' participative governance is needed combining processes of policy initiation and adoption (bottom-up) and the implementation of the required fundamental transformations (top down). This requires peaceful negotiation processes based on diversity and tolerance.

As these four concepts show, all dominant paradigms have been socially constructed, but are deeply involved in the complex process of civilization of global society; therefore a mere 'paradigm shift' is not enough. One shortcoming of the debate in the natural sciences so far has been that the political dimension and the emerging thinking in the social sciences, e.g. the postmodern approaches in philosophy, sociology, in political science and specifically in the programmes on peace, security, development and environment have not been taken up in the discourses in the natural sciences while their conceptual suggestions are only gradually being considered in the debate in the social science communities on GEC, on natural hazards and security (Brauch/Oswald Spring 2011).

An isolated approach from the natural or social science alone will not be able to develop the required revolutionary changes in thinking and policy (Held/Hervey 2009). Therefore, we need a 'Fourth Sustainability Revolution' where material and immaterial processes, beliefs and behaviours are changed, including power relations and control mechanisms. The transformation in the thinking on the human intervention into the Earth System must be accompanied by fundamental changes in the cultural, social, and political systems.

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