Navigating the Paradigm Shift

Challenges and opportunities for the two communities of Cyprus, in the search for sustainable patterns of economic and social development

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This report has been prepared through a collaborative and participatory process which included numerous stakeholders from both communities of Cyprus. The following is a non-exhaustive list of individuals who, in varying capacities, contributed to the development of the report:

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All members of the Sustainable Development Stakeholder Panel participated in their personal capacities, and it is understood that any views expressed during the meetings were their own and not necessarily of any organisations or authorities that they otherwise represent. While the recommendations contained in this report can be said to reflect the broad consensus of the Sustainable Development Stakeholder Panel and its Working Groups, such recommendations should not be ascribed to, or identified with, any specific participant.

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Preface

Cyprus 2015 is a peace-building initiative which aims to complement the ongoing peace process by exploring broader societal issues that are directly or indirectly linked with the efforts to achieve lasting peace in Cyprus. The stated purpose of the Cyprus 2015 Initiative is to contribute towards a creative and constructive social debate for the long-term sustainable future of Cyprus, while the methodological framework it utilizes towards this end can best be described as participatory action research – in which research and dialogue come together, in the service of socially desirable change.

After consulting with societal stakeholders on both sides of the Green line, and reviewing the relevant literature, four sub-topics were identified to be covered by our report on sustainable development in Cyprus: Namely issues of energy, water, construction and transportation/ mobility. What we have sought to achieve through this research process, beyond the desk research itself, is to bring together stakeholders from both communities to identify, where possible, common visions in the form of policy recommendations in the selected areas; and where this cannot be achieved, to prepare an agenda of issues that require further societal dialogue.

In the Global Trends sections of our report, we aimed to identify global challenges in the sub-topics concerned, and to discuss different ways the rest of the world deals with the challenges of sustainable development with a view to raise awareness within the Cypriot society. Together with the EU Policies sections, the Global Trends sections constitute a benchmark; the ideal/ best practices we strive to reach from where we stand at the moment, which is taken up in the Current Situation sections of the report. Based on this analysis, community stakeholders have engaged in a process of dialogue and participatory action research to identify potential future directions for Cyprus.

This report is intended to be used as a versatile policy resource for decision makers in the two communities, whether these are policy makers, businesspeople, researchers, or civil society activists. As such, it is acknowledged that different groups of readers will be interested in different aspects of the report: As an exploration of some key challenges for sustainable development in Cyprus, this report will serve to some practitioners as a window into the current realities facing the other community, while for others the report will serve as a window into current global best practices, or EU policies, in matters related to sustainable development. Some readers may only be interested in Energy related issues, while others may have an interest in Water, Construction or Mobility. In acknowledgment of these differing needs and priorities of readers, this report is structured in a modular fashion wherein readers can focus on the themes or topics which specifically interest them, thus drawing the maximum benefit from the report while efficiently utilizing time.

Others still, it is hoped, will draw on the 'future directions' sections of the report in their search for new and creative approaches for solving some of the long-standing sustainability-related challenges facing Cyprus. As an exploration of the added-value that island-wide solutions can bring to key sustainable development challenges, this report can serve as an invitation to stakeholders and policy-makers to engage in collaborative processes that not only enhance

the efficiency of the technical response, but become milestones in the development of inter-communal trust, therefore contributing to the peace process.

Further to the participants and contributors cited in the front flap, we also wish to thank the following for making possible the preparation of this report: Bernardo Arévalo de León and Enrique Sánchez of the Joint Programme Unit for UN/Interpeace Initiatives, for their patient supervision and guidance of the participatory process in accordance with international best practices; The United Nations Development Programme "Action for Cooperation and Trust" for supporting and funding this wide reaching and multi-faceted year-long effort. More specifically from UNDP, we wish to thank Jaco Cilliers, Christopher Louise, Nicholas Jarraud, John Lewis, Tzvetan Zafirov, Pembe Mentesh, and Michalis Michail, for their consistent support of the Cyprus 2015 Initiative and their invaluable feedback to the draft versions of the report; The European Commission Representation in Cyprus, more specifically Androulla Kaminara, Lefteris Eleftheriou and Peter Sandor, for the time and effort they invested in supporting the Cyprus 2015 Initiative and for the Representation's financial contribution towards covering our printing costs; and finally we wish to thank the numerous policy makers, officials, academics, experts, and professionals from both communities who agreed to be interviewed thus adding substance and relevance to this report.

Introduction to the Concept of Sustainable Development

Although the issue of the long-run ecological sustainability of human society has deep and diverse historical roots, it was clearly articulated and stated as an international and national policy agenda only by late 1980s and early 1990s.[1] Connors and Dovers consider the broadest manifestation of this policy agenda, which has come to be known as sustainable development, as 'the most profound intellectual and political agenda facing human society today'. [2]

The World Commission on Environment and Development, which is also known as the Brundtland Commission, has introduced the concept of sustainable development to a wider audience in 1987. The Commission's report, Our Common Future, launched this 'big new idea,' 'which brought environmentalism into poverty reduction and poverty reduction into environmentalism in a neat and simple formula'. The report raised the awareness on the issue, and 'led to the first Earth Summit - the UN Conference on Environment and Development - at Rio de Janeiro in 1992, and to the formulation of Agenda 21, an internationally accepted "blueprint for survival" of its day'. [3]

The commission was tasked by the General Assembly of the United Nations in 1983

- 'to propose long-term environmental strategies for achieving sustainable development by the year 2000 and beyond;
- to recommend ways, so that concern for the environment may be translated into greater co-operation among countries of the global South and between countries at different stages of economical and social development and lead to the achievement of common and mutually supportive objectives that take account of the interrelationships between people, resources, environment, and development;
- to consider ways and means by which the international community can deal more effectively with environment concerns; and
- to help define shared perceptions of long-term environmental issues and the appropriate efforts needed to deal successfully with the problems of protecting and enhancing the environment, a long term agenda for action during the coming decades, and aspirational goals for the world community'.

The report, which has attained the status of a classic and a benchmark in the relevant literature, defines sustainable development as 'development that meets the needs of the present without compromising the ability of future generations to meet their own needs.

[1] Robin Connor and Stephen Dovers: Institutional Change for Sustainable Development, Cheltenham (UK): Edward Elgar Publishing, 2004, p. 203.
[2] Ibid.
[3] http://www.worldinbalance.net/agreements/1987-brundtland.php

… In essence, sustainable development is a process of change in which the exploitation of resources, the direction of investments, the orientation of technological development, and institutional change are all in harmony and enhance both current and future potential to meet human needs and aspirations'. [4]

According to the Brundtland Commission's report, 'critical objectives for environment and development policies that follow from the concept of sustainable development include:

- Reviving growth;
- Changing the quality of growth;
- Meeting essential needs for jobs, food, energy, water, and sanitation;
- Ensuring a sustainable level of population;
- Conserving and enhancing the resource base;
- Reorienting technology and managing risk; and
- Merging environment and economics in decision-making'.

Environmentally sustainable development has occupied a major place especially in the economics literature.[5] However, the concept is not all about environment. It has a social dimension as well, which extends beyond poverty. It 'presents a suite of interrelated and significant challenges,' which includes inter alia 'reconciling ecological, social and economic imperatives in the long term; correcting grossly inequitable levels of human development; … creating participatory modes of policy and management; and using innovative policy tools'. [6]

In the course of time, the integration of social issues into the concept has been prioritized by some economists, who sought to emphasize that development, which fails to provide all with basic needs and democratic rights 'is not desirable and may not be sustainable'. [7] 'These efforts have taken their most coherent form with the evolution of the "human development paradigm," which has found an institutional home in the United Nations Development Programme (UNDP) and an ambitious set of comparative data and analysis in the annual Human Development Report'. [8] In these annual reports, which have been published annually since 1990, the UNDP has not only contributed to the progress of human development theories but also came up with 'an alternative set of economic measures designed to illuminate the diverse quality-of-life outcomes produced by per capita incomes'. [9] The UNDP's principles are straightforward: 'Human development is a process of enlarging people's choices. … (A)t all levels of development, the three essential ones are for people to lead a long and healthy life, to acquire knowledge and to have access to resources needed for a decent standard of living'. [10]

In a similar vein, in its strategy for sustainable development, entitled 'Quality of Life counts,' the UK government states that 'sustainable development is about ensuring a better quality of life for everyone, now and for generations to come. It means a more inclusive society, in which the benefits of increased economic prosperity are widely shared, with less pollution, and less wasteful use of natural resources'. [11]

[4] Brundtland Commission Report, 1987.
[5] Timothy A. Wise: Overview Essay. In Jonathan M. Harris et. al. (eds.) A Survey of Sustainable Development: Social and Economic Dimensions, Washington DC: Island Press, 2001, p. 47.
[6] Connor and Dovers, p. 203.
[7] Wise, p. 47.
[8] ibid.
[9] ibid. p. 49.
[10] UNDP cited in Wise: 49.
[11] Cited in Jennifer A. Elliott: An Introduction to Sustainable Development, London and New York: Routledge, 2006: 238.

Given that, if we are to talk about sustainable development we have to realize that 'economic growth alone is not enough: the economic, social, and environmental aspects of any action are interconnected'; 'economic, environmental and social systems must all be kept in relative equilibrium, and also balanced with each other, to be sustainable'. 'The well being of the environment, of economies, and of people is inextricably linked. … Considering only one of these at a time leads to errors in judgment and "unsustainable" outcomes' . [12]

So, what do we need to do to have sustainable outcomes? According to EU's 5th Environmental Action Programme and the Maastricht Treaty, to achieve sustainable outcomes all these dimensions should be integrated into other policy sectors and in particular into economic policy. This is an ambitious aim that implies a policy-making process, which involves 'constant strategic planning and concerted effort by a variety of different actors', [13] which in turn requires institutional change. This was exactly what the Brundtland Commission's report has called for. Institutional change was needed as the economic and political institutions of the time, both in national and international level, had failed to address the challenges that should be overcome to attain sustainable development.

It seems not much has changed in the mean time. Almost 20 years after the report, Connor and Dovers wrote, 'past patterns of production and consumption; settlement and governance have been unsustainable and have evolved to be so over a long period of time'. Therefore 'the problems are structural rather than superficial and not amenable to marginal organizational or policy change … there is a prima facie case that the deeper institutional system of modern society is not suited to the different and difficult social goal of sustainable development'. Consequently, '(t)here is a strong consensus in the theoretical and empirical literature, and even in official policy, that sustainable development requires significant institutional change'.[14]

This brings in the fourth dimension, which is politics. Obviously, beyond its economic, social, and environmental dimensions, sustainable development is basically a political concept, [15] as the legal and institutional change required cannot be achieved without the involvement of governments.

[12] Tracey Strange and Anne Bayley: Sustainable Development: Linking Economy, Society, Environment, OECD, 2008: pp. 16-25.
[13] Geoffrey Pridham and Dimitrios Konstadakopulos: Sustainable development in Mediterranean Europe? Interactions between European, national and sub-national levels. In Susan Baker et.al. (eds.). The politics of sustainable development: theory, policy and practice within the European Union. London and New York: Routledge, 1997, p. 25.
[14] Connor and Dovers, p. 203.
[15] Candice Stevens: Europe Leads the World in Sustainability, But Could Do Better, Europe's World, Spring 2009.

PART I

Energy Sustainability

'The Stone Age did not end for lack of stone, and the Oil Age will end long before the world runs out of oil.' [16]

1.1 Global Trends in Energy Sustainability

From the sustainability point of view, the biggest challenge concerning the energy sector at the moment is tackling climate change: 'Science is now unequivocal as to the reality of climate change. Human activities, in particular emissions of greenhouse gases (GHG) like carbon dioxide are recognized as its principal cause' [17]. (See table 1).

Table 1: Share of different anthropogenic GHGs in total emissions in 2004 in terms of carbon dioxide equivalents (CO_2-eq.)

Source of Emission	%
CO2 (Fossil Fuel Use)	57
CO2 (Deforestation, decay of biomass etc.)	17
CO2 (Other)	3
CH4	14
N2O	8
F-Gases	1

Many scientists as well as policy makers have a firm belief that keeping the rise in global mean temperatures below 2 degrees compared with pre-industrial levels is a significant target, as a higher increase "will entail sharply rising risks of crossing a climate 'tipping point' that could lead to intolerable impacts on human well-being, in spite of all feasible attempts at adaptation" [18]. Basically, there is virtually no country left that seriously doubts this target [19]. To achieve that aim, scientific consensus dictates that global GHG emissions must be reduced by at least 50 per cent by 2050 [20]. At 57 percent, burning of fossil fuels in various sectors has the biggest share of GHG emissions (see table 2), and given that, exploring possible ways to reduce the use of fossil fuels is one of the most pressing issues on the agenda of the international community.

[16] Sheikh Zaki Yamani cited in The Future of Energy: The End of the Oil Age, The Economist, 23 October 2003.
[17] Forum 2009: Climate Change - The Anatomy of a Silent Crisis, Global Humanitarian Forum, Geneva, p. 1.
[18] Sigma Xi/UN Foundation Report on Global Warming cited in Friedman, Hot, Flat, and Crowded: Why We Need a Green Revolution - And How It Can Renew America, 2008, p. 120; see also Pathways to a Low-Carbon Economy, McKinsey&Company, 2009, p. 7.
[19] Fritz Vahrenholt: On Green Technology, Germany Is the Envy of the World, Spiegel Online, 14 December, 2009.
[20] Low Carbon Transport: A Greener Future A Carbon Reduction Strategy, 2009, p. 5.

Table 2: Share of different sectors in total anthropogenic GHG emissions in 2004 in terms of CO_2-eq (Forestry includes deforestation

Sector	%
Energy Supply	25,9
Industry	19,4
Forestry	17,4
Agriculture	13,5
Transport	13,1
Residential & Commercial Buildings	7,9
Waste & Water	2,8

However, climate change is not the sole challenge the energy sector has to heed at the moment. Two other broad challenges are rising energy costs due to 'peak oil' dynamics; and energy security.

In the last couple of years, fossil fuel prices have become increasingly expensive. Furthermore, 'there is growing concern that the supply of oil may soon peak as consumption continues to grow, known supplies run out and new reserves become harder to find,' making the prices go up further [21].

In a similar vein, energy security became more of a pressing concern for importers of oil and natural gas especially after the dispute between Russia and Ukraine in January 2009 'deprived a number of Central and Eastern European countries – especially Bulgaria and Slovakia – of gas supplies for two weeks in the middle of winter [22],' once again showing how problematic it can be to be dependent on a single supplier. Similarly, relying on 'politically unstable Middle East' for its oil has been a concern for the US [23], ever since the oil shocks of 1973 and 1979 [24].

These three considerations together are aptly called an "energy trilemma": a challenge of striking the right balance between three competing targets of environmental sustainability (low carbon emission), economic competitiveness (affordability), and energy security (reliability) [25]. This situation makes many pundits believe that big changes are under way in the field of energy: 'The carbon based energy paradigm of the last century, upon which we have grown rich, now looks increasingly unsustainable … This is a major technological, financing and organizational challenge. Across both developed and developing country, we will need a fundamental shift in energy systems – a new energy paradigm [26],' the World Economic Forum concludes. In countries like the UK, the question currently being asked is not 'whether we need to replace our existing generating capacity - it is with what [27]'.

This big change or shift of paradigm will obviously involve an increasing use of other energy sources beyond fossil fuels, along with measures to increase efficiency and conservation.

[21] The Power and the Glory, The Power and the Glory, p. 3.
[22] A Change for the Better in Europe, Spiegel Online, 30 November 2009.
[23] Fiona Harvey: The Case for Turning the Stimulus Green, Clean Energy, Financial Times Special Report, 19 January 2009.
[24] Energetic Progress, A Special Report on America's Economy, The Economist, 3 April 2010.
[25] Andrew Charlesworth: Talking Energy: The Energy 'Trilemma', Telegraph, 28 October 2009.
[26] The Global Agenda 2009, World Economic Forum, p. 19.
[27] Andrew Charlesworth: Talking Energy: The Energy 'Trilemma', Telegraph, 28 October 2009.

1.1.1 Supply Side: Alternative Energy Resources

A former energy minister of the UK, Malcolm Wicks, was quoted saying 'diversity of supply is crucial. There can be no over-reliance on any one region, country, energy source or pipeline [28]'. Furthermore, there is a tendency to develop a strategy to address all aspects of the energy trilemma without overlooking any of the three considerations, and alternative energy resources play a significant role in this chess game.

There are different alternative energy resources. The most widely cited of them are wind, solar, bio-fuels, geothermal, nuclear, and hydro-electrical. The first two of these resources will be taken up in this section, while bio-fuels will be covered in the section on transportation. As nuclear, geothermal and hydroelectric are not suitable for the conditions of the island, they are left out in this report.

There is a broad agreement among scientists that there is no silver bullet to tackle climate change. However, it is believed that a mix of existing technologies, especially in the renewable energy sector, have the potential to reduce emissions substantially [29]. In addition to their green credentials, renewables play a significant role in addressing the energy security and affordability aspects of the energy trilemma too: by making the electricity generation system less reliant on fossil fuels, countries using renewables become 'less exposed to volatility in domestic and global fuel markets [30]'. This is not to say investing in renewables is seen as the sole strategy to solve the problems of the energy sector. But rather, they are seen as an important element of a broader portfolio on the way to diversify the energy supply.

Accordingly, investing in such sources is now a global trend. According to the IEA, global power capacity from renewables reached 280,000 MW in 2008. This amount is three times more than the total amount of energy generated by all US nuclear power plants combined. Particularly, the joining of new actors in the sector further reinforces this trend: According to Cheng, 'India and China are now among the leaders in the installation and manufacture of renewable energy [31]'.

The major problem with renewable energy resources at the moment is their cost. That is to say, generating energy using renewable energy sources is still costlier than using fossil fuels [32]. The capital cost of wind and solar power stations is still higher than that of using coal. However, it is highly likely that this will change soon, as the relative costs will be determined by the price of carbon, and the prices of alternative energy sources [33]. The EU's cap and trade system (discussed later in this section), for instance, is levelling the playing field by adding a price tag to carbon emission [34]. Although the December 2009 Copenhagen summit did not yield any 'firm commitments to new caps on emissions [35]', a cap-and-trade bill, 'the American Power Act' [36] is on the agenda of the US Senate, and some 30 countries have either adopted, or plan to adopt similar models [37].

The necessity to build new transmission lines is another factor hindering the development of renewables [38]. As large-scale solar and wind power plants are often built in remote locations, they require construction of new, expensive, and controversial transmission lines [39].

[28] Andrew Charlesworth: Talking Energy: The Energy 'Trilemma', Telegraph, 28 October 2009.
[29] Constance Cheng: Top 10 Environmental Moments of the Decade, CNN, 29 December 2009.
[30] Komor, 2009, p. 4.
[31] Constance Cheng: Top 10 Environmental Moments of the Decade, CNN, 29 December 2009.
[32] Komor: "Wind and Solar Electricity: Challenges and Opportunities" Pew Center on Global Climate Change, Solutions White Paper Series, 2009, p. 1.
[33] Ibid, p. 2.
[34] The Power and the Glory, The Power and the Glory: A Special Report on Energy, The Economist, 21 June 2008, p. 4.
[35] Energetic Progress, The Economist.
[36] For more on this bill please see The Climate-Change Bill: Once More onto the Breach, the Economist, 13 May 2010.
[37] Constance Cheng: Top 10 Environmental Moments of the Decade, CNN, 29 December 2009.
[38] Komor, 2009: 5.
[39] Ibid.

The third major problem is the intermittency of wind and solar energy. As Crooks put it, '(a)ll too often, wind and solar power are produced in the wrong place at the wrong time [40]'.

(T)heir availability as an energy source fluctuates due to weather patterns, clouds, and cycles of day and night. The electricity output from power plants dependent on these variable resources varies accordingly. The demand for electricity, however, does not follow the same pattern. In the case of wind electricity, electricity generation is sometimes greatest at night when electricity demand is lowest [41].

> This renders renewable energy a non-viable option unless energy can be stored on a large scale [42]. Although there is progress in the physical storage technologies as a possible remedy for this problem, costs are still high, and performance is uncertain [43].

Wind Energy

At the moment, wind power is the most mature, and cost competitive option among all renewable energy resources [44]. Modern turbines are 50% efficient; just 9.3 percentage points lower than the theoretical maximum efficiency achievable [45]. The cost of generating electricity from wind power has fallen from as much as 30 cents per kilowatt-hour in the early 1980s to around 10 cents in 2007 [46]'. The German Law for the Promotion of Renewable Energies, the EEG [47], 'mandates that energy companies buy wind power for 9 cents per kilowatt-hour - not much more than the price for conventional power on the electricity markets [48]'.

Advantages of wind energy are numerous. Firstly, it is widely available: Theoretically speaking, wind power can generate as much as 1.3 million terawatt hours of energy per year while global energy consumption stands at just 15,666 terawatt hours, according to the IEA. In other words, we need to turn only 1.2 percent of the calculated potential of wind energy into electricity to meet the total global demand [49]. Secondly, it does not pollute or emit GHG. Thirdly, contrary to most power stations, wind farms can be built piecemeal. The day the first turbine is installed, it starts generating electricity, and therefore money [50]. Fourthly, building and installation of windmills is easier than other renewable energy sources [51].

There are disadvantages as well, however: Wind farms should be located in remote areas where winds are strongest, which most of the time means they are also far away from urban centers where the demand is highest, and thus from existing transmission lines. Therefore their development depends on the building of new transmission lines, which are among other things very expensive to build (2-4 million dollars a mile) [52]. Another major problem is intermittence: the fact that a vast majority of windmills stop generating power when the wind blows slowly, and when it blows too fast. Getting them to work whenever there is wind seems to be the biggest challenge [53]. Furthermore, there is as yet no good way to store excess energy produced by wind power, meaning that if strong winds are blowing at a time when consumers

[40] Obama's Smart Vision for the Electricity Grid, Clean Energy, Financial Times Special Report, 19 January 2009.
[41] Komor, 2009: 5.
[42] http://www.nature.com/news/2010/100106/pdf/463018a.pdf
[43] Komor, 2009: 2.
[44] Paul Komor: "Wind and Solar Electricity: Challenges and Opportunities" Pew Center on Global Climate Change, Solutions White Paper Series, p. 1; Ethical Investing: The Green Guide 2009/2010.
[45] Trade Winds, The Power and the Glory: A Special Report on Energy, The Economist, 21 June 2008, p. 6.
[46] Wind of Change, p. 21.
[47] 'which mandates the prices at which energy companies have to buy green power' Anselm Waldermann, Spiegel Online, 02/10/2009.
[48] Lubbadeh and Waldermann.
[49] Ibid.
[50] Trade Winds, The Power and the Glory: A Special Report on Energy, The Economist, 21 June 2008, p. 6.
[51] Meir Shargal.
[52] Wind and Solar Electricity: Challenges and Opportunities", Paul Kramer. University of Colorado at Boulder, p. 1.
[53] Meir Shargal.

are using little electricity, much is wasted [54]. Yet another handicap is that the public is generally against them because they are noisy, spoiling the view, and dangerous for the birds [55].

Installing the windmills offshore -generally several kilometers off the coast- can be a remedy for some of these problems: 'Offshore wind parks have the dual advantage that they take advantage of stronger sea winds and are not as disruptive as they are on land [56]'. 'Planning permission can be easier to obtain than onshore, farms can be built at scales impossible on land, and the availability of space is almost unlimited if deep waters are mastered [57]'.

Drawback of offshore wind parks, on the other hand, is their cost: It is more expensive to build a wind farm in the middle of the sea;'each turbine costs at least 50% more than one built on land [58]'.

These problems notwithstanding, wind power holds an important place in global projections. 'Globally, wind power installations are expected to triple from 94GW at the end of 2007 to nearly 290 GW in 2012, according to BTM Consult, a Danish market-research firm. They will then account for 2.7% of world electricity generation, the company predicts, and by 2017 their share could be nearly 6% [59]'. In the US, a recent report by the Department of Energy laid out a plan to reach 20% wind power by 2030 [60]. According the estimations of the IEA, 'if global GHG emissions are to be halved by 2050, as scientists say is necessary, then wind must represent about 17 per cent of worldwide power generation by that date [61]'.

Currently, wind generates only about 1% of all electricity globally [62]. However, it already constitutes a considerable portion of electricity supply in several European countries, and American states (See table 3). In some German states, wind power supplies more than 35 percent [63].

Table 3: Wind penetration rates: Percentage of in-state or in-region generation that comes from wind (2007)

Country/Region	%
Denmark	20
Spain	12
Portugal	9
Ireland	8
Minnesota	7,5
Iowa	7,5
Colorado	6,1
South Dakot	6

Source: U.S. Department of Energy, 2008 cited in Paul Kramer, p. 16.

[54] Lubbadeh and Waldermann.
[55] Wind of Change, p.23.
[56] Lubbadeh and Waldermann.
[57] Ethical Investing: The Green Guide 2009/2010.
[58] A new twist for offshore wind, Technology Quarterly, The Economist, 7 June 2008, p. 7.
[59] Wind of Change, Technology Quarterly, The Economist, December 6 December 2008, p. 21.
[60] Ibid.
[61] Fiona Harvey, Winds of Change Blow Across the Global Market, Financial Times, 30 June 2008
[62] Wind of Change, Technology Quarterly, The Economist, 6 December 2008, p. 21.
[63] Lubbadeh and Waldermann.

Wind power is, obviously, on the rise in the US 'where capacity jumped by 45% to reach nearly 17 GW at the end of 2007 (about 35% of new electricity generating capacity in 2007 came from wind power) [64]'. China's pace of installing new wind turbines has been even more spectacular: 'Since the end of 2004, the country has nearly doubled its capacity every year [65]'. 'By the end of 2010, the country's wind-generating capacity will be about 20 gigawatts—equal to Spain's and only slightly behind Germany's and America's' according to The Economist, and '(t)he aim is to have 100 gigawatts by 2020. That is an eighth of China's present electricity-generating capacity [66]'.

Table 4: Countries with most installed wind power (Gigawatts)

Country	2008 (GW)	2009 (GW)	% of world total, 2009
U.S.	25	35	22,3
Germany	24	26	16,3
China	12	25	15,9
Spain	17	19	12,1
India	9,5	11	6,9
Italy	4	5	3,1
France	3,5	4,5	2,8
Britain	3,5	4	2,6
Portugal	3	3,5	2,2
Denmark	3	3,5	2,2

Source: Global Wind Energy Council cited in Economist.

Solar Energy

As far as its potential as a source of energy is concerned, none of the alternatives can compete with solar energy. Energy received from the sun in 1 hour can satisfy the yearly energy demand of the earth's entire population [67]. In principle, 'the current electricity needs of the US could be generated from the solar energy falling on PV cells over an area of 400 km square or on CSP installations covering a somewhat smaller area' (Houghton,2009: 361-2). Furthermore, unlike fossil fuels, there is no danger of it running out; it is ubiquitous; it produces no CO2 emissions or other downside for the environment; and unlike wind turbines, there is public support for solar energy [68].

However, so far 'only a small fraction of this vast potential has been exploited [69]'. By 2008, only 0.1 percent of all energy produced came from solar [70] because the cost of producing electricity

[64] Wind of Change, Technology Quarterly, The Economist, December 6 December 2008, p. 21.
[65] Ibid.
[66] The Coming Alternatives, The Economist, 13 November 2009.
[67] Jerry Silver, 2008: 198.
[68] Heffernan 2008
[69] Jerry Silver, 2008: 198.
[70] Heffernan, 2008

from solar energy is still too high to compete with coal, gas, wind, or nuclear [71]. It still requires a great deal of 'investment for research and development to grow the economies of scale required to bring costs down to acceptable levels' [72]. Nevertheless, it should be noted that prices are falling rapidly. In 1995, a kWh of photovoltaic electricity used to cost 50 cents. That had fallen to 20 cents in 2005 and is still dropping according to Cambridge Energy Research Associates [73].

Another handicap of solar energy (similar to wind) is intermittency: It is not available at night and is less available when it is cloudy [74].

There are two competing approaches in generating electricity using the sun. One of them is using photovoltaic cells (PV), which directly convert sunlight into electricity. The second method is to concentrate the sun's rays, use them to boil water and employ the resulting steam to drive a turbine [75]. There is a firm belief among the experts that this competition will foster continued innovation, and a growing supply of clean electricity, in the years to come [76].

Solar-Photovoltaic

PV cells are the most common form of solar power at the moment [77]. Existing solar PV power capacity has reached 9.2 GW by 2007 [78].

A good thing about PV cells is that they 'are quiet, have no moving parts, can be installed very quickly, and can be sized to power anything from a single light to an entire community [79]'. As they can be installed in small, modular systems, they require much less capital investment [80], and this makes every roof a 'potential mini-power plant' [81] rendering it possible to generate electricity at home even in sun-poor countries like Germany [82]. For large-scale deployments to be feasible however, sunnier climates and locations like 'deserts where there is plenty of space for the panels to be installed' are required [83].

Furthermore, PV's can generate electricity off the grid [84], meaning that they can be used to generate electricity where it is 'otherwise inconvenient, too expensive, or impractical to connect to existing power lines [85]'. For that reason, a majority of 'the photovoltaic installations over the past few decades were used to provide new power rather than to replace electricity generated by fossil fuels[86]'. Nowadays, the trend has changed, and the market for on-grid systems is growing faster than the off-grid ones[87]. On-grid applications have a number of benefits for both the consumers, and the utilities:

> If a solar array produces more power than is needed at a particular time, that power can be delivered to the power grid for distribution to other customers by the local utility. Individual producers of solar-generated electricity can (legally) run their electric

[71] Heffernan, 2008
[72] Houghton: 2009: 362.
[73] Cited in Another Silicon Valley, The Power and the Glory: A Special Report on Energy, The Economist, 21 June 2008, p. 12.
[74] Meir Shargal.
[75] Another Silicon Valley.
[76] The Other Kind of Solar Power, Technology Quarterly, The Economist, 6 June 2009, p. 20.
[77] The Other Kind of Solar Power, p. 19.
[78] The Other Kind of Solar Power, p. 19.
[79] Ibid.
[80] The Other Kind of Solar Power, Technology Quarterly, The Economist, 6 June 2009, p. 19.
[81] 'Japan was the first to encourage rooftop solar installations and by 2000 had installed 320 MW capacity. Germany and the USA followed with large rooftop programmes, Germany with a target of 100 000 roofs that was met by 2003 and the USA with a target by 2010 of 1 million roofs' (Houghton, 2009: 365).
[82] Jens Lubbadeh and Anselm Waldermann: How Effective Are Renewables, Really?, Spiegel Online, 16 December 2009.
[83] Lubbadeh and Waldermann.
[84] The Other Kind of Solar Power.
[85] Jerry Silver: Global Warming and Climate Change Demystified, McGraw Hill, 2008, p. 198.
[86] Silver, 2008: 198.
[87] Ibid.

> meters backwards and be compensated for that power. Although power purchased by utilities is regulated at the state level, it can provide a benefit to the utilities by providing power during peak-demand periods. During the hottest part of the day, when air-conditioning loads are greatest, local grid-connected PV systems can help utilities to avoid firing up their more costly supplemental natural gas–fired turbines. It also can reduce the need to add capacity just to meet peak demand[88].

These advantages notwithstanding, 'from an economic standpoint photovoltaic is much less attractive; although the cost of generating electricity from PV 'cells has reduced dramatically over the past 20 years' [89] its price at 43 cents per kilowatt-hour, -compared to wind at just 9 cents (the price mandated by the EEG) [90] - is still too expensive to compete with its alternatives. This is seen as a major obstacle to widespread use of PV panels [91]. According to Silver, PVs 'are about three times more expensive than they need to be to compete in today's energy market with fossil fuel–generated electricity' [92]. This high cost largely stems from the difficulty of the production process of solar panels. However, this seems to change with the joining of new producers in the market. Only in 2008, 'prices fell by 25 percent, a trend driven primarily by Chinese manufacturers' [93].

Solar-Thermal

Solar thermal is an old and technically proven technology, which was introduced in 1980s in California as a remedy for high oil prices. Though it was sidelined when oil prices fell, the technology is making a comeback. However, existing solar-thermal power capacity is only 500 MW.

It is believed that large solar thermal power plants in countries with lots of sun have huge potential, and another 12 GW is reportedly being planned, showing that the method has a bright future [94]. The Desertec project is the most important case in point. This is 'a concept developed by a group of scientists that envisions gigantic power plants in the Sahara Desert that could, in theory, provide enough electricity for the entire world. High-tension lines are to transport the power across the Mediterranean to Europe [95]'.

> Should Desertec in the Sahara Desert ever become reality… then huge quantities of power could be generated by solar thermal technology. And for the moment, it looks like progress is being made. In October (2009), a number of industrial and financial heavyweights joined forces to create the Desertec Industrial Initiative. The goal: by 2050, the project hopes to supply 15 percent of Europe's energy needs. The costs, however, are high. The power plant itself will cost some €350 billion with an additional €50 billion required for a new and efficient grid [96].

'Despite having been around for decades, the technology, with an energy-conversion efficiency rating of 15 to 20 percent, is not yet as efficient as coal or nuclear. A kilowatt-hour of solar thermal electricity costs between 14 and 18 cents. But improvement is in sight, with experts predicting that technological improvements will sink the cost to below 10 cents per kilowatt-hour by 2020' [97].

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[88] Silver, 2008: 198.
[89] Houghton, 2009: 365.
[90] Lubbadeh and Waldermann.
[91] Silver, 2008: 199.
[92] Ibid.
[93] Lubbadeh and Waldermann.
[94] The other kind of solar power, Technology Quarterly, The Economist, 6 June 2009, p. 19.
[95] Lubbadeh and Waldermann.
[96] Ibid.
[97] Ibid.

'Developments that are currently being pursued are of integration of solar and fossil fuel heat sources in combined cycle operation to enable continuous electricity provision throughout the day, and, in arid areas, of co-generation of power and heat for desalination for the delivery of fresh water' [98].

Basically there are 3 different solar thermal technologies, though commercially only the first two have been so far implemented:

1- Parabolic troughs
2- Power towers
3- Stirling-engine (Dish-engine) system

Solar-thermal plants have numerous advantages: First of all, they are large-scale, and the cost of producing electricity is much lower, making it probably the best option among renewable sources to match a utility's electrical load [99]. Secondly, the generated heat can be stored therefore intermittency is less [100]. Thirdly, they use a turbine to generate electricity from heat; therefore most of them can be easily and cheaply supplemented with natural-gas boilers, enabling them to perform as reliably as a fossil-fuel power plant [101].

Downsides of solar-thermal technology on the other hand are as follows: Firstly, although solar-thermal power produces no carbon-dioxide emissions, it can have some negative environmental impacts. Both power-tower and trough-based systems are typically water-cooled, and require millions of gallons of water annually. That can cause big problems, especially where water shortages are widespread. In contrast, Stirling-engine designs do not require water for cooling [102]. Secondly, when building power plants in remote locations – as best locations i.e. where the sun shines best, are far from major population centers - a lack of transmission lines poses a serious problem, since it is difficult and expensive to get new transmission lines approved and built [103].

Carbon Capture and Storage (CCS)

Coal, which is abundant, is the cheapest source of producing electricity. However, as far as the GHG emissions are concerned, it is the most harmful as well: 'It creates more carbon dioxide than any other method of power generation[104]'. The problem is that as the US energy secretary Steven Chu recently stated, big economies like the US [105], China and India are highly unlikely to stop burning coal in the near future [106]. This makes CCS, which is also known as 'clean coal' vital in the struggle against global climate change [107].

CCS is basically, a method, which makes coal's use less harmful, and involves burying carbon dioxide deep underground to avoid emissions from entering the atmosphere [108]. 'Possible storage methods under consideration include injection in stable underground geologic formations, dissolution in the ocean depths, or binding in solid form as chemical carbonates' [109].

[98] Houghton, 2009: 365.
[99] The other kind of solar power, p. 18.
[100] Ibid.
[101] Ibid.
[102] The other kind of solar power, Technology Quarterly, The Economist, 6 June 2009, p. 20.; see also Meir Shargal.
[103] The other kind of solar power, Technology Quarterly, The Economist, 6 June 2009, p. 20; see also Meir Shargal.
[104] Rebecca Bream: Carbon Capture at Core of Plans for Fossil Fuels, FT Special.
[105] In 2007, 49% of the US's electricity came from coal-burning plants (Komor, 2009: 3).
[107] Andrew Charlesworth: Talking Energy: carbon capture and storage, Telegraph, 27 Nov 2009.
[108] Dig Deep, The Power and the Glory, p. 9.
[109] Silver, 2008: 204.

The main problem with this method is that no one knows if it will work or not in practice. Although the technology has been used in petrochemical and chemical processes for many years, 'fully operational CCS as it is envisaged by the power companies is still several years away[110]'.

Furthermore, it is expensive. 'The one serious attempt to investigate its use in an actual power station … was cancelled … because the expected cost had risen from $830m to $1.8 billion'[111].

1.1.2 Demand Side: Conservation and Efficiency

We have to bear in mind that although the 'most renewable energy sources do not produce pollution directly, the material, industrial processes, and construction equipment used to create them may generate waste and pollution' [112]. Given that 'the cheapest kW of energy is the one not used' [113].

While supply side involves macro changes in technology and government policies, demand side (or at least conservation) has more to do with micro decisions most of the time at the consumer level.

The nuance between conservation and efficiency is that conservation is basically doing less with less, while efficiency means wasting less energy. 'More efficient appliances, lighting, factories, and buildings, as well as vehicles, could wipe out one fifth to one third of the world's energy consumption without any real deprivation' according to Michael Grunwald [114].

Smart Grids

One way of increasing efficiency is improving the distribution network. The term smart grid 'encompasses almost anything that would make power transmission more reliable, flexible and convenient, from meters that send in readings automatically to software that detects snapped cables and reroutes power supplies around them' [115]. Ed Crooks of Financial Times defines it as 'an electricity network that uses information technology to manage generation and consumption more flexibly' [116].

Although companies around the world are investing billions of dollars to develop clean energy technologies, unless power grids that link them together are not upgraded, everything will be in vain. This is largely due to the renewable energy sources' distributed and intermittent nature, which makes their integration into the existing grid difficult. The flow of energy between new sources of supply and new forms of demand can be accommodated only if the world's electrical grids become 'a lot smarter [117]'.

A smart grid, which will be equipped with computer power, is expected to be far more responsive, interactive and transparent than today's grid. In this way, the grid will cope better with new sources of renewable energy; make the co-ordinated charging of electric

[110] Andrew Charlesworth: Talking Energy: carbon capture and storage, Telegraph, 27 Nov 2009.
[111] Dig Deep, The Power and the Glory, p. 9.
[112] Meir Shargal, The Myth and Realities of Renewable Energy
[113] Sustainability, Energy and Environment: Printcity Special Report, 2008. p. 3.
[114] Michael Grunwald: Seven Myths About Alternative Energy, Foreign Policy, 24 August 2009.
[115] Clever, But Unprincipled, The Economist, 08.10.2009.
[116] Obama's Smart Vision for the Electricity Grid, Clean Energy, Financial Times Special Report, 19 January 2009.
[117] Building the Smart Grid, 4 June 2009.

cars possible, inform the consumers about their consumption; allow utilities to monitor and control their networks more effectively, and in doing so help in reducing the GHG emissions.

Technology alone, however, is clearly not a substitute for policy in the effort to green the energy production [118]. The lack of a price on carbon is considered as the biggest impediment to the spread of renewable energy sources [119]. Therefore, investment in energy efficiency, and cleaner forms of generation should be encouraged through new legislations. Alternative options that can be implemented to this end are discussed below.

Reducing fossil fuel subsidies

This basically includes 'dismantling of any fiscal support for fossil fuels – fuel subsidies, research grants, exploration concession waivers, investment tax holidays, accelerated depreciation, export guarantees and soft loans' [120].

Feed-in tariff

This is a requirement that electricity providers purchase electricity from renewable electricity generators at a mandated price. Feed-in tariffs are a popular policy approach in Western Europe, with Germany's feed-in tariff (called the Renewable Energy Law, EEG) being the most well known [121]. The EEG requires utilities to purchase electricity from certain types of renewable generators, and sets the price that utilities must pay. In 2006 utilities paid 52 to 72 US ¢/kWh for electricity from solar PV systems, for wind the set price was 11 ¢/kWh. These prices generally decline over time.

Given these generous prices, it's not a surprise that the EEG has triggered a renewables boom in Germany. Germany has more wind power (~22 GW), and more installed PV (~4 GW) than any other country in Europe [122]. The EEG constitutes the centerpiece of the country's climate-change program: 'Without prescribing any specific action, the law subsidizes citizens who produce their own energy from renewable sources, and allows them to sell surplus back to the grid' [123]. The German Environment Ministry estimated that more than 14% of the country's electricity in 2008 came from renewable sources, which is two times more than the proportion in 2000, the year that the federal government introduced the feed-in law. Time magazine reports that the law has support from all of Germany's major political parties, and that Sven Teske, renewable-energy director for Greenpeace International, also endorses it. 'It's the most successful tool. It's the cheapest way of phasing in renewables,' [124] Teske says.

'Spain, Italy — and the state of California — now have their own versions of the feed-in law' [125].

Cap-and-trade system

The cap and trade system is considered to be one of the most influential instruments in the fight against climate change. Basically, it works by making emitting GHG expensive, and in doing so motivating large-scale emitters such as utilities, factories, cement plants, municipalities,

[118] Clever, but unprincipled, The Economist, 8 October 2009.
[119] Ibid.
[120] Ethical Investing: The Green Guide, 2009/2010.
[121] Among others, China also has a similar scheme (A Chinese wind-power IPO: Puffed Up, The Economist, 3 December 2009).
[122] Komor, 2009:21.
[123] Laura Blue/Schwandorf: Lessons from Germany, Time, 23 April 2008.
[124] Ibid.
[125] Ibid.

steel mills etc. to switch to more environmentally friendly technologies by using free-market principles and government regulation. This is basically how it works: Governments limit the amount of emissions permitted (cap), and impose heavy fines on those who exceed those limits. On the other hand, they allow them to buy and sell permits (trade) among themselves. For instance, 'if an organization emits less than its allotment, it can sell the unused permits to entities that plan on exceeding their limits. They can trade permits with one another through brokers or in organized local or global markets' [126]. The amount of permits issued over time decreases and this is expected to increase the price of the permits, and in turn, to reduce pollution levels [127].

Currently, the EU has the largest emissions trading market, which was launched in January 2005 [128].

Carbon Tax

A potentially more effective alternative to the cap-and-trade system is carbon tax. 'IPCC… reckons that fossil fuels should carry a tax of $20-50 for every ton of carbon dioxide they generate in order to pay for the environmental effects of burning them' [129].

The basic distinction between cap-and-trade system, and carbon tax is that the former 'provides environmental certainty, since the quantity of total allowable emissions is set', while the latter 'provides price certainty, since the cost of emitting a given amount of GHGs is set' [130]. Price certainty is 'an important benefit to industries like power generation, which produces a lot of GHG, and which must be confident that an expensive new power station will stay profitable for several years' [131]. Cap-and-trade system on the other hand, leads to fluctuations in price, as the experience of the European case has already shown.

One of the downsides of this method is that '(d)etermining the correct level at which to set a tax in order to drive any given level of emissions reductions is difficult' [132]. The political difficulty of convincing the electorate, which has not yet decided what it thinks about climate change, is another obstacle before the carbon tax [133].

[126] Joel Kurzman: The Low Carbon Diet: How the Market Can Curb Climate Change, Foreign Affairs, September/October 2009.
[127] Constance Cheng: Top 10 Environmental Moments of the Decade, CNN, 29 December 2009.
[128] Ibid.
[129] The Power and the Glory, p. 6
[130] Pew Center on Global Climate Change: Climate Change 101 Cap and Trade, January 2009.
[131] Some More Thoughts on a Carbon Tax, The Economist, 18 June 2010.
[132] Pew Center on Global Climate Change: Climate Change 101 Cap and Trade, January 2009.
[133] Some More Thoughts on a Carbon Tax, The Economist, 18 June 2010.

1.2 European Policies for Energy Sustainability

Europe's citizens and companies need a secure supply of energy at affordable prices in order to maintain their standards of living. At the same time, the negative effects of energy use, particularly fossil fuels, on the environment must be reduced. Within this context, EU policy focuses on creating a competitive internal energy market offering quality service at low prices, on developing renewable energy sources, on reducing dependence on imported fuels, and on doing more with a lower consumption of energy.

1.2.1 An Energy Policy for Europe (COM(2007) 1) [134]

In striving towards an effective European Internal Energy market, national energy regulators must be harmonized on the basis of the highest common denominator, including technical standards in order to facilitate cross-border trade. Additionally, national regulators should be promoting the development of the EU Internal Energy Market.

Vertically integrated companies, which control energy networks as well as production or sales, not only prevent competition but also lack the incentives to adequately invest in their networks. As part of an effective Internal Energy market, the EC is proposing an *ownership unbundling* where network companies are wholly separate from the supply and generation companies.

The EC promotes *transparency* in all available information in the energy markets, in order to facilitate market players and avoid price manipulation.

One of the top priorities of the Priority Interconnection Plan of the EC is the identification of the most significant missing *infrastructure* up to 2013 and the ensuring of pan-European political support to fill the gaps.

Network security, established through the set-up of minimum security standards for networks, is considered essential in the effort to increase the reliability of EU's electricity systems and prevent black-outs.

In order to secure the required investment for future electricity generation that would provide for the *adequacy of electricity generation and gas supply capacity,* the Internal Energy Market needs to be properly functioning by providing the correct investment signals. In addition, close monitoring of the demand/ supply balance is also needed, to identify any potential shortfall.

Finally, the EU, managing *energy as a public service,* needs to tackle energy poverty of European citizens by: (a) assisting in establishing schemes to help the most vulnerable citizens deal with increases in energy prices, (b) improving the minimum level of information available to citizens to help them choose between suppliers and supply options, (c) reducing paper work when customers change supplier, and protecting customers from unfair selling practices.

It is important for EU to promote diversity with regard to source, supplier, transport route and transport method within its Member States that would guarantee *security of supply for oil, gas and electricity.* In addition, effective mechanisms need to be put in place to ensure *solidarity between Member States* in the event of an energy crisis.

[134] http://ec.europa.eu/energy/energy_policy/doc/01_energy_policy_for_europe_en.pdf (accessed 22nd October 2010).

The EU has a *long-term commitment to greenhouse gases reduction.* The EU traditionally favours the use of economic instruments to internalize external costs as they allow the market to determine how to react most efficiently and with limited costs. One of the tools utilized towards this end is the *EU Emissions Trading System.*

The EU has set an ambitious programme of energy efficiency measures at Community, national, local and international level. On 19 October 2006 the Commission adopted the *Energy Efficiency Action Plan,* containing measures that would put the EU well on the path to achieving a key goal of reducing its global primary energy use by 20% by 2020. This will require significant efforts both in terms of behavioural change and additional investment.

Having said that, the EU has fallen short of its target for 12% share of renewable energy in its overall mix by 2010. The main reason for the failure (besides the higher costs of RES today compared to "traditional" energy sources) is the lack of a coherent and effective policy framework throughout the EU and a stable long-term vision. A *longer-term target for renewable energy* needs to be set. The challenge of renewables policy is to find the right balance between installing large scale renewable energy capacity today, and waiting until research lowers their cost tomorrow. Finding the right balance means taking the following factors into account: (a) using renewable energy today is generally more expensive than using hydrocarbons, but the gap is narrowing – particularly when the costs of climate change are factored in; (b) economies of scale can reduce the costs for renewables, but this needs major investment today; (c) renewable energy helps to improve the EU's security of energy supply by increasing the share of domestically produced energy, diversifying the fuel mix and the sources of energy imports and increasing the proportion of energy from politically stable regions as well as creating new jobs in Europe; and (d) renewable energies emit few or no greenhouse gases, and most of them bring significant air quality benefits.

EU Member States should have the flexibility to promote the renewable energies most suited to their specific potential and priorities. The way in which Member States will meet their targets should be set out in National Action Plans to be notified to the Commission. The plans should contain sectoral targets and measures consistent with achieving the agreed overall national targets.

The EU needs to invest a lot in Carbon Capture and Storage (CCS) technologies and their wide commercialization if it is to head *towards a low CO_2 fossil fuel future* and achieve almost zero carbon emission from carbon power generation by 2050, so that the likely continued use of the vast global coal reserves is not to exacerbate climate change.

Nuclear energy is one of the cheapest sources of low carbon energy that is presently being produced in the EU and also has relatively stable costs. The next generation of nuclear reactors should reduce these costs further. It is for each Member State to decide whether or not to rely on nuclear electricity.

The challenges of security of energy supply and climate change cannot be overcome by the EU or its Member States acting individually. It needs to work with both developed and developing countries, energy consumers and producers, to ensure competitive, sustainable and secure energy. The EU must therefore develop *an International Energy Policy that actively pursues Europe's interests* as well as pursuing effective energy relations with all its international partners, based on mutual trust, cooperation and interdependence.

Europe has two key objectives for energy technology: to lower the cost of clean energy and to put EU industry at the forefront of the rapidly growing low carbon technology sector. To meet these objectives, the Commission has presented in 2009 *a European Strategic Energy Technology Plan (SET Plan).* This Plan implies a long term vision to match the long term challenge of moving towards a low carbon energy system in a competitive manner. The Plan is presented in the next section.

1.2.2 Investing in the Development of Low-Carbon Technologies - SET Plan (COM(2009) 519) [135]

Reinventing our energy system on a low carbon model is one of the critical challenges of the 21st Century. Today, in the EU, our primary energy supply is 80% dependent on fossil fuels. Networks and supply chains have been optimised over decades to deliver energy from these sources to our society. Economic growth and prosperity has been built on oil, coal and gas. But, fossil fuels have also made the EU vulnerable to energy supply disruptions from outside the EU, to volatility in energy prices and to climate change.

Markets and energy companies acting on their own are unlikely to be able to deliver the needed technological breakthroughs within a sufficiently short time span to meet the EU's energy and climate policy goals, nor will they be willing or able to accelerate technology development over a sufficiently broad portfolio of technologies. The European Strategic Energy Technology Plan (SET-Plan) is the EU's response to the challenge of accelerating the development of low carbon technologies, leading to their widespread market take-up.

The medium- to long-term goals of this plan are as follows:

- *By 2020,* technologies will have to make the 20% renewable target a reality by permitting a sharp increase in the share of lower cost renewables.
- *By 2030,* electricity and heat will increasingly need to be produced from low carbon sources and extensive near-zero emission fossil fuel power plants with CO_2 capture and storage. Transport will need to increasingly adapt to using 2nd generation biofuels and hydrogen fuel cells.
- *For 2050* and beyond, the switch to low carbon in the European energy system should be completed, with an overall European energy mix that could include large shares for renewables, sustainable coal and gas, sustainable hydrogen, and, for those member states that want, Generation IV fission power and fusion energy.

In order to achieve the set targets, the Commission, working together with stakeholders, has drawn up Technology Roadmaps which describe the way forward. Following are some of the proposals of the Plan:

Wind energy has to accelerate the reduction of costs, increasingly move offshore and resolve the associated grid integration issues if it is to fulfil its huge potential. To support its rapid expansion, we need: to develop a better picture of wind resources in Europe, through coordinated measurement campaigns; to build 5-10 testing facilities for new turbine components; up to 10 demonstration projects of next generation turbines; at least 5 prototypes of new offshore substructures tested in different environments; demonstrate new manufacturing processes; and test the viability of new logistics strategies and erection techniques in remote and often hostile weather environments. All of this must be underpinned by a comprehensive research programme to improve the conversion efficiency of wind turbines. The total public and private investment needed in Europe over the next 10 years is estimated as €6 bn. The return would be fully competitive wind power generation capable of contributing up to 20% of EU electricity by 2020 and as much as 33% by 2030. More than 250,000 skilled jobs could be created.

[135] http://ec.europa.eu/energy/technology/set_plan/doc/2009_comm_investing_development_low_carbon_technologies_en.pdf (accessed 22nd October 2010).

Solar energy, including photovoltaics (PV) and concentrated solar power (CSP), has to become more competitive and gain mass market appeal. Problems derived from its distributed and variable nature need to be resolved. To support the development of PV, we need: a long-term research programme focussed on advanced PV concepts and systems; up to 5 pilot plants for automated mass production; and a portfolio of demonstration projects for both decentralised and centralised PV power production. For CSP, the overriding need is for industrial up-scaling of demonstrated technologies by building up to 10 first-of-a-kind power plants, supported by a research programme to reduce costs and improve efficiency, particularly through heat storage. The total public and private investment needed in Europe over the next 10 years is estimated as €16 bn. Up to 15% of EU electricity could be generated by solar power in 2020 as a result of such a programme coupled with market-based incentives. More than 200,000 skilled jobs could be created.

Electricity networks have to respond to three interrelated challenges – creating a real internal market; integrating a massive increase of intermittent energy sources; and managing complex interactions between suppliers and customers. To ensure that our electricity networks are fit for the 21st Century, we need a strongly integrated research and demonstration programme: research to develop new technologies to monitor, control and operate networks in normal and emergency conditions and develop optimal strategies and market designs to provide all actors with the right incentives to contribute to the overall efficiency and cost-effectiveness of the electricity supply chain; up to 20 large-scale demonstration projects at real life scale to validate solutions and assess their real system benefits, before rolling them out across Europe. The total public and private investment needed in Europe over the next 10 years is estimated as €2 bn. The goal is that by 2020, 50% of networks in Europe would enable the seamless integration of renewables and operate along 'smart' principles, effectively matching supply and demand and supporting the internal market for the benefit of citizens.

Bio-energy has to bring to commercial maturity the most promising technologies, in order to permit large-scale, sustainable production of advanced biofuels and highly efficient combined heat and power from biomass. Different bio-energy pathways are at various stages of maturity. For many, the most pressing need is to demonstrate the technology at the appropriate scale – pilot plants, pre-commercial demonstration or full industrial scale. Up to 30 such plants will be needed across Europe to take full account of differing geographical and climate conditions and logistical constraints. A longer term research programme will support the development of a sustainable bio-energy industry beyond 2020. The total public and private investment needed in Europe over the next 10 years is estimated as €9 bn. By 2020, the contribution to the EU energy mix from cost-competitive bio-energy used in accordance with the sustainability criteria of the new RES directive could be at least 14%. More than 200,000 local jobs could be created.

Carbon capture and storage (CCS) technologies have to be widely commercialised if the EU is to achieve almost zero carbon power generation by 2050 and if the likely continued use of the vast global coal reserves is not to exacerbate climate change. The pressing need is to demonstrate at industrial scale the full CCS chain for a representative portfolio of different capture, transport and storage options. At the same time, a comprehensive research programme will deliver improved components, integrated systems and processes to make CCS commercially feasible in fossil fuel power plants going into operation after 2020. The total public and private investment needed in Europe over the next 10 years is estimated as €13 bn. The target is to reduce the cost of CCS to 30-50 € per tonne of CO_2 by 2020, making it cost-effective within a carbon pricing environment.

Energy efficiency is the simplest and cheapest way to secure CO2 reductions. In transport, buildings and industry, available technology opportunities must be turned into business opportunities. This new European initiative – Smart Cities – has the objective to create the conditions to trigger the mass market take-up of energy efficiency technologies. The initiative will support ambitious and pioneer cities (e.g. from the Covenant of Mayors) that would transform their buildings, energy networks and transport systems into those of the future, demonstrating transition concepts and strategies to a low carbon economy. Participating cities and regions will be expected to test and demonstrate the feasibility of going beyond the current EU energy and climate objectives – i.e. towards a 40% reduction of greenhouse gas emissions through sustainable production, distribution and use of energy by 2020. The total public and private investment needed in Europe over the next 10 years is estimated as €11 bn. By 2020, the Smart Cities initiative should put 25 to 30 European cities at the forefront of the transition to a low carbon future. These cities will be the nuclei from which smart networks, a new generation of buildings and low carbon transport solutions will develop into European wide realities that will transform our energy system.

The *European Energy Research Alliance (EERA)* is elevating cooperation between national research institutes to a new level – from an ad-hoc participation in uncoordinated joint projects to collectively devising and implementing joint programmes. To accelerate the development of new generations of low carbon technologies, we need to build on the momentum of the Alliance and boost the scale of its joint programmes through additional investment. Taking ideas out of the laboratory and developing them to the point where they can be taken up by industry is a step that needs to be shortened considerably. The involvement of universities in the Alliance through the platform created by the European University Association will help ensure that the best brains can be mobilised. Over the next two years, the Alliance will launch and implement joint programmes addressing the key challenges of the SET-Plan with concrete technological objectives. Strong links will be developed with the Industrial Initiatives to ensure industrial relevance. On the basis of current progress, we estimate that the Alliance could expand its activities to effectively manage an additional public investment, EU and national, of €5 bn over 10 years.

1.3 Energy Sustainability: Current Situation in the Greek Cypriot Community

Cyprus' energy legislation is already broadly harmonized with that of the European Union, which aims at the attainment of a healthy competition in the market and the sufficient supply of energy to meet the needs of the country, with as low as possible burden on the economy and the environment. The implementation of the above is to be achieved through: (a) the liberalization of the electricity and gas market, ending the monopoly of the EAC (Electricity Authority of Cyprus) in the production and supply of electricity by opening about 35% to free competition; (b) the liberalization of petroleum market with abolition of price controls and cross-subsidies between different fuels, and pricing based on free market rules with an adjustment of the related tax-system; (c) the creation of storage terminals for the strategic and operating reserves of petroleum; (d) the implementation of programs for the development and use of energy-saving technologies, the exploitation of renewable energy sources and the protection of the environment from industrial pollution; and (e) the promotion of other environmentally friendly energy sources, such as natural gas [136].

1.3.1 Energy Authorities of the Republic of Cyprus

The National Energy Policy of Cyprus is formulated by the Energy Service of the Ministry of Commerce, Industry and Tourism. The Cyprus Energy Regulatory Authority (CERA) is the competent authority responsible for the general overview of the energy market in the country, so that the aforementioned policies are duly promoted and implemented. Furthermore, the Cyprus Institute of Energy (CIE) is particularly involved in the promotion of Energy Conservation and Rational Use of Energy, as well as the development and promotion of Renewable Energy Sources (wind, solar, biomass, hydro, geothermal or any other form of known renewable energy, or may prove worthy of consideration in the future) in Cyprus.

1.3.2 Conventional sources of energy

By the end of 2009, the conclusion of works for the Energy Centre at Vasiliko was expected, which shall include a terminal for the importation, storage and de-liquefying of LNG (liquefied natural gas), as well as a terminal for the importation and storage of petroleum. As a result, it was expected that by the end of 2009 Cyprus would be able to start the production of energy using natural gas. It is important to note that the Vasiliko Energy Centre's design includes all required provisions for coverage of the energy needs of the whole of Cyprus [137].

By 2015, it is expected that actions for exploitation of the hydrocarbon deposits that might be present within the Economic Zone of Cyprus, will further be promoted by the Cyprus government.

[136] Ministry of Commerce, Industry and Tourism – Energy Service (website), "Energy Policies & Targets".
[137] Cyprus 2015 interview, Solon Kasinis, Director of Energy Service, Nicosia, 8 September 2009.

1.3.3 Development of Renewable Energy Sources (RES)

As a member of the EU, Cyprus has made some progress over the years to coordinate with EU directives regarding energy issues - development of RES, improvement of energy efficiency, quality standards of petroleum products, supervision of fossil fuels market, retaining of safety energy reserves, purchase of electricity and natural gas, etc. When it comes to Renewable Energy, it is expected that by 2015 and beyond, major projects for electricity production shall be concluded using wind and solar energy, biomass and biogas, as well as geothermic energy. Also, a series of EU directives and regulations shall be implemented.

As mentioned in the previous chapter, the EU is committed to reducing its overall emissions to at least 20% below 1990 levels by 2020. It has also set itself the target of increasing the share of renewables (wind, solar, biomass, etc) in energy use to 20% by 2020 as well as cutting energy consumption by 20% of projected 2020 levels by improving energy efficiency. Currently, the share of renewables in energy use within EU is about 8.5%. Cyprus has set a respective target of 13% for year 2020, and in 2008 stood at a share of 4.5%.

Official data by the EU shows that the Town Planning bureaus in Cyprus constitute a major obstacle to the development of RES systems in the country, although the procedures for a permit for the installation of RES systems have recently been significantly simplified [138]. Another issue is the number of authorities involved in the issuance of a licence (more than the average number of authorities in other Member States), which delays the whole procedure. Nevertheless, Cyprus compares favourably to other Member States when it comes to informing the public regarding RES systems development.

The Cyprus government provides a number of subsidy programmes, which aim to encourage the private sector to invest in RES systems and the deployment of energy efficient systems (e.g. purchase of eco-friendly cars). All sorts of subsidies provided for these purposes come from a special RES fund, financed by additional tax on electricity bills to consumers (currently set at 0.22 €cents/kWh with plans to increase to 0.55 €cents/kWh) [139].

The private sector has responded very positively to the various opportunities provided for the development of RES. Many companies have already applied for the various photovoltaic and wind farm projects, as well as for the production of energy through biofuels.

No wind farms are currently operating in Cyprus, but nevertheless, the special RES fund has pre-approved the installation of wind farms totalling 165 Mw. The main obstacles to the development of these farms are: (a) the limited potential for wind energy generation, (b) land planning problems, and (c) oppositions of local communities.

More than 2.5 Mw of PV systems have been installed so far in Cyprus, which ranks the country 6th in the EU regarding the per capita production of electricity using solar energy. Main obstacles to the development of PV systems have been the following: (a) low efficiency, (b) high capital investment (very high initial cost), and (c) need of very high subsidies in order to be (individually) viable.

Although some reports suggest negative effect of biofuels to automotive engines, Cyprus has to proceed with a 10% substitution of fossil fuels with biofuels by 2020. One company has been registered for the production of biofuels (600,000 lt. for the year 2008). The main obstacles Cyprus faces in meeting the biofuels target are the following: (a) limited suitable agricultural land, (b) water scarcity, (c) high dependence on imports to satisfy the targets, and (d) high cost of imports. The use of biofuels produced by genetically modified plants is prohibited [140].

[138] Cyprus 2015 stakeholder panel, Nicosia, 16 February 2010.
[139] Cyprus 2015 stakeholder panel, Nicosia, 1 March 2010.
[140] Solon Kasinis, "Renewable Energy & Energy Conservation: The Business Environment in Cyprus", Ministry of Commerce, Industry & Tourism - Energy Service, Nicosia, May 2009.

1.4 Energy Sustainability: Current Situation in the Turkish Cypriot Community

As a recent study on the current state of energy efficiency and renewable energy in the northern part of Cyprus points out, 'none of the provisions of the main EU Directives on energy (electricity and gas markets Directive, requirement for 90 days oil stocks, RES Directive, Energy Services Directive, Buildings Energy Performance Directive, Energy Labeling of Devices, etc.) is in force in the northern part of the island' [141]. More significantly, the local regulatory framework for energy in general is 'elementary' [142]. As an academic specialized on energy issues commented in our interview, the most evident setback in the northern part of Cyprus as far as the energy sector is concerned, is the lack of a legal framework regulating the production and distribution of energy in general, and renewable energy in particular [143].

To address this problem, the Turkish Cypriot administration established the Energy Efficiency Agency in January 2010. The Agency is tasked 'to raise awareness about more efficient use of energy, and to work on determining new energy policies' [144]. The agency is comprised of representatives from different professional associations, and universities as well as Kib-Tek (Turkish Cypriot Electricity Authority). Although this issue has been on the agenda of the 'parliament' for a long time, legislators are yet to finalize their deliberations regarding the long expected legislation, the draft for which has been prepared in a participatory manner.

In the absence of a regulatory framework, the vast potential of renewable energy sources – solar heated rooftop hot water systems aside [145] - has not been utilized. As a rather late first initiative, a pilot project -solar PV plant- is being implemented with the EU's financial assistance near Serhatkoy. Although the plant, which will have a capacity of 1.26 Mw, was initially scheduled to go online in June 2010, at the time of writing its construction was still in progress [146]. Reportedly, the administration is planning to commission private companies to establish another 25-30 Mw capacity in the same region [147].

When it comes to the utilization of renewable energy sources, the private sector's role has also been very limited. Although there are a few companies active in the sector, the off-grid solar energy capacity they have installed so far is estimated to be around 0.5 Mw [148]. According to private sector representatives, the biggest handicap hindering the development of the sector is the absence of government incentives [149]: 'the average cost of a PV system is 10-15 thousand dollars, and without long-term subsidised credit opportunities, demand is doomed to be minimal; this is the biggest challenge we have at the moment' says an entrepreneur in the sector. He urges the government to pass the legislation, which has been in the pipeline for months, 'as soon as possible'. 'Statements like "we'll promote solar energy," is making the potential buyers postpone their purchasing decisions,' he says 'further deteriorating the already dismal situation in the market' [150].

[141] The Energy II – Demand-side management - Public awareness campaign. http://www.efficient-energy-use.eu/index.php?option=com_content&view=article&id=5&Itemid=15&lang=en (accessed 24 June 2010).
[142] Ibid.
[143] Cyprus 2015 Interview, 1 February 2010.
[144] Havadis: Enerji Verimlilik Ajansi Kuruldu, 22 January 2010.
[145] According to Ali Korakan, the president of Energy Professionals Association, as their technology is from 1960-70's, the efficiency of these systems is quite low, and hence, they should be replaced by more efficient ones (Presentation made at the Cyprus Climate Conference, November 2009).
[146] Halkın Sesi: Güneş Enerjisi Santrali, Haziran'da devreye girecek, 26 December 2009.
[147] Ibid.
[148] Cyprus 2015 Interview, 14 January 2010.
[149] Cyprus 2015 Interview, 13 January 2010.
[150] Cyprus 2015 Interview, 13 January 2010.

As for energy efficiency, one of the rare, concrete steps so far taken was the government's decision to distribute 300 thousand energy-efficient light bulbs in 2007. The effort was welcomed not only by the public but also by experts [151].

Kib-Tek also has recently started installing 'smart meters', which will make it possible for households to sell excess energy they produce at home back to the grid. Kib-Tek is expected to complete replacing 137 thousand mechanical meters by 2012 [152].

As for the current electricity production, the northern part of Cyprus relies solely on thermal plants [153]. The established capacity is around 307.5 Mw [154]. 85 Mw of this capacity belongs to AKSA, a privately owned Turkish company [155].

At around 30-40%, the efficiency of these plants is quite low [156]. Furthermore, the quality of fuel used, 'heavy fuel oil No. 6' is also quite low. According to the Programme for the Future Adoption of the Acquis (PFAA), the administration is aiming to develop 'a new strategy for importing a higher quality heavy fuel oil' [157]. There are also major inefficiencies in transmission lines, according to the various stakeholders interviewed.

In an effort to solve the energy shortage problem of the northern part of Cyprus once and for all, the Energy Minister of Turkey initiated a feasibility study to evaluate the prospects of realizing interconnectivity between Turkey, and the northern part of Cyprus [158]. The result of this study is yet to be disclosed.

[151] Kibris: Ekonomik lamba seçimine ve dağıtımına dikkat edilmeli, 2 January 2007.
[152] Halkın Sesi: Güneş Enerjisi Santrali, Haziran'da devreye girecek, 26 December 2009.
[153] Ayse Tokel, presentation made at the Cyprus Climate Change Conference, Nicosia, November 2009.
[154] Halkın Sesi: Güneş Enerjisi Santrali, Haziran'da devreye girecek, 26 December 2009.
[155] http://www.efficient-energy-use.eu/index.php?option=com_content&view=article&id=5&Itemid=15&lang=tr (accessed on 24 June 2010). According to the same sources, the established capacity is 347 MW.
[156] Cyprus 2015 Interview, 20 January 2010.
[157] PFAA (Programme for the Future Adoption of the Acquis), Nicosia, January 2009, p. 406.
[158] http://www.abhaber.com/haber.php?id=26959 (accessed on 29 June 2010).

1.5 Energy Sustainability: Future Directions for Cyprus

Several meetings of energy stakeholders, including Greek Cypriot and Turkish Cypriot energy experts, environmentalists and entrepreneurs active in the energy sector, were convened by the Cyprus 2015 initiative in February and March 2010. The stakeholders were presented with the research findings of Cyprus 2015 staff in relation to global trends, EU polices and current situation in Cyprus, and were asked, on the basis of this situation, to formulate relevant policy recommendations for the future of Cyprus. The following is a summary of their recommendations, and accompanying rationale:

1.5.1 An issue of averting climate change or securing energy supplies?

A fundamental prerequisite for an integrated energy strategy is conceptualizing the problem in its correct dimensions. Seen from a viewpoint of energy security, the problem is one of ensuring that Cyprus will avoid the risk of inadequate or excessively priced energy, such that would impact the functioning of the economy but also the daily life of citizens. Seen from a climate change viewpoint, the problem is one of averting the negative impact on the environment that arises from unsustainable energy production practices.

While in the context of an energy security narrative Cyprus is in a similar situation as most other developed countries, in relation to the problem of climate change Cyprus is in a paradoxical position: On the one hand, as a small country it has a comparatively small impact on global climate change, however unsustainable energy production practices in Cyprus may be. On the other hand, Cyprus – as a small island state under the threat of desertification – will be one of the first to suffer from a global climate change. Rising water levels would decimate coastal areas while rising temperatures would catalyze the already unsettling process of desertification.

Seen from this viewpoint, unsustainable energy production practices in large industrial nations around the globe are very much a concern of Cyprus. Even as Cyprus works to ensure energy security through a local conversion to sustainable and reliable sources of energy, it should devote extensive resources towards contributing to the global sustainable energy agenda. Island states within the EU should establish a platform to jointly undertake a leading position in promoting the issue of rising sea levels, putting it forward as a moral issue on behalf of island-states world-wide. Cyprus could take the initiative in proposing the establishment of such a platform.

1.5.2 Developing an island-wide energy strategy

An island-wide energy strategy is urgent and essential, regardless of the outcome of the current inter-communal talks. An island-wide energy strategy should include plans, not only to increase sustainable energy production, but also to reduce energy consumption and increase energy efficiency. Additionally, it should be based on forecasts of energy requirements over the coming decades, utilize a broad portfolio of energy sources, especially solar energy for which Cyprus has very high potential, and aim towards the creation of a smart island-wide

energy grid. This energy strategy should be ambitious in proposing a rapid transition to renewable energy sources, at a rate that is even faster than the planned EU average, given Cyprus' small size and therefore small number of infrastructural projects that are required to make the transition.

Establishing an ultimate target for 100% renewable energy generation, after the precedent of Australia which has already established a target for 100% renewable energy within 10 years, should also be an element of Cyprus' strategy, thus setting an example for the rest of the EU to follow. The incorporation of cogeneration technologies to increase the efficiency of existing power plants, seen as a transitional measure for the period when we still rely on the existing power plants, should also be a part of this energy strategy. Importing renewable energy from neighboring countries can also be a valid component of Cyprus' renewable energy strategy.

To ensure that this transition takes place smoothly and with the minimum of economic or social upheaval, the following principles should guide the planning process:

- Cypriot energy to be provided entirely from renewable and other non-carbon emitting sources at the end of a transition period.
- Use of proven technological solutions only, which are reliable and commercially available.
- Security and reliability of Cyprus energy supply to be enhanced during transition process.
- Food and water security to be maintained or enhanced during transition.
- Cypriots to continue to enjoy a high standard of living.
- Social equity maintained or enhanced by the transition.
- In case of delayed comprehensive solution, bi-communal cooperation in energy to be enhanced during transition.
- External current account balance and national debt to be maintained or improved by end of transition.
- Design to maximize number of productive Cypriot jobs during and after the transition.

Such an island-wide energy strategy must be designed together by the two communities, while the design and implementation process would be most effective if it takes place in parallel, both at a civil society level and at the official level, with the two levels co-operating closely and reinforcing each other's work. At the civil society level, existing environmental initiatives along with stakeholders and experts could co-operate to put together a proposal for an energy blueprint, to be submitted to the leaderships of the two communities for ratification. At the official level, a suitably mandated technical committee under the auspices of the Leaders of the two communities could be tasked with planning an island-wide energy strategy [159]. In case there is a comprehensive settlement in the mean time, responsibility for the implementation of the energy strategy would be transferred to the new Federal administration. If in contrast a comprehensive settlement is delayed, then the agreed island-wide strategy can be implemented separately by appropriate authorities in the two communities under the supervision of the aforementioned inter-communal technical committee, until such time as a comprehensive settlement is found.

[159] Specifically, the existing Technical Committee on the Environment could establish an Energy Task Force with the mandate of developing such an island-wide energy strategy.

1.5.3 Building confidence in peace through energy co-operation

Cooperation on energy issues, and particularly sustainability in energy production, can serve as a symbol for a cooperative and dynamic future, even before an integrated energy strategy as proposed above is designed and implemented. Specifically, we propose the following three projects, which could be taken up without delay by the leaderships of the two communities, the EU, the UN, and any other actors willing to be of help:

A Solar Thermal Power Plant in the buffer zone. Experts agree that Cyprus is in a unique position to benefit from solar thermal power generation, a highly efficient power generation technology that could potentially produce desalinated water as well as electricity, with virtually no ongoing inputs other than seawater and sunlight. A small number of such power plants could completely cover the electricity generation needs of the whole island. The greatest challenges of solar-thermal are, firstly, the large quantity of land that is required to lay out the mirror array, which is why in other countries such plants are usually located in deserts, and secondly, the large initial cost of laying out the mirror array. It is proposed that planning could go ahead for a solar thermal power plant that would be located in the buffer zone not far from the coast so as to ensure access to seawater, with the cooperation of the leaderships of the two communities, and with an inter-communal business consortium funding the project, which would then provide electricity (and perhaps water) to the grids of both communities [160].

A grant scheme for private sector co-operation in the field of sustainable energy production. Such a scheme could be funded by the EU or the UN, a pooled fund in which both communities would contribute, or from private or other third party donations. Funded businesses would have to demonstrate that they are owned and managed by members of both communities, that their activities fall within the fields of promoting energy efficiency or producing energy by renewable sources, and that they make their services available in both communities. The grant scheme could be managed inter-communally under the auspices of the leaders of the two communities at a technical committee level.

An inter-communal research and development unit for energy sustainability. Such a unit could build on the success of other research centers and initiatives that operate successfully with participation from both communities and utilize already existing scientific and scholarly know-how. Such a unit could contribute greatly to the cause of converting Cyprus into a testing ground for the development and practical application of cutting edge technologies to increase energy efficiency and produce energy sustainably through novel and more efficient means, utilizing funds that will be made available in line with the EU Strategic Energy Technology Plan as discussed in a previous section. Beyond the specific technological gains that are expected to arise out of this centre, there are broader benefits in bringing together the scientific minds of the two communities: Enhancing contact, while at the same time facilitating the process of economic and social convergence of the two communities.

[160] Some private sector actors have already approached UNFICYP for planning permission. The Cyprus Institute (http://eewrc.cyi.ac.cy/) has already worked out the technical details and is implementing a feasibility study for a solar-thermal facility that would also produce desalinated water, with EU funds (http://eewrc.cyi.ac.cy/CSP-DSW/CSP-DSW). The US Bi-Communal Support Programme has already launched a competition in 2010 for an island-wide solar park, however it seems it met with limited success.

PART II

Water Sustainability

'Til taught by pain, men really know not what good water is worth' [161].

2.1 Global Trends in Water Sustainability

Water, an indispensable element for all forms of life, is also 'the primary medium through which climate change influences the Earth's ecosystems and therefore people's livelihoods and well-being' according to the UN-Water, an inter-agency mechanism formally established in 2003 by the UN High Level Committee on Programmes. Climate change is expected to influence the fresh water systems mainly in three ways: Due to increase in temperature; rise in sea level; and increased precipitation variability [162].

Increase in temperature has already been leading to the melting of glaciers at 'an alarming and ever accelerating rate' [163], and causing 'snow to fall as rain' [164]. 'Snow and ice are natural regulators, storing water in winter and releasing it in summer' [165]. In their absence, therefore, 'countries are swinging more violently between flood and drought' [166]. The Himalaya glaciers, for instance, which constitutes 'the largest body of ice outside the poles,' and supplies water to a population of 2 billion, is losing about 7 percent of its ice each year, and 'may completely disappear as early as 2030' [167].

As regards to increase in sea level, the IPCC predicts 'a rise of 0.18 – 0.38m increase by 2100 in the most optimistic scenario and 0.26 – 0.59m in the most pessimistic' [168]. This is expected to 'extend areas of salinization of groundwater and estuaries, resulting in a decrease in freshwater availability for humans and ecosystems in coastal areas' [169]. Furthermore, this will threaten the habitats of some low-lying regions, like Tuvalu, an island state in Pacific, 'which is already experiencing severe flooding which is damaging … homes and affecting drinking water' [170].

Speeding up of the hydrologic cycle [171] —'that is, the rate at which water evaporates and falls again as rain or snow,' is another consequence of climate change. Simply put, this is rendering 'wet regions more sodden, and arid ones drier, and bringing longer droughts between more intense periods of rain' [172]. There are already many tangible examples: Australia – the world's driest inhabited continent- was recently struck by a decade-long drought; worst in a century [173], followed by a flood [174]. 'Although few scientists are confident that they can ascribe any individual event (like this) to global warming,' the Economist comments, 'most agree that droughts … will become more common' [175].

Semi-arid and arid areas like the Mediterranean basin 'are particularly exposed to the impacts of climate change on freshwater' [176]. According to the World Water Development Report,

[161] Lord Byron.
[162] Kundzewicz et. al.,2007: 175.
[163] Human Impact Report: Climate Change — The Anatomy of a Silent Crisis, the Global Humanitarian Forum, Geneva, 2009, p. 57.
[164] Sin aqua non, The Economist, 8 April, 2009.
[165] Ibid.
[166] Ibid.
[167] The Anatomy of a Silent Crisis, p. 57.
[168] http://www.bbc.co.uk/climate/impact/sea_level.shtml (accessed 14.05.10)
[169] Kundzewicz et. al.,2007: 175.
[170] http://www.bbc.co.uk/climate/impact/sea_level.shtml (accessed 14.05.10)
[171] Houghton defines it as '(t)he exchange of water between the atmosphere, the land and the oceans' (2009: 422).
[172] Sin aqua non.
[173] Ibid.
[174] Australia's Floods: The Drought Ends, the Shouting Starts, The Economist, 22 April 2010.
[175] The Big Dry, The Economist, 26 April 2007.
[176] Kundzewicz et. al.,2007: 175.

Southern Mediterranean ecosystems risk losing 60-80% of species even if the target of limiting the temperature rise to 2 degrees will be achieved [177].

As it is in the case of energy, climate change is not the only factor that we have to take into consideration when investigating the issue of water. There are also non-climatic factors 'significantly or even dramatically' affecting water resources [178]. These non-climatic factors have much to do with demographic (population growth) and economic growth (changes in consumption patterns; increasing urbanization; changing lifestyles; land use changes) [179]. To tackle this triple challenge, we need to strike a balance between our fundamental needs, and 'our collective pursuit of higher living standards' on the one hand, and 'the need for water to sustain our planet's fragile ecosystems', on the other. [180]

In the last 50 years the amount of water used trebled, while the world's population rose to 6.5 billion from 3 billion, and it is projected to rise further to 8.5 billion by 2025, pushing the demand for fresh water even higher [181]. What really makes the difference, however, is not the absolute numbers, but diet, which basically constitutes the most important single factor in water demand [182].

Different foods require radically different amounts of water. To grow a kilogram of wheat requires around 1,000 litres. But it takes as much as 15,000 litres of water to produce a kilo of beef. The meaty diet of Americans and Europeans requires around 5,000 litres of water a day to produce. The vegetarian diets of Africa and Asia use about 2,000 litres a day (for comparison, Westerners use just 100-250 litres a day in drinking and washing). So the shift from vegetarian diets to meaty ones … has big implications for water… In 1985 Chinese people ate, on average, 20kg of meat; this year (2009), they will eat around 50kg. This difference translates into 390km3 (1km3 is 1 trillion litres) of water—almost as much as total water use in Europe.

The shift of diet will be impossible to reverse since it is a product of rising wealth and urbanization. In general, "water intensity" in food increases fastest as people begin to climb out of poverty, because that is when they start eating more meat. So if living standards in the poorest countries start to rise, water use is likely to soar. Moreover, almost all the 2 billion people who will be added to the world's population between now and 2030 are going to be third-world city dwellers—and city people use more water than rural folk. The FAO reckons that, without changes in efficiency, the world will need as much as 60% more water for agriculture to feed those 2 billion extra mouths. That is roughly 1,500km3 of the stuff—as much as is currently used for all purposes in the world outside Asia [183].

Growing stress on surface water (mostly rivers, lakes, and reservoirs) due to increasing demand for agricultural products made groundwater (aquifers) seem to be a 'miraculous solution' [184]. However, groundwater is being withdrawn 'at a rate much faster than the aquifers are recharged' [185]. In major cities like Mexico City, Bangkok, Buenos Aires, and Jakarta aquifers are under immense stress [186]. Same applies to the aquifers on which farmers depend. 'Farmers around the world… have been sinking millions of bore wells and pumping water out of once plentiful groundwater aquifers at an astounding rate' [187]. India alone, which had about 17 million bore wells by 2001, pumps 230 km³ each year, which represents over a quarter of the world total [188].

[177] World Water Development Report 3, p. 212.
[178] Kuylenstierna.
[179] See Kuylenstierna; Kundzewicz et. al.,2007.
[180] UN 3, p. xx.
[181] Sin aqua non.
[182] Ibid.
[183] Sin aqua non.
[184] For Want of a Drink.
[185] Sachs, 2009: 122.
[186] For Want of a Drink.
[187] Sachs, 2009: 122.
[188] Making Farmers Matter, Special Report on Water, The Economist, 22 May 2010.

Though bore wells were an essential part of the Green Revolution, particularly in India, the indiscriminate use of and unregulated access to groundwater resources is putting entire aquifers in peril. The over pumping not only leads to the disappearance of the resource, it also has further harmful consequences. It can lead to land subsidence – literally collapse of the land above the aquifers – a phenomenon that is increasingly frequent in major cities such as Beijing. It can also lead to the contamination of those aquifers with salt water, the salination and poisoning of soils, and collapse of aquifers that reduces their storage capacity [189].

In the village of Bhutal Kalan in Sangrur district (India), for instance, the farmers complain not just of water levels dropping by two metres after each of the two harvests a year but also of fluorosis, which may cause mottling of the teeth and skin, or, in its skeletal form, arthritic pain and bone deformities. Cancer is also rising, which the farmers blame on the natural poisons and on pesticides…' [190].

At around 70 percent, agriculture represents the lion's share of the global water demand [191]. Industry, and domestic activities, on the other hand, account for 22 and 8 percent respectively, and the combined demand emanating from these two latter categories 'quadrupled in the second half of the 20th century, growing twice as fast as those of farming, and forecasters see nothing but further increases in demand on all fronts' [192].

2.1.1 Sustainable Water Management

Although its supply is finite, in fact, 'water is by far the commonest substance on earth' [193]. Almost '70 percent of the earth's surface is covered with water' [194]. The problem is only 1 percent of it is of use for human consumption, as 97% of the total is seawater, and two third of what is left is 'locked up in glaciers or ice and snow around the poles' [195]. Even so, should it be managed properly the remaining 1 percent would be enough. Indeed, globally speaking, 'there is no shortage of water' [196]. 'On average, people are extracting for their own uses less than a tenth of what falls as rain and snow each year' [197] [198]. In this sense, it would be inaccurate to say that there is a global water shortage crisis. This is not to deny that there are many shortage problems at regional levels. Currently, 'more than one billion people live in areas where water is scarce' [199]. However, the fact that even places like Cherrapunji, Bangladesh, which is 'officially the wettest place on earth', are suffering frequent water shortages [200], makes scholars like Sumita Dasgupta of the Centre for Science and Environment in Delhi, think that 'the problem is water management, not water scarcity' [201]. There are some businessmen who share the same conviction, going one step beyond, and compare water with oil: 'I am convinced that, under present condition and with the way water is being managed' Peter Brabeck-Letmathe, chairman of Nestle, observes 'we will run out of water long before we run out of fuel' [202].

[189] Sachs, 2009: 122.
[190] Making Farmers Matter.
[191] 'In Britain, for example, farming takes only 3% of all water withdrawals. In the United States, by contrast, 41% goes for agriculture, almost all of it for irrigation. In China farming takes nearly 70%, and in India nearer 90%' (For Want of a Drink, A Special Report on Water, The Economist, 22 May 2010).
[192] For want of a drink, A Special Report on Water, The Economist, 22 May 2010.
[193] Priceless
[194] Jerry Silver: Global Warming and Climate Change Demystified, McGraw Hill, 2008, p. 165.
[195] Priceless; see also Sachs, 2009: 117.
[196] Awash in waste, The Economist, 8 April 2009.
[197] Awash in waste.
[198] 'The global average withdrawal of fresh water was 9% of the amount that flowed through the world's hydrologic cycle. Both Latin America and Africa used less than 6%' (Sin aqua non, The Economist, 8 April 2009).
[199] Tapping the Oceans.
[200] Irrigate and Die, the Economist, 17 July 2003.
[201] Cited in Irrigate and Die, The Economist, 17 July 2003.
[202] Cited in A Water Warning, The Economist, 19 November 2008.

Koïchiro Matsuura, the director-general of UNESCO, points out the phenomenon of political negligence in relation to water, in his forward to The UN World Water Development Report 3: Water in a Changing World (2009: vii): 'Despite the vital importance of water to all aspects of human life, the sector has been plagued by a chronic lack of political support, poor governance and underinvestment' [203]. In the same report (2009: v), Ban Ki-moon, the Secretary General of the UN, also underscores the significance of management: 'Managing water is essential if the world is to achieve sustainable development'.

The cost of inaction is growing each day. Compared to a century earlier, twenty percent of the world's freshwater fish species have either already become extinct or face extinction, while half of the wetlands disappeared [204]. Furthermore, the financial cost of poor management is far beyond negligible: According to The Economist, 'groundwater depletion takes 2.1% of Jordan's GDP; water pollution and scarcity knock 2.3% of China's; 11% of Kenya's was lost to flooding in 1997-98, and 16% to drought in the next two years' [205]; 'the drought knocked one percentage point off Australia's growth rate' in 2006 [206].

To sum up, for a long time '(w)ater resources have been exploited with no heed either to sustainability or to the environmental consequences. And water policy has suffered from a near-total disregard for the discipline and tools of economics, especially pricing, trading and cost-benefit analysis' [207].

2.1.2 Possible Remedies

As in the case of energy sector, there is no silver bullet to tackle the challenges of water management. However, this does not necessarily mean that we cannot talk about general principles of sustainable water management. This basically starts with improving efficiency. 'Combined savings in agriculture, industry and domestic water supplies', suggests the Dublin Statement on Water and Sustainable Development, 'could significantly defer investment in costly new water-resource development and have enormous impact on the sustainability of future supplies'.

In this context, Integrated Water Resources Management (IWRM) [208], which, 'is a systematic and targeted process to the sustainable development and equitable allocation of water resources through a holistic approach to water management',[209] emerges as a broad guideline. IWRM is based on the following principles:

1. Freshwater is a finite and vulnerable resource, essential to sustain life, development and the environment, and in this sense access to water is a fundamental human right.
2. Water development and management should be based on a participatory approach, involving users, planners and policy-makers at all levels.

[203] World Water Development Report 3: Water in a Changing World, p. vii.
[204] For Want of a Drink.
[205] The Ups and Downs of Dams, Special Report on Water, The Economist, 22 May 2010.
[206] The Big Dry, The Economist, 26 April 2007.
[207] Irrigate and Die.
[208] 'IWRM as a concept was first presented at the International Conference on Water and Environment in Dublin, and in Chapter 18 of Agenda 21, a consensus document from the United Nations Conference on Environment and Development (UNCED) in Rio, both in 1992' (Wilk, and Wittgren, 2009: 7). For the whole text of The Dublin Statement on Water and Sustainable Development, please see http://www.gdrc.org/uem/water/dublin-statement.html (accessed on 22.05.10).
[209] Wilk, J. and Wittgren, H.B. (eds). Adapting Water Management to Climate Change, Swedish Water House, Policy Brief nr. 7. SIWI, 2009. Adapting Water Management to Climate Change 3, p. 7.

3. Women play a central part in the provision, management and safeguarding of water [210].
4. Water has an economic value in all its competing uses and should be recognized as an economic good [211].

Another, somewhat more specific set of principles to increase the efficiency of water use was identified by the World Economic Forum: 'raise awareness, reduce leakages, maximize recycling, price water adequately and redirect the implicit and explicit subsidies to water demand to measures that reduce water demand' [212]. Furthermore, although it is a controversial issue, desalination can also be seen as an instrument of sustainable water management as long as the energy used in the desalination process comes from renewable sources [213], and brine is disposed of properly. Although there are no one-size-fits-all policy prescriptions, the exchange of best practices is clearly crucial [214]. In what follows, some of these measures will be briefly discussed.

Evidently, agriculture, which accounts for 70-75% of the demand, is like 'Agasthya, the mythical Indian giant who drank the seas dry,' [215] and improving irrigation practices can play a major role in tackling the inefficiency of water use. 'As much as 70% of water used by farmers never gets to crops, perhaps lost through leaky irrigation channels or by draining into rivers or groundwater' [216]; or through evaporation and seepage [217]. Improving irrigation practices can increase water efficiency by 30%, according to Chandra Madramootoo of the International Commission on Irrigation and Drainage [218]. 'The simple, affordable, and proven technology' of drip irrigation, which involves bringing 'a constant, low pressure stream of very small amounts of water directly to the crop roots,''instead of flooding a field or bringing water to it via canals in which water can pool and evaporate' is a significant tool in this regard [219].

Evaporation of water in dams is another factor causing waste of water, and it can be avoided by 'pumping water into natural aquifers for seasonal storage' [220]. This does not only avoid waste, but also stands as a cheaper alternative to building dams – which is a highly contested issue [221].

According to Mark Zeitoun of the London School of Economics, 'agriculture is responsible for the greatest waste of water, largely because of government subsidies' [222]. 'Substituting thirsty crops such as oranges with more abstemious olives and dates' in arid regions like the Middle East can be a remedy, he suggests: 'Ideally, countries that are short of water would concentrate on growing the most valuable cash crops, and use the proceeds to import staples' [223]. Mexico, for instance, is saving 9 billion m3 of water by importing cereals from the US, instead of growing them itself [224]. However, this is more like an exception than the rule in international trade. As 'most water use is not measured, let alone priced, trade rarely reflects water scarcities' [225]. Consequently, farmers don't mind growing thirsty crops like alfalfa in arid California. Similarly,

[210] 'In the world's impoverished villages … women and girls, … often spend hours each day walking many miles to fetch the household's water supply' (Sachs, 2009: 115). For more on the women's role in water sector, please see World Water Development Report, p. 38.
[211] Wilk and Wittgren, 2009: 7.
[212] WEF: Rebuilding Water Management, 2010.
[213] Kundzewicz et. al.,2007: 200.
[214] WEF.
[215] Sin aqua non.
[216] Running Dry, The Economist, 18 September 2008.
[217] Houghton, 2009: 195.
[218] Cited in Sina Aqua Non.
[219] Sachs, 2009: 132.
[220] Running Dry.
[221] For more on dams, please see The Ups and Downs of Dams, A Special Report on Water, The Economist, 22 May 2010.
[222] Cited in A Soluble Problem, The Economist, 19 July 2008.
[223] Cited in Running Dry, The Economist, 18 September 2008.
[224] Sin Aqua Non.
[225] Sin Aqua Non.

although growing wheat in India and Brazil consumes twice as much water compared to the US and China, these countries continue growing wheat, and 'dry countries like Pakistan export textiles though a 1kg bolt of cloth requires 11,000 litres of water' [226].

Another option to increase the efficiency of water use is to 'engineer crop varieties that need less water and can thrive in drought-prone areas' [227]. According to Sachs spectacular results have already been achieved in early scientific trials to transfer genes from drought resistant natural varieties to food crops [228]. Additionally, it is important to achieve a better understanding of soil structures and soil ecosystems. Plants don't grow in a vacuum independently of soil microorganisms. One commonly used approach in organic farming is to inoculate plant roots with mycorrhizal fungi, which form a naturally-occurring symbiosis with plant roots, resulting in better soil water retention, as well as more efficient water use by the plants, thus enabling significant drought tolerance.

The crux of the issue lies in the pricing of water. 'In all of these cases,' Sachs says, 'a price for use of water (together with a lifeline tariff) is needed to help induce farmers to shift from overuse of water supplies to sustainable use based on high crop per drop technologies' [229].

Just as with low carbon technologies, it will be one thing to develop water-efficient seed varieties and more efficient irrigation methods, and quite another to have the technology accepted. To get these methods adopted in the place of unsustainable groundwater harvesting, farmers will need to have a market incentive. For the poorest of the poor, this might be a subsidy or grant for the improved technology. For richer farmers, it should be the contrary: a price of water tariff that reflects the true social costs of drawing unsustainably on groundwater or river-based irrigation [230].

Indeed, there are many pundits who agree that more efficient use of water depends on pricing it properly [231]. However, there is a resistance against this approach on the grounds that as 'humans cannot live without water, it should be a basic human right, available to all, preferably for nothing' [232]. Furthermore, farmers who are enjoying zero or near-zero rates are also resisting the idea [233], making effective pricing quite difficult, and rare.

Nonetheless, there are some success stories. One of these rare cases is Chile: Instead of providing subsidies to keep down water tariffs in general, a policy, which favors the well-off more than others, Chile is charging the full cost of water, while providing the poor with stamps to redeem against their bills [234]. South Africa is another similar and successful case. With a water law passed in 1998, the government took over the full control of the country's water, 'abolished previous riparian rights, made water allocations both temporary and tradable, and required full costs to be charged to all users except for the very poorest' [235].

To make pricing of water politically less problematic, the WEF suggests redirecting the implicit subsidies to water consumption into other means, which will benefit the consumers. For instance, instead of giving them free water, giving the farmers free facilities for drip irrigation [236].

As pricing water keeps bumping to the political barriers, a practical alternative is emerging in Australia. This is a system called the tradable usage rights, which resembles to the cap-and-trade system discussed in the energy section. It works as follows:

[226] Awash in Waste.
[227] Sachs, 2009: 132.
[228] 2009: 132.
[229] Sachs, 2009: 133.
[230] Sachs, 2009: 133-4.
[231] A Soluble Problem, The Economist, 19 July 2008.
[232] Awash in Waste, The Economist, 8 April 2009.
[233] Awash in Waste.
[234] Liquid Assets, The Economist, 17 July 2003.
[235] Liquid Assets.
[236] WEF

> (F)armers have the right to use a certain amount of water for free. They can sell that right… to others. But if they want more water themselves, they must buy it from a neighbor. The result of this trading is a market that has done what markets do: allocate resources to more productive use… farmers have responded to the new market signals by switching to less thirsty crops and kept the value of farm output stable. Water productivity has doubled. Australia's system overcomes the usual objections because it confirms farmers' rights to water and lets them have much of it for nothing [237].

A similar system is being implemented in some parts of Pakistan's Punjab [238], and in California [239].

As 'a technology of last resort, not first instance,' as Gidon Bromberg of Friends of the Earth Middle East put it, desalination also has a role to play in tackling the water problem [240]. Basically, desalinating seawater to be used in irrigation does not make economic sense, as it requires considerable amount of energy [241]. Furthermore, it would be counterproductive to do so as it 'adds to the global warming that exacerbates the water problem and reduces the incentive to save water, even though conservation is usually cheaper' [242]. However, as its cost has been constantly going down, it is emerging as a viable option for domestic water supplies. 'In places such as Bermuda, San Diego and St Petersburg, Florida, desalination already supplies a share of drinking water' [243].

A cheaper alternative to desalination is treating city wastewater: 'An estimated 90 per cent of all wastewater in developing countries is discharged untreated directly into rivers, lakes or the oceans… Currently an estimated 245 000 km2 of marine ecosystems are affected with impacts on fisheries, livelihoods and the food chain' [244]. Wastewater can be treated, however, 'until it can be used in industry and agriculture. This costs about 1/3 less than desalination, and cuts pollution [245]'.

'For, one way or another, supply and demand will find an equilibrium,' concludes the Economist in its latest special report on water, 'the greatest chance of it being a stable and fairly harmonious one is the spread of democratic self-management among informed farmers. That would not solve all water problems, but it would solve the biggest' [246].

[237] Awash in Waste.
[238] Awash in Waste.
[239] Liquid Assets.
[240] Cited in Don't Make the Desert Bloom, The Economist, 5 June 2008.
[241] Irrigate and Die.
[242] Don't Make the Desert Bloom.
[243] Irrigate and Die. For more on desalination please see Tapping the Ocean, The Economist, 5 June 2008.
[244] Corcoran, E., C. Nellemann, E. Baker, R. Bos, D. Osborn, H. Savelli (eds). 2010. Sick Water? The central role of waste-water management in sustainable development. A Rapid Response Assessment.UN Environment Programme, UN-HABITAT, GRID-Arendal. , p. 5.
[245] Running dry, The Economist, 18 September 2008.
[246] A Glass Half Empty, The Economist, 22 May 2010.

2.2 European Policies for Water Sustainability

Even though we can only directly use about 1% of Earth's surface water resources, many forms of human activity put the total of water resources under considerable pressure. Polluted water, whatever the source of the pollution, flows, one way or another, back into our natural surroundings – into the sea or water tables – from where it can have a harmful effect on human health and the environment. One of the most important pieces of European legislation in this area is the Water Framework Directive.

2.2.1 Water Framework Directive (2000/60/EC) [247]

By means of this Framework Directive, the EU provides for the management of inland surface waters, groundwater, transitional waters and coastal waters in order to prevent and reduce pollution, promote sustainable water use, protect the aquatic environment, improve the status of aquatic ecosystems and mitigate the effects of floods and droughts.

Identification and analysis of waters

The Member States have to identify all the river basins lying within their national territory and assign them to individual river basin districts. River basins covering the territory of more than one Member State will be assigned to an international river basin district. By 22 December 2003 at the latest, a competent authority will be designated for each of the river basin districts.

Within four years after the date of entry into force of this Directive, Member States must complete an analysis of the characteristics of each river basin district, a review of the impact of human activity on water and an economic analysis of water use, while compiling a register of areas requiring special protection. All bodies of water used for the abstraction of water intended for human consumption providing more than 10 cubic metres a day on average, or serving more than fifty persons, must be identified.

Management and protection measures

Nine years after the date of entry into force of the Directive, a management plan and programme of measures must be produced for each river basin district, taking account of the results of the analyses and studies carried out.

The measures provided for in the river basin management plan seek to: (a) prevent deterioration, enhance and restore bodies of surface water, achieve good chemical and ecological status of such water and reduce pollution from discharges and emissions of hazardous substances; (b) protect, enhance and restore all bodies of groundwater, prevent the pollution and deterioration of groundwater, and ensure a balance between groundwater abstraction and replenishment; and (c) preserve protected areas.

The abovementioned objectives have to be achieved no later than fifteen years after the date of entry into force of the Directive, but this deadline may be extended, albeit under the conditions laid down by the Directive.

[247] http://ec.europa.eu/environment/water/water-framework/index_en.html (accessed on 22nd October 2010).

The Member States will encourage the active involvement of all interested parties in the implementation of this Directive, in particular as regards the river basin management plans.

A temporary deterioration of bodies of water is not in breach of the requirements of this Directive if it is the result of circumstances which are exceptional or could not reasonably have been foreseen and which are due to an accident, natural causes or force majeure.

From 2010, Member States must ensure that water pricing policies provide adequate incentives for users to use water resources efficiently and that the various economic sectors contribute to the recovery of the costs of water services, including those relating to the environment and resources.

Member States must introduce arrangements to ensure that effective, proportionate and dissuasive penalties are imposed in the event of breaches of the provisions of this Framework Directive.

A list of priority substances selected from among the ones which present a significant risk to the aquatic environment has been drawn up using a combined monitoring-based and modelling-based procedure. This list is set out in Annex X to the Directive. Control measures for these priority substances and quality standards for concentrations of the substances have also been proposed.

Administrative measures

No later than twelve years after the date of entry into force of this Directive and every six years thereafter, the Commission will publish a report on its implementation. The Commission will convene, at the appropriate time, a conference of interested parties on Community water policy which will involve Member States, representatives from the competent authorities, the European Parliament, NGOs, social and economic partners, consumer bodies, academics and other experts.

The Water Framework Directive establishes a legal framework to guarantee sufficient quantities of good quality water across Europe. Its key aims are to (a) expand water protection to all waters (inland and coastal surface waters and groundwater), (b) achieve "good status" for all waters by 2015, (c) base water management on river basins, (d) combine emission limit values with environmental quality standards, (e) ensure that water prices provide adequate incentives for water users to utilize resources efficiently, (f) involve citizens more closely, and (g) streamline legislation.

River Basin Management Plans

River Basin Management Plans are a requirement of the Water Framework Directive and a means of achieving the protection, improvement and sustainable use of the water environment across Europe. This includes surface freshwaters (including lakes, streams and rivers), groundwater, ecosystems such as some wetlands that depend on groundwater, estuaries and coastal waters out to one nautical mile.

The Directive requires member states to aim to achieve at least good status in each water body within their river basin districts. Each member state must produce a plan for each of the river basin districts within its territory.

Plans must include: objectives for each water body; reasons for not achieving objectives where relevant; and the programme of actions required to meet the objectives.

These plans, which are due by December 2009, will bring further real improvements for the whole water system in the form of programmes of measures, which must be operational by 2012 and deliver the environmental objectives of the Directive by 2015.

Recommendations to Member States – Time to act until 2009

Member States have to complete the first river basin management plans by the end of 2009, and they have to put a water pricing policy in place in 2010. Learning from experience with implementation to date, there is still ample time to improve the situation and close gaps on data. Moreover, the obligation to inform and consult the public when preparing the management plans will require more transparency and justification on what measures are necessary and cost-effective, and what exemptions can be justified.

The Commission therefore urges the Member States to focus especially on the following three areas:

Overcoming the current shortcomings. To reach this objective, Member States are encouraged to: (a) fully implement other relevant EU legislation, in particular on urban wastewater and nitrates; (b) put in place all the economic instruments required by the Directive (pricing, recovery of costs of water services, environment and resource costs, and the polluter pays principle). Full exploitation of these economic instruments will contribute to truly sustainable water management; (c) put in place a comprehensive national ecological assessment and classification system as the basis for implementing the Directive and meeting its "good ecological status" objective. The deficiencies of the current inter-calibration exercise must be remedied as soon as possible. Only complete, robust and reliable ecological assessment will generate faith in the WFD and ensure its credibility; (d) improve the methodologies and approaches on some key issues (such as designation of heavily modified water bodies, criteria for assessing risk or addressing groundwater quantitative status) and enhance comparability between the Member States, in particular in international river basins; (e) considerably reduce the existing data gaps and shortcomings of the Article 5 analysis as part of preparation of the river basin management plans.

Integrating sustainable water management into other policy areas. To reach this objective, Member States are encouraged to: (a) make sure that infrastructure and sustainable human development projects, which could cause deterioration of the aquatic environment, undergo an appropriate environmental impact assessment; (b) ensure the allocation of the appropriate funding. To reach this objective, it is important to make the best use of the potential of national funds and EU financing instruments, such as the Common Agricultural Policy and the Cohesion Policy. The national allocations so far of these funds for improvements in the water field are insufficient to cover all needs as identified in the findings of the environmental analysis under the WFD.

Making the best use of public participation. Public participation should be seen as an opportunity. The ongoing work on voluntary reporting and the Water Information System for Europe will assist in informing the public in a transparent way.

2.3 Water Sustainability: Current Situation in the Greek Cypriot Community

One definition of sustainable water management is to achieve a state whereby permanent reserves of underground water are replenished at a faster rate than they are consumed. This has not been happening in Cyprus over the last 60 years. Underground water reserves are categorized in permanent reserves – 'deep' aquifers - and renewable reserves – that are renewed annually by rainfall and other processes. Back in the 1920s, Cyprus started studying the possibility of utilizing underground water reserves and aquifers. Initially, water was being extracted from renewable reserves, which is a sustainable practice. Since the 1950s though, the development of Cyprus was based on water extracted from permanent reserves. Even by the 1960's this practise resulted to the salting of underground aquifers. Principles of sustainable water management indicate that permanent reserves should only be used in years of extreme drought, but that was obviously not followed in Cyprus.

Plans for the construction of large water dams started in the 1960s in order to collect surface waters. It was only after 1974 though that the construction of water dams began to increase. Those dams were designed to cover for the increasing deficit of underground reserves. Nevertheless, due to unexpected demand - it is estimated that an average of 70% of Cyprus' water reserves are used for agricultural purposes - as well as a statistically proven reduction of rainfall after the 1970s, the newly built dams did not collect the necessary quantities and therefore could not match the increased demand. The design of dams was prepared in the late 1960's when rainfall was still at high levels. As a result, water dams did not solve the problem and permanent underground reserves were further utilised [248]. Furthermore, the dams have had a negative environmental impact because the downstream rivers have dried out leading to some biodiversity loss of freshwater vertebrates and invertebrates as well as increased coastal erosion.

2.3.1 Current Desalination Practices

Until 1997 the main source of water in Cyprus was rainfall. That year, the first desalination unit was built as a response to the unsatisfactory coverage of demand from water dams. The current desalination units along with their respective daily production capacity are presented in the following table:

Current desalination units	Daily capacity (m3)	Notes
Dekeleia	60,000	
Larnaca	62,000	
Moni	20,000	Shall close in 2 years
Garyllis	10,000	Shall close in 5 years
Total	**152,000**	

[248] Cyprus 2015 interview, Costas Constantinou, Head of Hydrogeology Sector, Geological Survey Department, Nicosia, 13 January 2010.

In 2008, the government decided to totally cease any dependence of the town watering system on climatic conditions. The goal is to be able to cover the maximum demand which occurs in July; therefore, during the other months there is to be an excess production which will be stored in dams. As a result, it was decided to further increase the production of desalinated water with the construction of new units and the expansion of capacity of existing ones. All projected desalination units along with their daily capacity for desalinated water is presented in the following table:

Future desalination units	Daily capacity (m3)	Notes
Dekeleia	60,000	
Larnaca	62,000	
Vasiliko/ AHK	50,000	Ready in 2 years
Episkopi	40,000	Contract is signed – ready by 2011
Paphos	40,000	Currently 30,000 – tender for upgrade next year
Total	**252,000**	

There was also a plan for the development of a floating desalination plant but it was abandoned due to technical problems and higher projected costs. Fossil-fuel-based desalination is not considered a sustainable practice due to the high energy consumption of the process – the current plants alone consume about 7-8% of total energy used in Cyprus. Nevertheless, desalination is seen as a necessary evil since a choice has to be made between the coverage of water needs and the environmental costs of the process. The question, as posed by one stakeholder, should not be whether desalination is needed but how many desalination units are really needed [249].

2.3.2 Solar-thermal desalination parks

As a solution to the sustainability problems that desalination projects face, solar thermal parks are being proposed to desalinate water with the use of renewable energy sources. The Cyprus Institute along with Harvard University have prepared a feasibility study of a project for the implementation of a solar-thermal park that will produce desalinated water and energy. A similar park is operating in Seville, Spain which only produces energy. The project is estimated to cost around €15 million and the probable location of the project is the Pentakomo area. The high initial investment required for this project constitutes the major problem for its implementation [250].

[249] Cyprus 2015 interview, Spyros Stefanou, Planning Office, Water Development Department, Nicosia, 1 September 2009.
[250] Cyprus 2015 stakeholder panel, Nicosia, 2 March 2010.

2.3.3 Recycled water

Besides the following sources of water: a) desalinated water, b) underground water, and c) surface water (e.g. dams), recycled water is also used in Cyprus (coming from sewage water). Recycled water is used for irrigation purposes or is washed out to the sea, rivers, etc. Recycling water is also an expensive process but it's a process the EU is mandating. Nevertheless, it is not as polluting as desalination due to the fact that recycled water is used for irrigation purposes and therefore does not require as much pressure treatment through osmosis. During winter a storage problem for recycled water is observed. A new station for sewage processing is being planned for Larnaca, where recycled water will be supplied back into the watering grid, while the stations in Limassol and Paphos are both scheduled for expansion [251].

2.3.4 Meeting EU directives

The general guidelines of the EU on the issue of water, as given by the various directives and mainly the Water Framework Directive, as those were previously described, are: (a) no degradation of the quality and quantity of waters, (b) conservation of biodiversity, and (c) efficient pricing policy.

In this respect, the Water Framework Directive requires from Member States to define their river basin districts and prepare a management plan and programme of measures for each district. The whole island of Cyprus is defined as a single river basin district. The competent authority for this plan is the Minister of Agriculture while the plan is implemented, among others, by the following bodies: (a) Water Development Department; (b) Geological Survey Department; (c) Environmental Service; (d) Department of Agriculture; (e) Department of Fisheries. The final report shall be approved by a broader board (public, environmental organisations, etc.). Although this plan should have been furnished to EC by the end of 2009, all Member States seem to have some delays.

This report entails an assessment of the quantity and quality state of waters. For Cyprus the following give a rough assessment of the current situation [252].

Quantity assessment

a) Underground reserves: the situation is quite bad and their replenishment is an urgent matter.

Quality assessment

a) Underground reserves: their quality is affected by the salted water aquifers and the composition of the rocks (i.e. their bad state is not only due to human intervention but also to physical causes) – their quality improves with the renewal of these waters.
b) Coastal waters: very good state.
c) Surface waters: limited issues (Garyllis river is polluted by the nearby dumpsite of Vati) but generally in very good state.

[251] Cyprus 2015 interview, Spyros Stefanou, Planning Office, Water Development Department, Nicosia, 1 September 2009.
[252] Cyprus 2015 interview, Costas Constantinou, Head of Hydrogeology Sector, Geological Survey Department, Nicosia, 13 January 2010.

The measures included in the Cyprus plan regarding underground reserves move along the following points: (a) replenishing the permanent underground reserves (with technical means – probably using recycled water), and (b) reducing the quantities drilled.

Pricing policy is also part of this plan. Currently, water prices in Cyprus cover the costs of production of water but do not account for the environmental cost of this production. This is covered in the plan and shall be imposed soon.

The Water Framework Directive with its guidelines and requirements promotes the sustainability of water resources but does not impose any strict timeframes in the production of results.

2.3.5 Water consumption

On the consumption side of the equation, Cypriot citizens seem to retain their consumption habits despite the scarcity problem. It has been noted numerous times that saving is the most important parameter in the efforts for correct water management. For years now, the government through the Water Development Department has been trying to urge Cypriots on changing habits into more sustainable consumption practices. Nevertheless, public awareness has a long way to go before consumers' sustainable use of water starts contribute to solving the issue of water management on the island.

2.3.6 Agriculture

It is widely believed that no matter how much an effort is made to save water through households, it won't solve the country's water problem. About 70% of the water resources are consumed annually by the agricultural sector. One of the main reasons for this is the type of crops used on the island. Most of them are water-intensive, and in this sense unsuited for the realities of the Cyprus climate. Until recently, the government has normally been subsidizing the plantation of such crops, despite the fact that they use water inefficiently. Nevertheless, currently there are various subsidy schemes for farmers to extract / replace their crops. Additionally, the Cyprus government has significantly reduced the amount of EU funding that goes to agricultural activities through the Republic of Cyprus.

Water resources are currently not exclusively managed by a single authority creating problems in their efficient use. Authorities responsible for the agricultural sector aim the boosting of the agricultural activities but without taking into account water management issues and without cooperating with the Water Development Department (WDD) [253].

[253] Cyprus 2015 stakeholder panel, Nicosia, 2 March 2010.

2.4 Water Sustainability: Current Situation in the Turkish Cypriot Community

2.4.1 State of the Water Resources

In the absence of adequate surface water, almost all (95%) of the water supply of the northern part of Cyprus comes from groundwater [254]. The main sources of water are two aquifers in the Morphou and Kyrenia regions. The Morphou aquifer is the bigger and more important of these two aquifers in terms of capacity. It provides water for irrigation purposes in the Morphou region as well as for domestic consumption in Nicosia and Famagusta [255].

The Famagusta aquifer, which used to be the main aquifer providing water for the whole island in 1960s, on the other hand, had been completely salinated by sea water intrusion due to over-pumping, and therefore currently cannot be used for any purpose [256]. The drying up of the Famagusta aquifer has led to a growing strain on the Morphou aquifer. Years of over-pumping has given way to salination, which subsequently led to worsening of the quality of water extracted to the extent that it is no longer potable [257].

Indeed, as it was put on the Biodiversity Analysis commissioned by US AID, mainly due to 'over-pumping of groundwater to meet consumption demands and for irrigation,' '(s)altwater intrusion into Cyprus's aquifers' has come to be 'a pressing problem' [258]. 'Over time as agricultural lands are irrigated with ever increasing levels of salinity,' the Analysis warns, 'the soil will become an inhospitable environment for native species from invertebrates to flora,' a process which ultimately may result in desertification [259].

The agriculture sector, which is currently using about 70 percent of available water, will be the first to be hit by further salination. In fact, salination has already started causing a decline in the agricultural yield [260].

> As an example, the average yield of orange trees is 15 t/ha, in 2001, whereas the expectation was 35 t/ha. The decrease in the yield can be seen in all the crops and orchards. In addition, the decrease in the yield is aggravated every year. Owing to the limitations in water resources and decrease in water quality, agricultural income in 2001 was found to be US$ 41 million; however it would be US$ 72 Million if water quality and land reclamation were considered [261].

The salination problem is being worsened by increasing the number of boreholes, which are being continuously drilled without being subject to any regulation leading to excessive extraction. Selling water obtained this way with tankers by private vendors is widespread especially in the summer when water rationing becomes stricter.

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[254] Gozen Elkiran and Aysen Turkman: 'Salinity Problems in Northern Cyprus and Desalination Applications,' Paper presented at BALWOIS 2008, Ohrid, Republic of Macedonia, 27-31 May 2008, p. 1.
[255] Gozen Elkiran and Mustafa Ergil: 'Integrated Water Resources Planning and Management of North Cyprus: Case Study on Water Supply and Demand including Drought Conditions', Paper presented at International Conference on "Water Observation and Information System for Decision Support" Ohrid, Republic of Macedonia 23-26 May 2006, p. 7.
[256] Ozturk cited in in Gozen Elkiran and Aysen Turkman, 'Water Scarcity Impacts on Northern Cyprus and Alternative Mitigation Strategies' in Qi, Jiaguo and Evered, Kyle T. (Eds.), Environmental Problems of Central Asia and their Economic, Social and Security Impacts, Proceedings of the NATO Advanced Research Workshop on Environmental Problems of Central Asia and their Economic, Social and Security Impacts Tashkent, Uzbekistan 1-5 October 2007, p.245.
[257] Bozer; Ergil cited in Elkiran and Turkman: 2007, 245.
[258] FAA 119 BIODIVERSITY ANALYSIS, USAID Cyprus, 2006, p.3.
[259] FAA 119 BIODIVERSITY ANALYSIS, USAID Cyprus, 2006, p.3.
[260] Elkiran and Turkman, 2008: 5.
[261] Elkiran and Turkman, 2008: 5.

Another factor posing a serious threat against the aquifers is contamination due to 'infiltration of inappropriately discharged domestic and industrial wastewater' [262].

The water loss due to the leakages in the distribution system, which stands about 30-60%[263] is another factor exacerbating the water problem in general, in the northern part of Cyprus.

Rising demand (population growth; rising living standards; increasing importance of the tourism and higher education sectors) on the one hand, and declining supply (decreasing amount of rainfall over the last 30 years [264]; salination; pollution [265];), on the other, clearly shows that water scarcity will continue to be an important issue in the years to come calling for better water management practices.

2.4.2 Dams

With a view to improve the infrastructure in the face of increasing water scarcity, 41 dams were constructed in the northern part of Cyprus in 1980's [266]. 16 of these dams were built 'to store water for irrigation purposes. The remaining were constructed for preventing the direct flow to the sea and thus, contributing more efficiently to the aquifer recharge [267]'.

2.4.3 Wastewater Treatment

The biggest wastewater treatment plant is located in Mia Milia/Haspolat. The plant, which was established in 1980 as a bi-communal project, is no longer able to cope with the growing volume, and has serious shortcomings. 'We are not satisfied with the operation of the Haspolat plant,' said Nevzat Oznel, the manager of the plant in an interview published in Kibris daily. 'One of the problems is odour. Second one is evaporation, which causes salination, lowering the quality of water. … The quality of water is below the EU standards. Capacity is inadequate. … We need a new plant,' he concludes [268].

Accordingly, earlier this year the construction of a new, bi-communal wastewater treatment plant to replace the current one has commenced. According to the European Commission's Representation in Cyprus [269] - which foots the bill on behalf of the Turkish Cypriot community, the rest being financed by the Sewerage Board of Nicosia- the plant, which will use 'state-of-the-art technology [270]', will have a capacity of producing 10 million m3 of water a year to be used in irrigation. As a by-product, the plant will also produce biosolids, which will be used to generate 'green electricity [271]' to power the plant [272].

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[262] Nevzat Oznel: 'Wastewater Management,' Unpublished Paper.
[263] Mavioglu cited in Elkiran and Turkman, 2007: 242.
[264] Nicos Tsiourtis: Cyprus-Water Resources Planning and Climate Change Adaptation, Paper presented at Mediterranean Regional Roundtable, Athens, Greece, December 10-11, 2002, p. 4.
[265] Elkiran and Turkman, 2008: 1.
[266] Elkiran and Ergil, 2006: 3.
[267] Elkiran and Ergil, 2006: 3.
[268] Gozde Surec: 'Mesarya'ya Hayat,' Kibris, 8 June 2009.
[269] According to the Representation, 'the investment is in line with water conservation policy introduced by the EU Water Framework Directive and EU legislation on urban wastewater treatment' http://ec.europa.eu/cyprus/news/press_releases/20100319_waste_water_plant_en.htm (accessed on 30 June 2010).
[270] 'One of the largest facilities using Membrane Bioreactor Technology, … in the world' (ibid.).
[271] http://ec.europa.eu/cyprus/news/press_releases/20100319_waste_water_plant_en.htm (accessed on 30 June 2010).
[272] Cited in Surec, 2009.

The project is aimed to help 'the protection of the Pedhieos river catchment, and eliminate the odours generated by the existing wastewater treatment plant' [273].

The plant, which is expected to go online by 2012, will be serving the needs of Greater Nicosia, as well as processing 'tankered septic material coming from outlying areas' [274].

2.4.4 Importing Water

While the Greek Cypriot decision-makers are focusing their attention on desalination as a remedy to increasing demand, and investing heavily on desalination plants to ease the water shortage problem, the Turkish Cypriots are placing high hopes on the project of importing water from Turkey via an underwater pipeline [275]. Partly due to this prospect, unlike in the south, desalination has been playing only a minor role in the supply of water in the north.

The project, which can be traced back to 1998, is already underway, and it involves a pipeline of about 105 kilometers running from Mersin to Kyrenia (approximately 25 km on the land and 80 km under the sea). The water will come from the Dragos Stream in Mersin and will be stored in Geçitkoy near Kyrenia. The capacity of the pipeline is envisaged to be about 75-million m3 per year [276]. In a recent interview with Anatolia Agency, Numan D. Gündüz, the regional director of State Waterworks Authority (DSİ) of Turkey said that they aimed to complete the project by 2014 [277].

Some experts are criticizing this project on the grounds that it will only deepen dependence on Turkey, while not solving the real problem, which is considered to be poor demand management rather than water shortage per se [278].

An earlier effort to import water from Turkey with huge water bags towed by tugboats had failed due to technical difficulties [279].

[273] http://ec.europa.eu/cyprus/news/press_releases/20100319_waste_water_plant_en.htm (accessed on 30 June 2010).
[274] Ibid.
[275] Works were due to start on this pipeline, on 20th July 2010.
[276] Ercan Yavuz: 'Eni, Alarko compete for water project for Northern Cyprus', Today's Zaman, 9 July 2009.
[277] Cited in 'Kıbrıs'a 'yüzen su' için geri sayım başladı,' http://ekonomi.haberturk.com/makro-ekonomi/haber/524418-kibrisa-yuzen-su-icin-geri-sayim-basladi (accessed on 30 June 2010).
[278] Cyprus 2015 Interview, November 2009.
[279] Mithat Rende: Water Transfer from Turkey to Water-Stressed Countries, in Hillel I. Shuval, and Hassan Dwiek (eds.) the Middle East, in Water Resources in the Middle East: Israel-Palestinian Water Issues – From Conflict to Cooperation, Berlin: Springer, 2007, p. 171.

2.5 Water Sustainability: Future Directions for Cyprus

Several meetings of water stakeholders, including Greek Cypriot and Turkish Cypriot water experts, farmers, and others with an interest in water issues, were convened by the Cyprus 2015 initiative in February and March 2010. The stakeholders were presented with the research findings of Cyprus 2015 staff in relation to global trends, EU polices and current situation in Cyprus, and were asked, on the basis of this situation, to formulate relevant policy recommendations for the future of Cyprus. The following is a summary of their recommendations, and accompanying rationale:

2.5.1 Finding the right balance in agriculture

Currently the agriculture sector in Cyprus, by focusing its production on water-thirsty crops consumes approximately 70% of the available water supplies, while its contribution to GDP is limited to a mere 3-4%. This problem should be solved in cooperation with the farmers, and not through confrontation. It is proposed that a structured dialogue should take place between farmers, scientists studying the water issue, officials responsible for agricultural strategy, and officials responsible for water management, which would aim to produce a new strategy for water-efficient and profitable agriculture, more suited for the current climatic conditions of Cyprus.

Once the aforementioned stakeholders agree on the most appropriate agricultural strategy, the most effective way to implement it on the ground is by linking farming incentives and subsidies to making the switch to water efficient techniques; farmers employing sustainable practices, such as installation of drip irrigation system or switching of crops will be in a position to most benefit from incentives provided by market gate keepers – such as cooperatives, insurance companies, government departments etc. At the same time, an awareness-raising campaign will need to be conducted among farming communities, with technical and expert capacity building provided by appropriate authorities to those who decide to make the transition to sustainable farming practices [280].

2.5.2 Towards an integrated water management system

Currently, within each community water management is fragmented among several local boards, a situation which makes it very difficult to implement a cohesive water management strategy in response to current challenges. As a first step, it is recommended that each community should institute a central supervisory mechanism by appointing an autonomous water authority, which shall be comprised of a broad cross-section of relevant stakeholders and experts, to allow water strategies to be implemented in a cohesive manner within each community. As a second step, it is proposed that the two communities should begin to coordinate and integrate their water management practices, by developing in parallel their policies, guidelines and regulations [281].

[280] This measure is already partially scheduled to be implemented island-wide, as part of an Environment Technical Committee confidence building measure

[281] This should be done at first through the Environment Technical Committee's Water Task Force.

2.5.3 Resolving the problem of boreholes

The practice of pumping water from aquifers through boreholes is prevalent in both communities, and is currently unregulated. However, over-pumping from aquifers through boreholes reduces not only the quantity but also the quality of available water through seawater intrusion, thus contributing to the process of desertification.

In this regard, the most urgent task if to study the issue thoroughly: On the one hand, to study and find out the capacity of the aquifers, and on the other hand, to assess the true quantity and rate of use of boreholes. On the basis of such a model the use of boreholes can then be regulated, by installing meters to existing boreholes and making new boreholes subject to a strict permission procedure. Extraction of water through boreholes will then be subject to charges, which reflect the resource and environmental cost of water.

2.5.4 Towards sustainable water supplies

Currently, the water supply situation is severely problematic in both communities, with the Greek Cypriots resorting to importing water from Greece by ship and the Turkish Cypriots making plans to import water from Turkey via a pipeline. Current desalination practices are fossil-fuel dependent, and therefore unsustainable. In coming decades the water shortage is projected to become even more severe, as the population of Cyprus grows and climatic conditions worsen.

In this regard, it is proposed that cogeneration technologies and Concentrated Solar Power (CSP) should be utilized, to provide a sustainable avenue for sea water desalination. CSP is fossil-fuel free and only requires two basic 'raw materials', which are particularly abundant in Cyprus: Seawater, and sunlight. With these 'raw materials', CSP - a technology that is already tried and tested - can potentially produce limitless supplies of both electricity and fresh water. Thus, Concentrated Solar Power should be seen as a major component of any sustainability strategy for Cyprus.

2.5.5 Highlighting the challenge of desertification

Water related issues are all too easy to ignore in Cyprus, as the related problems are masked by a highly urbanized culture where water is easily available on a daily basis while costing only a tiny fraction of a person's earnings. Thus, societal – and by extension political – motivation to take action for sustainable water is low. And yet, the challenge of desertification is currently on Cyprus' doorstep, and unless radical action on water management issues is taken today Cyprus will be mostly comprised of desert a few decades from now.

In this regard, it is proposed that any water awareness strategy in Cyprus[282] should go beyond the conventional messages, and explicitly link water-related practices, whether demand- or supply-related, to the looming threat of desertification. Averting desertification is an obviously important goal that most citizens would identify with, and this could serve as a motive for the transformation of our water management practices.

[282] Such a water awareness raising campaign is scheduled to commence under the auspices of the Environment Technical Committee.

PART III

Sustainable Construction

3.1 Global Trends in Sustainable Construction

In the quest to realize sustainable development, adopting a comprehensive approach becomes indispensible. This requires a simultaneous development in economic, social, and environmental spheres. In other words, while seeking economic development, environmental and social development goals should not be ignored. Construction sector has an important role in sustainable development due to the environmental, social and economic effects created throughout the building process.

3.1.1 Economic, Social and Environmental Effects of the Construction Sector

Most human activities that have an effect on the environment are somehow connected with the construction sector. The possible negative effects of these activities can be alleviated with some changes in construction practices. The most obvious or measurable of these negative effects is the one inflicted on the environment. Nevertheless, socio-economic effects should also be heeded [283].

With respect to the environmental effects of the construction sector, the exploitation of natural resources; solid and liquid waste produced; along with the gases emitted throughout the building process can be counted. These negative effects can be classified as exploitation of non-renewable natural resources, threatening with loss of biological diversity, loss of agricultural areas, deforestation, global warming and pollution of water, air, and earth.

As far as the economic effects of the construction sector are concerned, it is a well-known fact that the sector has strong linkages with the rest of the economy[284] stimulating the production of various goods and services, and therefore, largely contributing to employment and economic growth.

It should be borne in mind that the sector is not limited to housing but 'In addition to the private sector activities, public sector road works and restorations, water and sewage system works and restorations also have a positive effect on the growth of the construction sector [285]'.

Construction is a significant economic activity, which constitutes a significant portion of GNP in many countries. Therefore more often than not, growth in the construction sector translates into growth in the economy in general. Furthermore, thanks to the huge employment potential it provides, and its linkages with other economic sectors, it is defined as a locomotive force in the economy.

The sector also has diverse social effects. It affects the quality of life of all individuals via the quality of services, products, and the constructed environment it provides. By creating employment opportunities for a significant number of people thanks to its labour-intensive nature, it plays a significant role in the struggle to eradicate poverty. Issues such as job security, insurance, life safety and income equality or lack thereof, are among other important social effects of the sector.

[283] CIB and UNEP-IETC, 2002: 13
[284] World Bank: The Construction Industry: Issues and Strategies in Developing Countries, Washington DC, 1984.
[285] SPO, 2009: 84.

3.1.2 Construction within the framework of Sustainable Development

In the light of the environmental and social effects of the construction sector mentioned above, it can clearly be observed that contrary to the traditional approach, the effects of the sector are not solely in the economic domain but also in the social and environmental domains as well. In this context, when sustainable development principles and objectives are considered, it becomes crucial that all the activities within the construction sector are considered in line with sustainable development principles in order to achieve sustainable development. The importance of the construction sector vis-à-vis sustainable development is highlighted in international reports such as Agenda 21 and Habitat II Agenda.

Agenda 21 is primarily an action plan for sustainable development that addresses objectives, goals and pledges for stakeholders, as well as strategic programmes. It defines the programmes and actions, which are necessary to increase sustainability [286].

Habitat II Agenda, which followed Agenda 21, on the other hand, focuses on housing and real estate, and therefore its relevance with the construction sector is more direct [287]. It includes wider issues with regards to sustainable residential housing. For instance, it includes chapters focusing on how governments should encourage the sector [288]. Accordingly, paragraph 40 emphasizes "the necessity of governments in all countries but particularly in developing countries, to support the construction sector to become locally accessible, appropriate, affordable, secure and productive with environmentally conscious building methods and technologies including national, regional and sub-regional levels with the aim of highlighting the optimal use of local human resources and energy-efficient methods that protects public health" [289]. Especially in paragraphs 69, 70 and 71, actions for planning, designing, construction, maintenance, renewing, sustainable supply of building materials, their use and introduction, and sustainable production of these materials are defined for governments and the construction sector [290].

The important role of the construction sector for sustainable development triggered the very concept of sustainable construction.

It is very important to explore the inter-related concepts of sustainability, sustainable development, and sustainable construction along with sustainable residential areas and sustainable urbanisation concepts, as they are addressed in the publication titled *"Agenda 21 for sustainable construction in developing countries",* by CIB and UNEP-IETC [291].

Accordingly, the central objective is to sustain the existence of species of homo sapiens, supporting and keeping the human species alive. Sustainability is a condition that guarantees the existence of homo sapiens and provides a space for a productive, healthy and secure life that is in harmony with local, cultural and moral values. Sustainable development is a continuing process that preserves the dynamic balance among justice, welfare and life quality with the demands of the community and what is ecologically feasible.

[286] CIB: Agenda 21 on Sustainable Construction, CIB Report Publication 237,Rotterdam, 1999, p. 39.
[287] CIB, 1999: 39.
[288] CIB, 1999: 39.
[289] CIB, 1999: 39.
[290] CIB, 1999: 39.
[291] CIB and UNEP-IETC, 2002. Agenda 21 for sustainable construction in developing countries: A discussion document, Boutek report No Bou/E0204, WSSD edition, Pretoria, South Africa: CSIR Building and Construction Technology, p.6. Available at http://www.sustainable-design.ie/sustain/CIBsustainConstruct_DevelopingCountries.pdf [Accessed 20 August 2009].

Sustainable residential areas are those cities, towns, villages and their communities that enable us to live in a way that supports a state of sustainability and sustainable development principles.

Urban sustainability is a more comprehensive process for creating sustainable residential areas especially in cities and towns. Urban sustainability also includes the establishment of institutional, social and economic systems that support sustainable development besides sustainable construction.

Sustainable construction means the application of sustainable development principles in the large construction cycle that includes a wide range of issues from planning of buildings and infrastructure, designing and construction of buildings, extraction and exploitation of natural resources to deconstruction and waste management. Sustainable construction is a comprehensive process that aims to re-establish the harmony between a natural environment and a constructed environment while creating settlements that encourage economic justice and is fit for human dignity.

3.2 European Policies for Sustainable Construction

Energy consumption is perhaps the most significant environmental impact of buildings during their operational phase. Therefore, saving energy and improving energy efficiency is part of the key priorities of European policy, which is expressed by a number of directives and guidelines to assist Member States. Increased energy efficiency is also an important part of the package of policies and measures needed for the EU to meet its commitments under the Kyoto Protocol.

Among other instruments, European Directives 2002/91 and 2006/32 were promulgated. Directive 2002/91 deals with the energy efficiency of buildings and establishes the concept of energy performance certificate, which all buildings should gradually acquire, starting with the public buildings. Furthermore, Directive 2006/32 concerns the energy efficiency during the end-use and the use of energy services, while raises an obligation on Member States to set a savings target of at least 9% by 2015. Article 5 of the Directive makes specific reference to energy end-use in the public sector stating that Member States should ensure that the public sector performs an exemplary role. According to Article 5, Member States should ensure acceptance by the public sector of measures to improve energy efficiency, with emphasis on cost-effective measures that lead to large energy savings. These measures should be taken at the national, regional, and/ or local level.

As mentioned above, achieving environmental quality of buildings requires on the one hand, to achieve conditions of thermal and visual comfort and indoor air quality, in order to ensure the health of users, and on the other hand the minimum energy consumption and maximum energy efficiency.

3.2.1 Energy Performance of Buildings (2002/91/EC) [292]

Directive 2002/91 aims to improve the energy efficiency of buildings, taking into account outdoor climatic and local conditions, as well as climate requirements of indoor spaces under a cost-benefit analysis. The Directive aims among others to establish requirements for: (a) the general framework of a methodology for calculating the integrated energy performance of buildings; (b) the application of minimum requirements for energy efficiency in new buildings; (c) the application of minimum requirements on energy performance of large existing buildings that are subject to major renovation; (d) energy certification of buildings (energy performance certificate); and (e) regular inspection of boilers and air conditioning in buildings and in addition an assessment of heating boilers which are more than 15 years old.

According to the Directive, Member States must implement, at national or regional level, a calculation methodology of the energy efficiency of buildings and to establish minimum energy efficiency standards. In setting requirements, Member States may differentiate between new and existing buildings and different categories of buildings. These requirements shall take account of general indoor climate conditions in order to avoid possible negative effects, such as inadequate ventilation, as well as local conditions and intended use and age

[292] http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2003:001:0065:0065:EN:PDF (accessed on 22nd October 2010).

of the building. The requirements should be reviewed at regular intervals not exceeding five years and, if necessary, updated to reflect technical progress in building methods.

For new buildings with a total useful floor area of over 1,000 square meters, Member States shall ensure that the technical, environmental and economic feasibility of alternative systems is considered and taken into account before construction starts.

For existing buildings, where buildings with a total useful floor area over 1 000 m2 undergo major renovation, Member States shall provide so that energy efficiency is upgraded to meet minimum requirements as far as this is technically, operationally and economically feasible.

Finally, the Directive refers to the regular inspection of boilers and air conditioning, given the large contribution of these facilities to the total consumption of the building.

3.2.2 Energy end-use efficiency and energy services (2006/32/EC) [293]

In 2006, Directive 2006/32/EC was adopted, the purpose of which is to enhance the cost-effective improvement of energy efficiency during the end-use of buildings in Member States, by providing the necessary indicative targets as well as mechanisms, incentives and institutional, financial and legal frameworks in order to remove existing barriers and imperfections that impede the efficient end-use of energy, and creating the conditions for the development and promotion of the market for energy services and the delivery to final consumers of other measures for the improvement of energy efficiency.

Member States must adopt and aim to achieve an overall national indicative energy savings target of 9% by 2015, with the use of energy services and other measures to improve energy efficiency. Member States shall take cost-effective, practicable and reasonable measures designed to help achieve this goal.

In accordance with the Directive, Member States shall ensure that the public sector performs an exemplary role. Many packages under this Directive relate to public sector buildings, which must act as role models for citizens on energy efficiency.

3.2.3 Energy Efficiency Action Plan (COM (2006) 545) [294]

In late 2006, the EU prepared the Energy Efficiency Action Plan, aiming to mobilize inter alia, public authorities, citizens and market players to undertake concerted actions that will lead to the construction of energy-efficient buildings, the reduction of energy consumption, the procurement of energy efficient household goods and the use of efficient energy systems. Under this Action Plan, public authorities need to be a model for citizens by making rational use of energy and adopting standards for sustainable consumption.

The measures outlined in the plan are designed for immediate implementation within the next 3-6 years and their ultimate aim is to reduce energy expenditure by 20% by 2020.

[293] http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2006:114:0064:0064:en:pdf (accessed 22nd October 2010).
[294] http://ec.europa.eu/energy/action_plan_energy_efficiency/doc/com_2006_0545_en.pdf (accessed 22nd October 2010).

The measures and policies analyzed and reflected in the Action Plan, primarily target the dynamic energy-efficiency demands of a wide range of products, services and buildings. The priority axes of the action plan are the following:

Priority	Description
1	Labelling of equipment and appliances, and specifications for their minimum energy consumption
2	Requirements for energy-efficiency of buildings ("passive buildings")
3	More efficient energy production and distribution
4	Delivering efficient fuel for vehicles
5	Facilitating financial support and investment on energy efficiency for small and medium-sized businesses and energy providers
6	Promoting energy efficiency in new Member States of the European Union
7	Rational use of the tax system
8	Awareness of energy efficiency
9	Energy efficiency in newly constructed areas
10	Promote energy efficiency worldwide

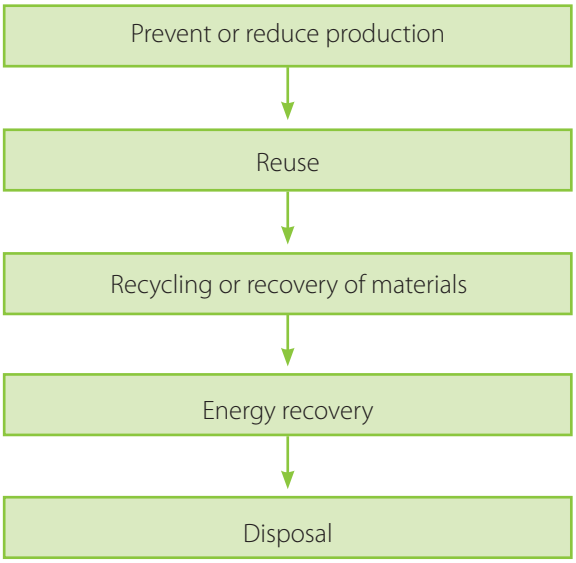
3.2.4 Green Paper on Integrated Product Policy (IPP) (COM(2001) 68) [295]

The production, use and disposal of products cause adverse effects on the environment. The Integrated Product Policy deals with the minimization of the environmental impact of products and services, taking into account their entire life-cycle. Life-Cycle Assessment is one of the basic tools of IPP. In the case of buildings IPP is of particular importance as it concerns the materials and services related to the life-cycle of buildings. A building that meets the principles of sustainability should, among others, be constructed from materials that have minimal environmental impact during their life-cycle.

[295] http://eur-lex.europa.eu/LexUriServ/site/en/com/2001/com2001_0068en01.pdf (accessed 22nd October 2010).

3.2.5 Construction, Demolition and Excavation Waste (CDEW) [296]

The CDEW is one of the priority waste streams as defined by the Priority Waste Streams program of the EU. The program gives emphasis on the hierarchy of waste management in accordance with the following flowchart:



Due to the large and growing volume of CDEW, the EU considered it essential to create systems of alternative management.

3.2.6 Policy on Green Public Procurement (COM(2008) 400/2) [297]

The Policy applies to procurement by public authorities of products and services that meet environmental criteria. Given the high purchasing power of public authorities, the increasing demand for environmentally friendly products will lead to an increase in the production of products with high environmental performance with a long-term positive impact on the environment. Buildings are an important subject of public procurement, and therefore the application of environmental standards for public buildings could lead to future large increase in the use of sustainable construction practices.

3.2.7 Other directives

a) Directive 2005/32/EC [298] establishes a framework for setting eco-design requirements for products that consume energy, and b) Directive 2004/8/EC [299] focuses on the promotion of cogeneration based on demand for heat.

[296] http://ec.europa.eu/environment/waste/construction_demolition.htm (accessed 22nd October 2010).
[297] http://ec.europa.eu/environment/gpp/pdf/com_2008_400.pdf (accessed 22nd October 2010).
[298] http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=CELEX:32005L0032:EN:HTML (accessed 22nd October2010).
[299] http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2004:052:0050:0060:EN:PDF (accessed 22nd October 2010).

3.3 Sustainable Construction: Current Situation in the Greek Cypriot Community

The notion of sustainable construction is still almost non-existent in Cyprus. Very little is done towards this direction in any construction activity on the island. Cyprus is currently at an infancy stage regarding sustainable construction practices and seems to be moving at an extremely slow pace. The main reason for this focuses on the lack of experience in the field as well as on the perceived lack of evident proof regarding the financial and environmental efficiencies of these practices.

3.3.1 Energy efficiency

The government has so far given more emphasis on the energy performance of buildings. The Energy Performance of Buildings Act of 2006 - N.142 (I)/ 2006, which incorporates the EU directive 2002/91/EU on Energy Performance, focuses on the following:

(a) The need for the development of a single methodology for the assessment of energy performance of buildings. This methodology was eventually developed and adopted by the Cyprus government in 2007.

(b) The minimum criteria that new buildings should meet regarding thermal insulation. Criteria were set in 2007 and put in force from January 1st, 2008.

(c) The issuance of energy performance certificates before the issuance of a construction licence. During the design phase, every new building should be given an operational rating with rates varying from Class A to Class F (Class A being the higher efficiency rating). For a new building to be provided with a construction licence, operational rating should be of Class A or B. These operational ratings are to be performed only by specialized experts who have passed the relevant examination by the Energy Service office. The issuance of the energy performance certificates is mandatory for all new buildings from January 1st, 2010. Nevertheless, no supervision is performed during the construction phase in order to ensure the correct application of energy efficiency principles.

(d) The need for systematic inspection and maintenance of air-conditioning units.

(e) The need for systematic inspection and maintenance of boilers.

The various governmental authorities responsible for these issues (environmental service and energy service office) limit their efforts to the provision of a number of funding programmes regarding the energy efficiency of buildings, use of insulations, use of photovoltaic systems and other RES, borehole drillings for domestic use (currently not regulated at all), recycling of water, etc. Other than the measures on energy performance, the principles of sustainable construction are not enforced by law and therefore their application is totally depended on the good will of people.

3.3.2 Use of "green" materials

Currently, any activities targeting sustainable, ecological design have focused on the use of some recycled materials and the use of some green materials (i.e. materials of low energy use and low carbon emission during their making – cement companies are now more sensitive to the production of cement in "greener" ways due to the heavy fines from the EU). The only building that was fully constructed under the principles of sustainable construction was that of the Electricity Authority of Cyprus (for which it received several awards) [300].

3.3.3 Other issues related to sustainable construction

Besides energy efficiency and the use of environmentally-friendly material, Cyprus also faces the following issues, which concern sustainability practices in construction and constitute major environmental problems for the island:

(a) Issue of quarry (used as raw materials for construction of buildings and public works).

(b) Issue of building debris – opportunities for recycling and reuse (currently almost nothing is done in this respect).

(c) Issue of water (collection of rain water and recycling).

3.3.4 Public sector and sustainable construction

The EU is generally promoting the use of sustainable construction practices by governmental and public authorities to serve an exemplary role in societies. Similarly, and due to the difficulties in promoting sustainable construction practices, efforts in Cyprus are concentrated in convincing governmental authorities to use sustainable practices for two reasons: (a) the government is easier to convince about the importance of environmental benefits as opposed to monetary benefits, and (b) applying these practices on governmental buildings will be a good opportunity to assess their utility before promoting them to the general public [301].

A good place to start would be the Cyprus Telecommunications Authority (CYTA), which is interested in applying the principles of sustainable construction to its new buildings.

3.3.5 Current obstacles to sustainable construction

In general, applying sustainable construction methods to buildings increases the initial investment of construction. In addition, a feasibility study on such buildings might not provide a positive Net Present Value (i.e. the benefits from energy and water savings might not outweigh the extra initial expenditure). ETEK wanted to implement a pilot project for sustainable construction with the Town Planning office using a refugee camp in order to

[300] Cyprus 2015 interview, Ioannis Ioannou, Assistant Professor, Department of Civil & Environmental Engineering, University of Cyprus, Nicosia, 23 December 2009.
[301] Cyprus 2015, stakeholder panel, Nicosia, 3 March 2010.

investigate the costs of such buildings and to see whether such construction methods would make sense for promoting to the general public. The Town Planning office was positive to the idea but unfortunately ETEK had a management change and the project was frozen [302].

As a result, current research efforts on sustainable construction are aiming to minimize the costs related to the development of sustainable practices (estimated to about 5%-8% extra cost compared to standard construction).

One difficulty in promoting sustainable construction practices is the fact that we do not yet have in Cyprus tangible examples of such buildings. Additionally, the information provided to the public regarding these practices is very poor. Someone who wants to have his house built according to sustainable construction principles would find it difficult to receive total consultation around the practices of sustainable construction as well as the financial opportunities related to these. A good start would be for architects and civil engineers to be more informed with their participation to more related seminars and workshops [303].

As mentioned earlier, the government currently concentrates mainly in promoting the energy efficiency of buildings. Nevertheless, there are two issues that impair the application of correct energy efficiency measures of new buildings: (a) authorities (energy service) do review the designs of the buildings to ensure compatibility with energy efficiency standards but do not inspect buildings during the construction stage; (b) even the new legally-enforced specifications for buildings are not adequate for truly energy efficient buildings (for instance, a general coefficient for thermal insulation is required, but not for each part separately, e.g. walls, windows, etc.) [304].

[302] Cyprus 2015 interview, Ioannis Ioannou, Assistant Professor, Department of Civil & Environmental Engineering, University of Cyprus, Nicosia, 23 December 2009.
[303] Cyprus 2015, stakeholder panel, Nicosia, 3 March 2010.
[304] Cyprus 2015 interview, Charalambos Theopemptou, Environmental Commissioner, Nicosia, 4 September 2009.

3.4 Sustainable Construction: Current Situation in the Turkish Cypriot Community

Socio-economic changes in the northern part of Cyprus coupled with the effects of the 2004 UN Plan on the construction sector, led to a significant acceleration, especially in residential construction in towns, during the 2003-2006 period. 'In parallel to this, a major increase in property sales to foreigners, as well as secondary home sales in rural areas has been experienced. The supply of residential estates during this period has contributed greatly to the overall economy and employment [305]'.

However, as stated by the State Planning Organization (SPO), these construction activities created not only significant amount of investment and employment, but also unplanned and random development, depletion of natural resources, loss of agricultural land, and damaged natural and historical heritage. Considering all these factors together, it can be said that in this period, irreversible environmental problems were created which also threatened sustainable development [306].

In this respect, '(t)he residential construction boom in Kyrenia after the 2004 UN Plan sets a bad example. The unregulated growth of residential construction has led to the destruction of agricultural areas. The current legal gaps with regards to residential construction, and the absence of town plans except for Nicosia have been resulting in developments that are scattered and unorganised. It is possible to build on all parcelled plots, which have access to water and roads. For this reason, parcelled plots are exceeding the actual need, and therefore residential constructions remain scattered' [307].

In a similar vein, Yorucu and Keleş assert that the rapid growth in construction activities in the northern part of Cyprus has created significant social costs. In this context, coastal areas with high potentials for tourism, natural and biologic diversity, agricultural areas with high productivity or areas with historical and architectural heritage have been gravely affected by unplanned development and widespread urbanisation [308].

Beyond these immediate problems, decreasing demand and surplus supply following the boom period have come to indicate that the sector is not sustainable. Even during times of growth, the added value has been considerably below the potential.

The most important reason behind the unsustainable tendencies in the sector is the absence of a comprehensive strategy and plan: National Sustainable Development Strategy; National Sustainable Construction Strategy; Country Physical Plan; Town Plans (Except for Nicosia).

Other obstacles to sustainable construction in the Turkish Cypriot community, according to the State Planning Organisation, include:

> 'The lack of technical know-how for geologic assessment of the ground for all kinds of constructions (assessments on the earthquake resistance, avalanche, water drainage and the penetration level of the layers ect.), financial difficulties and the increase in the costs due to the increased prices of the imported materials had a negative impact on the development of the sector [309]'.

[305] State Planning Organization (SPO), 2009: 86.
[306] SPO, 2008: 34.
[307] SPO 2009: 90.
[308] 2007: 85.
[309] SPO 2009: 90.

'Currently the system for quality control and for the standardization of locally produced or imported construction materials have not been employed in the northern part of Cyprus which in turn becomes a factor lowering the quality of construction as well as posing a threat to public safety. The lack of independent institutions exclusively established to scrutinise and inspect the whole process starting from the project stage until the final completion phase poses as a big problem' [310].

'As modern construction technologies are not being used widely in the northern part of Cyrus, maintenance and repair costs increase while damaging the environment which brings indirect consequences for a country where tourism is fundamental. Failing to pay due attention to heat insulation leads to significant energy loss both in winter and summer [311]'.

[310] SPO 2009: 90.
[311] SPO 2009: 90.

3.5 Sustainable Construction: Future Directions for Cyprus

Several meetings of construction stakeholders, including Greek Cypriot and Turkish Cypriot architects, civil engineers, academic researchers, and others with an interest in construction issues, were convened by the Cyprus 2015 initiative in February and March 2010. The stakeholders were presented with the research findings of Cyprus 2015 staff in relation to global trends, EU polices and current situation in Cyprus, and were asked, on the basis of this situation, to formulate relevant policy recommendations for the future of Cyprus. The following is a summary of their recommendations, and accompanying rationale:

3.5.1 Creating incentives for sustainable construction

Decisions about building practices are usually made at the level of the individual architect, engineer, developer or end-user, and any efforts to put in place sustainability standards is unlikely to succeed unless it offers clear incentives to these individual decision makers. Such incentives must be designed to help overcome concerns regarding the increased cost of sustainable construction practices. More specifically, the following options are available:

Offering monetary incentives: The conventional approach in offering incentives for sustainable construction – whether in upgrading existing homes or in constructing new homes - is to give out financial grants. Such an approach however can be very expensive on the state budget, and still fail to make an impact given the inevitably modest amount of the grant. A less expensive and more effective monetary incentive for sustainable construction would be to offer low cost credit linked to sustainable construction practices, with the collaboration of public and private financing institutions.

Offering bonus building ratios: An even more effective approach – in terms of providing a financial incentive - would be to offer bonus building ratios for sustainable construction practices, which could take the form of a specific 'bonus ratio catalogue' for specifically acknowledged sustainability practices. Of course, the implementation of this measure should take account of broader planning requirements, while different incentive ratios can apply for different areas. It is predicted that even a small percentile bonus would lead to the rapid generalization of sustainable construction practices, given the high impact on the net value of properties, while this policy would not significantly burden the state budget.

Making energy/water efficiency + waste reduction certificates compulsory: If each property comes with an efficiency certificate, classifying the property as Class A, Class B, Class C etc, then inevitably the energy/water/waste efficiency of a building will begin to be reflected in its overall value, thus enhancing the economic rationale to build in accordance with best practices for sustainability [312].

[312] As mentioned in a previous section, energy efficiency certificates are already compulsory in the Greek Cypriot community as 1st January 2010, though several commentators are arguing that the sustainability practices that are expected for a Class A or B certificate do not set the bar high enough.

3.5.2 Increasing awareness of available sustainable construction practices

Currently, awareness of available sustainable construction practices is quite low in Cyprus, which is understandable given that sustainable construction is a very recent trend in the global agenda. Increasing awareness should be seen as an essential corollary to the increasing of incentives that was elaborated above. In this matter, the following proposals are submitted.

Commissioning a sustainable construction planning guide: The development of such a guide should be carefully researched, in order to integrate best global practices with the realities of Cyprus' climate and construction tradition. The guide should highlight the several available technologies for different aspects of the construction process, highlighting for each one how much they will cost and the rate at which the investment will be paid back. Beyond the use of technological solutions, the guide should also include design recommendations for the passive improvement of a building's energy, water, waste efficiency by making smarter use of sunlight and wind patterns. This guide should be published in both Greek and Turkish, and made available to planners, developers, architects, engineers and the general public in both communities, in the context of a deliberate and well-designed training strategy and public awareness campaign.

Instituting an annual "best sustainable building" award: For such an award scheme to be effective in promoting awareness for sustainable construction practices, it must become a widely publicized event in which the media are brought in as sponsoring partners, informing the public in advance of who the chief contenders are and for which practices they are being considered, encouraging viewer feedback on who the winner should be etc. The award could be broken down into building categories (e.g. residential home category, block of flats category, office space category, tourism) while the value of the award should be such as to provide a significant incentive to enter the competition.

Develop a certification/accreditation scheme for engineers and architects: On the basis of the sustainable construction planning guide, discussed above, a certification / accreditation scheme could be institute to verify the training and credentials of engineers and architects in relation to sustainable construction best practices. Thus, professionals who wish to respond to the increasing public demand for sustainable construction services will have a strong motive to seek ongoing training in order to achieve certification.

3.5.3 Urban-level pilot projects

Sustainable construction is not just a matter of individually sustainable buildings, but also a matter of local communities that function as healthy and resilient ecosystems. A first step for achieving progress at the level of local communities is by taking the example of a local community and treating it as a pilot project for sustainable construction. If used strategically, such an approach could also hold symbolic value in terms of bringing the Greek Cypriot and Turkish Cypriot communities closer to each other. Specifically, the following pilot projects are proposed [313].

[313] Such projects may fit under the mandate of UNDP-ACT's Participatory Development Project.

Revising the Nicosia Master Plan: Already, the Nicosia Master Plan supports in theory the principles of sustainability, but there are very few specific elements in this regard. It is proposed that the two municipalities should work to revise the Master Plan in line with sustainability and sustainable construction principles, starting with the core of Nicosia, for instance, to create a role model for other local communities. EU funds could be sought for such an endeavour.

Twin-pilot projects: Grants, incentives and technical support could be offered to local authorities and other, private sector investors, to incorporate principles of sustainability, on the condition that they twin with a comparable town, village or municipality in the other community. Such pilot projects will assist the process of capacity building and benchmark setting, for urban-level sustainable construction practices.

Varosha as an eco-city: It is widely acknowledged that Varosha will ultimately have to be almost entirely rebuilt before it becomes habitable. This problem is at the same time a unique opportunity to convert Varosha into a smartly designed and fully sustainable eco-city which will serve as an example not only within Cyprus, but more broadly in the region and the European Union. [314]

[314] In this context, part of the agreement on Varosha could be that it will join the EU Smart Cities initiative, as instituted by the EU's Strategic Energy Technology Plan.

PART IV

Sustainable Mobility

4.1 Global Trends in Sustainable Mobility

4.1.1 Global Mobility Challenges

The most striking fact about the transportation / mobility sector today is its almost complete dependence on oil. According to the World Economic Forum (WEF), transportation is '97% dependent on oil and accounts for roughly half of global oil use [315].' It also accounts for "14 percent of global GHG emissions' [316]. The WEF expects the demand for oil to 'increase more rapidly in the transportation sector than in any of the other end-use sectors over the next 25 years [317]'. Therefore, the concerns mentioned in the energy section i.e. climate change; peak oil; energy security, apply to the transportation / mobility sector equally if not more.

Moreover, it should be borne in mind that although transportation is an indispensable part of modern life, it has many negative effects on human health, which manifest themselves also as economic costs. Beyond emissions from the burning of fossil fuels, health concerns related to the use of motorized transport include traffic accidents (collisions), high noise level [318], and air pollution [319].

> Slow moving traffic combined with poorly maintained and regulated vehicle stock, is a key contributor in making the megacities of developing countries the most polluted in the world. In the most heavily polluted cities, such as Bangkok, Kuala Lumpur, and Jakarta, economic losses from air pollution are estimated to reach 10 percent of GDP. … The World Health Organization estimates that urban air pollution (from transport and non-transport sources) causes 800,000 premature deaths each year, while urban road accidents cost developing countries US$ 65 billion each year [320].

The adverse effect of congestions on our quality of life is another obvious concern. The economic cost of congestion, which has reached 4.4% of GDP in Korea and 6% in Bangkok,' according to the WBCSD [321], is far beyond negligible.

Given this unsustainable state of the current transportation system [322], the biggest challenge, we are facing at the moment is devising a national transportation policy, which can address these considerations in an effective way without hampering economic growth: In other words, a sustainable transportation/mobility system.

4.1.2 What is sustainable transportation/mobility?

European Council of Ministers of Transport define sustainable transportation as the transportation system that

[315] World Economic Forum: The Global Agenda 2009, p. 207.
[316] WBCSD: Mobility for Development: Facts and Trends, September 2007, p. 12.
[317] World Economic Forum, 2009: 207.
[318] OECD: OECD Guidelines Towards Environmentally Sustainable Transport, 2002: 9; please see also the diagram prepared by Molina and Molina cited in WBCSD, 2007: 1.
[319] Stephen Marshall: The Challenge of Sustainable Transport, in Planning for a sustainable future, Antonia Layard, Simin Davoudi, Susan Battyeds (eds.), London: Spon Press, 2001, pp. 132-133.
[320] WBCSD, 2007: 9.
[321] WBSCD, 2007: 8.
[322] OECD, 2002: 31.

Allows the basic access and development needs of individuals, companies and society to be met safely and in a manner consistent with human and ecosystem health, and promotes equity within and between successive generations.

Is affordable, operates fairly and efficiently, offers a choice of transport modes and supports a competitive economy, as well as a balanced regional development.

Limits emissions and waste within the planet's ability to absorb them, uses renewable resources at or below their rates of generation, and uses non-renewables in a way that minimizes the impact on the use of land and the generation of noise [323] [324].

In a similar vein, World Business Council for Sustainable Development (WBCSD) defines sustainable mobility, a similar concept, 'as the ability to meet the needs of a society to move freely, gain access, communicate, trade and establish relationships without sacrificing other essential human or ecological value today or in the future'. 'For mobility to be sustainable,' the WBCSD continues, 'it must improve accessibility while avoiding disruptions in societal, environmental and economic well-being that more than offset the socio-economic benefits of accessibility improvements'.

4.1.3 Possible Remedies

In its Fourth Assessment Report, the IPCC summarizes key mitigation technologies and practices in transport in a very succinct and clear manner as 'More fuel-efficient vehicles; hybrid vehicles; cleaner diesel vehicles; bio-fuels; modal shifts from road transport to rail and public transport systems; non-motorized transport (cycling, walking); land use and transport planning; second generation biofuels; higher efficiency aircraft; advanced electric and hybrid vehicles with more powerful and reliable batteries' [325]. In what follows, some of these technologies and practices, which are deemed important for the case of Cyprus, will be further elaborated.

Making Personal Motor Vehicles Greener

In the last couple of decades, vehicle ownership, especially in the developing world has been growing at a rate of 15-20 percent annually [326]. By 2001, road transport represented 81 percent of energy consumed by the transportation sector as a whole [327]. 'Automobile travel now accounts for 15–30% of total trips in the developing world … 50% in Western Europe and 90% in the United States' [328]. As a result, cars alone already account for 10% of the man-made GHG [329]. Yet, the trend has hardly slowed down. Quite to the contrary, the number of passenger cars will quadruple to nearly 3 billion by 2050, forecasters say. Such expectations,

[323] Cited in The Centre for Sustainable Transportation: Defining Sustainable Transportation, Prepared for Transport Canada, 31 March 2005, pp. 5-6. Available at http://cst.uwinnipeg.ca/documents/Defining_Sustainable_2005.pdf (accessed 10 June 2010).
[324] This definition featured in a resolution entitled Strategy For Integrating Environment and Sustainable Development into The Transport Policy—also known as the April Resolution—adopted by the Ministers responsible for Transport and Communications at the 2340th meeting of the EU's Council of Ministers, held in Luxembourg, April 4-5, 2001 (The Centre for Sustainable Transportation 2005: 18).
[325] IPCC, 2007: Summary for Policymakers. In: Climate Change 2007: Mitigation. Contribution of Working Group III to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change [B. Metz, O.R. Davidson, P.R. Bosch, R. Dave, L.A. Meyer (eds)], Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA. , p. 10.
[326] WBCSD, 2007: 4.
[327] WBCSD, 2007: 12.
[328] Ribeiro et.al., 2007, 329.
[329] Charge!, The Economist, 3 September 2009.

The Economist reports, led the boss of the Renault-Nissan alliance, Carlos Ghosn, to declare that if the industry did not get on with producing cars with very low or zero emissions, the world would "explode" [330].

Fortunately, largely due to growing pressure from the regulators, the car industry is making huge efforts not only to make conventional engines cleaner but also to develop electric, battery-powered vehicles, which emit less 'even when the generation of the electricity needed to charge them is taken into account' [331]. Another parallel effort to lower carbon emissions is developing different sorts of biofuels.

Bio-Fuels

Bio-fuels have two variants: First-generation and second-generation biofuels. When we talk about first-generation bio fuels, basically we refer to 2 alternatives:

1- Ethanol, obtained via fermentation of sugars from cane or maize

2- Bio-diesel obtained from processed plant oils [332].

In both cases, crops are planted specifically for the purpose of fuel production [333]. In theory, as these crops take up CO_2 during their growth (photosynthesis), 'burning fuels made from them should have no net effect on the amount of that gas in the atmosphere' therefore burning them should have no effect on climate [334]. This is hardly the case in practice, however. According to a report by the International Council for Science (ICSU), 'a Paris-based federation of scientific associations from around the world… so far, the production of biofuels has aggravated rather than ameliorated global warming' because the amount of nitrous oxide (N_2O) 'released by farming biofuel crops… probably negates by itself any advantage offered by reduced emissions of CO_2' [335].

First-generation biofuels have other additional environmental drawbacks. These are, competition with food crops, which is driving up the food prices; the need to clear virgin land to grow them, which is leading to deforestation; and the energy costs of processing them [336]. We can also add the water shortage problem to this list of drawbacks: we need 'up to 9,100 litres of water to grow the soy for one litre of biodiesel, and up to 4,000 litres for the corn to be transformed into bioethanol' [337]. By promoting biofuels, the politicians are trying to alleviate a serious problem (climate change), by 'making another, even more serious problem (water shortage) worse,' argues Peter Brabeck-Letmathe, chairman of Nestlé [338]. Jean Ziegler, UN's Special Rapporteur for the Right to Food, is even harsher in his criticisms against biofuel production, calling it 'a crime against humanity' [339].

In the face of these criticisms, initial enthusiasm for biofuels has started waning [340]. Back in 2007, the 27 EU leaders had set a target of using 10 percent first-generation biofuels in road transport by 2020, as part of a wider climate change package. A couple of months later, the European Parliament's industry committee voted to revise this target to 6 percent.

Second-generation biofuels, on the other hand, are obtained through 'processing agricultural

330 Charge!, The Economist, 3 September 2009.
331 Charge!, The Economist, 3 September 2009.
332 Geoffrey Carr: The coming alternatives, The Economist, 13 November 2009.
333 Charles Hawley: Pressure Grows on EU to Abandon Biofuels, Spiegel Online, 16 April 2008.
334 Biofools, The Economist, 8 August 2009.
335 Biofools.
336 Geoffrey Carr: The coming alternatives, The Economist, 13 November 2009; Charles Hawley, Europe's Biofuels Conundrum, Speigel Online, 15 September 2008.
337 A Water Warning, The Economist, 19 November 2008.
338 A Water Warning, The Economist, 19 November 2008.
339 Charles Hawley, Pressure Grows on…
340 EU Committee Votes to Cut Biofuels Goal, Spiegel Online, 11 September 2008.

by-products, and other non-edible biomass'[341]. According to Carr, second-generation biofuels in the form of "'advanced" ethanol—made from straw, wood chippings and suchlike, using new technological tricks such as genetically engineered bacteria to do the fermenting (and) "designer" biodiesel, made from sugar but turned into hydrocarbons that should be even better than fuels from oil' will start coming out of pilot plants towards the end of 2010 [342]. However, they are 'still years away from making a significant impact' [343] according to Hawley.

Plug-in/Electric Cars

While enthusiasm for biofuels is in sharp decline, political support for electric cars is booming. Last year, the Global Agenda Council on the Future of Transportation called for a paradigm change that would pave the way for electric cars [344]. While the US, and China have already launched massive programs to promote electric vehicles, Germany, which fears falling behind in this race, has recently revealed plans to invest heavily in this technology. German 'Economics Minister Rainer Brüderle calls the electric car a "key technology for Germany as an industrial location," while Transport Minister Peter Ramsauer has already defined the subject as "the most important project of this legislative period." Chancellor Merkel, too, is calling it a "national task" [345]'.

The distinguishing characteristic of these cars is that the electricity they require comes simply from ordinary electric sockets we have at homes [346], which means although driving them emits zero-carbon, 'their overall environmental credentials depend on how the electricity is generated in the first place. If it comes from coal, they are still better in global-warming terms than traditional cars—but not by as much as they could be if the power were wind, solar or even... nuclear' [347]. The ideal case would be charging them 'up with low-cost wind- generated power at night, a time when much of the power generated by wind turbines goes wasted [348]'.

'Plug-ins are moving from idea to reality with an amazing speed,' The Economist comments [349]. By the end of 2010, mainstream manufacturers like Nissan, and Chevrolet are planning to release their electric cars [350]. Other major manufacturers are expected to follow suit. But this does not necessarily mean that electric cars will become mainstream any time soon. One of the biggest obstacles is their price. 'A vehicle in the lower mid-range class with an electric engine costs between €10,000 and 15,000 more than a comparable car with a gasoline engine' [351]. 'That is because of the high cost of batteries, and because other components must be redesigned for electric vehicles. In an industry driven by scale, small volumes lead to high costs' [352]. 'Without government subsidies,' write Hawranek and Neubacher of Spiegel Online, 'electric cars are virtually unmarketable. France offers customers an incentive of €5,000, China offers €6,500 and the United States offers €5,500'. Two other problems hindering their spread are too short ranges (According to Auto Motor und Sport, a German motoring magazine, 'the

[341] Charles Hawley, Pressure Grows on…
[342] Geoffrey Carr: The coming alternatives, The Economist, 13 November 2009.
[343] Charles Hawley, Europe's Biofuels Conundrum, Speigel Online, 15 September 2008.
[344] World Economic Forum, 2009: 210.
[345] Dietmar Hawranek and Alexander Neubacher: Germany to Promote Electric Cars with Massive State Aid, Spiegel Online, 28 April 2010.
[346] The End of the Petrollhead, A Special Report on Energy, The Economist, 21 June 2008.
[347] The Coming Alternatives, The Economist, 13 November 2009.
[348] Fritz Vahrenholt, Spiegel, 14,12,2009.
[349] The End of the Petrollhead.
[350] Charge!
[351] Dietmar Hawranek and Alexander Neubacher.
[352] Charge!

electric Smart only made it 106 kilometers on a single charge, while the Mitsubishi's battery was empty after 77 kilometers'[353]); and too long charging times for batteries [354].

Given these obstacles, a boom in electric car sales is not expected in the immediate future. 'Industry forecasts suggest that by 2020 about 10% of new cars will be either entirely battery driven vehicles or plug-in hybrids, with accelerated growth thereafter'[355].

Car-Pooling

If we cannot make private vehicles greener in the short run, at least we can minimize their negative effects by reducing personal motorized transport. One of the most practical methods of doing this is car-pooling. This 'is the simplest and most common "ridesharing" arrangement'[356]. It involves two or more persons –most of the time commuters- riding together in a private vehicle on a 'continuing basis regardless of their relationship to each other or the cost of sharing agreements'[357]. By promoting car-pooling, it is aimed to reduce the number of 'Single Occupancy Vehicles (SOV) that travel with low efficiency and thus contribute to congestion and green house gas emission'[358].

Nowadays, Malaysian authorities - among others - are considering carpooling as 'one of the strategic directions in the Draft Kuala Lumpur 2020 City Plan on building a more sustainable, integrated and environmentally friendly transport infrastructure in the city'[359]. The plan envisions 'incentives to those who carpool, especially to employees of government agencies and major corporations in the city centre. The incentives can also include subsidized parking for registered pool vehicles'[360]. According to Norliza Hashim, a consultant working on this issue, carpooling can help in reducing the number of vehicles drastically: "Say 125,000 SOV vehicles switch to high occupancy vehicles like a bus where more than 25 persons travel in it, the number of vehicles on the road will be reduced to 5,000. If it's a low occupancy vehicle where more than three persons travel in the same vehicle, the number is reduced to 42,000 vehicles which is a reduction of 66%"[361].

Public/Mass Transportation

In principle, mass transportation uses less energy and generates less GHGs than private cars [362]. It eases congestion, consequently allowing private vehicles to achieve greater fuel efficiency [363]. Additionally, it 'is considered favorably from a social sustainability point of view because it gives higher mobility to people who do not have access to a car'[364]. Given that, any policy that intends to cut carbon emission must be backed by investment in public transportation. '(L)arge capacity buses, light rail transit and metro or suburban rail can be feasible mitigation options for the transport sector'[365].

[353] Dietmar Hawranek and Alexander Neubacher.
[354] Dietmar Hawranek and Alexander Neubacher.
[355] A Netscape moment? The Economist, 4 February 2010.
[356] http://www.mwcog.org/commuter2/commuter/ridesharing/whatitis.html (accessed 1 February 2010).
[357] http://www.mwcog.org/commuter2/commuter/ridesharing/whatitis.html
[358] http://thestar.com.my/metro/story.asp?file=/2008/6/24/central/21630748&sec=central
[359] http://thestar.com.my/metro/story.asp?file=/2008/6/24/central/21630748&sec=central (accessed 01 February 2010).
[360] http://thestar.com.my/metro/story.asp?file=/2008/6/24/central/21630748&sec=central
[361] http://thestar.com.my/metro/story.asp?file=/2008/6/24/central/21630748&sec=central
[362] Kahn Ribeiro, S., S. Kobayashi, M. Beuthe, J. Gasca, D. Greene, D. S. Lee, Y. Muromachi, P. J. Newton, S. Plotkin, D. Sperling, R. Wit, P. J. Zhou, 2007: Transport and its infrastructure. In Climate Change 2007: Mitigation. Contribution of Working Group III to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change [B. Metz, O.R. Davidson, P.R. Bosch, R. Dave, L.A. Meyer (eds)], Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, p.348.
[363] American Public Transportation Association: The Benefits of Public Transportation.
[364] Ribeiro et.al. 2007: 349.
[365] Ribeiro et.al. 2007: 349.

The various advantages of public transportation notwithstanding, growing private vehicle ownership is in practice 'reducing the use and availability of public transport services' [366]. Promoting the Bus Rapid Transit (BRT) is one of the efforts aiming to buck this trend [367]. BRT, which was introduced in Curitiba, Brazil in 1974, and then spread all over the world, from New Zealand to China, stands as a cheaper alternative to light rail systems [368]. 'The cost of construction, at only US$2 million/km', according to Hook, is 'a fraction of most light rail systems (generally greater than US$20 million/km)'.

Wright defines BRT as a mass transit system, which uses 'exclusive right of way lanes that mimic the rapidity and performance of metro systems, but utilizes bus technology rather than rail vehicle technology' [369].

> BRT systems can be seen as enhanced bus service and an intermediate mode between conventional bus service and heavy rail systems. BRT includes features such as exclusive right of way lanes, rapid boarding and alighting, free transfers between routes and preboard fare collection and fare verification, as well as enclosed stations that are safe and comfortable, clear route maps, signage and real-time information displays, modal integration at stations and terminals, clean vehicle technologies and excellence in marketing and customer service [370].

'Privately run para-transit services such as share-taxis, minibuses and pick-up trucks' also play a significant role as modes of public transport in the cities of developing countries. In major cities of Asia, like Manila, Jakarta, Kuala Lumpur and Bangkok, para-transit services 'provide between 20-50 percent of public transport' [371].

Promoting Non-Motorized Transport (NMT) - Walking and Cycling

Certainly, '(t)he healthiest and most sustainable modes of transport are walking and cycling' [372]. According to the Environmental and Energy Study Institute based in Washington DC '(a) n estimated 40 percent of all personal trips are under two miles, creating vast potential to increase walking and biking as a practical and cost-effective means of travel' provided that 'safe, convenient, and comfortable options are made available' [373]. An additional benefit of NMT, which is gaining increasing attention in many countries, is its positive effect on public health.

The main obstacle impeding walking, on the other hand, especially in developing countries, is insufficiency of sidewalks: Most of the time they are either non-existent or obstructed [374]. In Indonesia, for instance, 60 percent of paved roads do not have usable sidewalks [375]. Another important factor discouraging pedestrians from walking more is the lack of safe road-crossing facilities [376]. Same shortcomings apply to biking as well. As one Sao Paolan remarks, 'you have to be brave to ride a bike to work in São Paulo' [377].

[366] WBCSD, 2007: 9.
[367] WBCSD, 2007: 9.
[368] Walter Hook: Bus Rapid Transit: A Cost-Effective Mass Transit Technology, EM, A&WMA's Magazine for Environmental Managers, June 2009, p. 26.
[369] Cited in Ribeiro et. al. 2007: 349.
[370] Ribeiro et. al. 2007: 349.
[371] WBCSD, 2007: 9.
[372] http://www.gdrc.org/uem/sustran/key-issues.html
[373] http://www.eesi.org/public_trans (accessed 1 February 2010).
[374] World Business Council for Sustainable Development: Mobility for Development, March 2009, p. 22.
[375] Hook cited in WBCSD, 2007: 9.
[376] WBCSD, 2009: 22.
[377] Cited in WBCSD, 2009: 42.

These problems can be overcome, and walking and cycling can be promoted, according to Marshall, by implementing such measures as pedestrianization, building pedestrian crossings, footpaths, cycle lanes, parking; and introducing traffic signals, signage, company cycle subsidy [378]. Beyond these infrastructural improvements, safety conditions for pedestrians and cyclists can be bettered through campaigns to educate drivers [379].

4.1.4 London: A Successful Case

London is a success story, which shows what a coherent policy mix can achieve: The authorities brought cross-modal transport planning and spatial planning together, and implemented a balanced package of interventions – investment in public transport, priority for buses and cyclists, a local freight strategy, and congestion charging. Consequently, between 1998-99 and 2005-06, bus use increased from 1.27 billion journeys a year to 1.81 billion, bucking the national trend; more trips are made by cycle and on foot, average traffic speeds in central and inner London have increased since 2003 (reversing a long-term trend); road casualties across London have declined faster than in the rest of the country [380].

[378] Marshall, 2001: 141.
[379] Ribeiro et. al. 2007: 350.
[380] Towards a Sustainable Transport System: Supporting Economic Growth in a Low Carbon World, UK Department for Transport, 2007, p. 20.

4.2 European Policies for Sustainable Mobility

Transport is one of the European Union's foremost common policies. Policies have been focused on eliminating borders between Member States and to therefore contribute to the free movement of individuals and of goods. Their principal aims are to complete the internal market, ensure sustainable development, extend transport networks throughout Europe, maximise use of space, enhance safety and promote international cooperation. The Single Market signalled a veritable turning point in the area of mobility. Since the 2001 White Paper, which was revised in 2006, this policy area has been oriented towards harmoniously and simultaneously developing the different modes of transport and in particular with making use of each means of transport (ground, waterborne or aerial) to its best effect.

4.2.1 Promotion of the use of biofuels or other renewable fuels for transport (2003/30/EC) [381]

According to Directive 2003/30/EC, Member States should ensure that a minimum proportion of biofuels and other renewable fuels is placed on their markets, and, to that effect, shall set national indicative targets. A reference value for these targets shall be 5.75%, calculated on the basis of energy content, of all petrol and diesel for transport purposes placed on their markets by 31 December 2010.

Biofuels may be made available in any of the following forms: (a) as pure biofuels or at high concentration in mineral oil derivatives, in accordance with specific quality standards for transport applications; (b) as biofuels blended in mineral oil derivatives, in accordance with the appropriate European norms describing the technical specifications for transport fuels (EN 228 and EN 590); (c) as liquids derived from biofuels.

Member States shall monitor the effect of the use of biofuels in diesel blends above 5% by non-adapted vehicles and shall, where appropriate, take measures to ensure compliance with the relevant Community legislation on emission standards.

In the measures that they take, the Member States should consider the overall climate and environmental balance of the various types of biofuels and other renewable fuels and may give priority to the promotion of those fuels showing a good cost-effective environmental balance, while also taking into account competitiveness and security of supply.

Member States shall ensure that information is given to the public on the availability of biofuels and other renewable fuels.

[381] http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2003:123:0042:0046:EN:PDF (accessed 22nd October 2010).

4.2.2 Greening Transport Package (COM(2008) 433) [382]

The main issues targeted by the Package are the following:

Climate change

Climate change is now a priority environmental problem and the EU receives measures to: (a) limit CO_2 emissions from new cars, (b) include aviation in the EU Emissions Trading System (ETS), (c) apply differentiated annual circulation and registration taxes for cars based on their CO_2 emissions, and (d) ensure that all means of transport not covered by the ETS contribute to achieving national targets for limiting greenhouse gas emissions.

Member States should meet objectives for increasing the share of renewable energy used in road transport. The Commission is committed to sourcing 10% of its transport fuel consumption from RES by 2020 (including biofuels, renewable electricity and hydrogen).

The Commission has also proposed that fuel suppliers reduce greenhouse gas emissions from fuel across its life-cycle by 10% by 2020.

Local pollution

Measures to limit air pollution are focused on limiting emissions from new vehicles (the "EURO" standards), vessels or recreational craft. There are also maximum levels of certain pollutants in fuels and rules to reduce emissions during fuel storage and distribution. In the case of waterborne transport, requirements exist to limit water pollution.

In terms of vehicle procurement the Commission has proposed that all public purchases of cars, vans, buses and lorries use a methodology that takes into account the energy consumption, CO_2 and pollutant emissions costs during the vehicle's use over its lifetime.

Most new transport infrastructure projects are also subject to rules on environmental assessment and some also to the rules on nature protection.

Noise pollution

EU measures to limit noise pollution have focused on providing a general framework for assessing noise and for limiting noise emissions from all new, motorised, inland transport modes in the framework of the Single Market.

Limits also exist for aircraft, and more stringent restrictions can be put in place at certain EU airports. Airports, large towns (including their ports), heavily-used railways and roads must also be mapped for noise, and action must be taken to reduce it where necessary. There are also limits for tyre noise which come into force in 2009 for replacement tyres.

[382] http://ec.europa.eu/transport/strategies/2008_greening_transport_en.htm (accessed 22nd October 2010).

Congestion

EU policy aims to move transport away from the most congested modes, while at the same time develop common charging frameworks. There are existing measures for charging heavy-goods vehicles for infrastructure use and also specific requirements for rail infrastructure.

Rail, inland waterways and maritime transport receive most funding for infrastructure provision under the Trans-European Networks and the Marco Polo programme, mainly in order to encourage a shift from road transport. There are measures in the air and rail sectors that aim to increase infrastructure efficiency, and work on technological improvements in the road sector is ongoing.

All sectors will benefit from the possibilities that Galileo will offer for fleet management, optimising transport routes to avoid congestion and preventing accidents.

Accidents

Safety has been one of the key parts of EU transport policy since its very beginning. There are many different EU safety requirements for (a) new road vehicles, (b) obtaining driving licences, (c) limiting the speed of buses and coaches, and (d) ensuring the roadworthiness of vehicles and the infrastructure itself.

In the maritime sector there are many measures to increase safety, prevent accidents involving ships, passengers and crew and reduce the environmental impacts of accidents; these are all backed up by inspections. In the aviation sector safety measures include the aircraft's design and maintenance, use and personnel licensing. The aviation, rail and maritime sectors have requirements on accident investigation and reporting.

4.2.3 Getting the prices right

Capitalising on the existing policy instruments is crucial to making transport more sustainable and addressing the different negative impacts of transport. As mentioned above, getting prices right is one significant way of doing this and is central to the Commission's approach [383]. The Commission is therefore presenting two initiatives along with this communication that aim to do this: a communication on internalising the external costs of transport; and a proposal to revise the existing directive on infrastructure charging for heavy goods vehicles.

Internalising the external costs of transport

This communication and its annexes contain two elements. The first is a common framework for estimating the external costs of transport. This is based upon the results of Commission-financed work to review best practices, suggest a methodology, and produce a handbook containing reference values that can be used for external costs. The communication provides guidance on how to use these values for external costs.

[383] http://europa.eu/rapid/pressReleasesAction.do?reference=IP/08/1119&format=HTML&aged=0&language=en&guiLanguage=en (accessed 22nd October 2010).

The second element of the communication is a strategy that sets out how external costs can be internalised in all modes of transport. In so doing it meets the requirement of the directive on heavy goods vehicles charging. The strategy takes into account that for some impacts — such as noise and congestion — the costs that transport users impose on society vary in space, time and depending on the mode in question, while for others, such as greenhouse gas emissions, this is not the case. As a result the strategy is both mode and impact-specific.

In the road sector the strategy launches immediate action to allow more effective and efficient internalisation with the proposal on infrastructure charging for heavy goods vehicles. Private transport is not covered because of the subsidiarity principle, but the Commission encourages Member States to implement a charging system for all road transport and not just heavy goods vehicles as this would create incentives for all road users to change their behaviour, thereby increasing the significant positive impacts.

Road charging

Road transport accounts for the majority of external costs from transport so getting the prices right in this area is particularly urgent. At present the directive effectively stops Member States from making the most effective use of their tolling systems or the systems they are developing. Charges cannot currently be calculated and varied on the basis of external costs. This means that Member States cannot put in place sufficient incentives for operators to modernise their fleet with cleaner vehicles and to adapt their route planning and logistics to make them more sustainable.

The proposal would change this by giving Member States a framework to better vary charges according to the local pollution (air and noise) and congestion that the particular vehicle causes at the time it is used. By reducing congestion it will also contribute significantly to reducing CO_2 emissions.

To ensure that the tolls are both proportionate to the actual environmental damage and congestion caused and that the internal market continues to work properly the Commission is proposing that a common and transparent method is used for calculating external costs. The directive would also insist that any revenues from the scheme are earmarked for reducing the environmental impacts of transport and congestion and that, after a transition period, charges are levied using electronic systems.

4.2.4 Green Paper: Towards a new culture for urban mobility (COM(2007) 551) [384]

The Commission proposes to encourage the emergence of a real "urban mobility culture" integrating economic development, accessibility and improvement to quality of life and the environment. For this purpose, the Green Paper identifies five challenges:

[384] http://eur-lex.europa.eu/LexUriServ/site/en/com/2007/com2007_0551en01.pdf (accessed 22nd October2010).

Improve fluidity in towns

Congestion is one of the key urban issues. It has numerous repercussions: economic, social and environmental. The Green Paper mentions a number of possible actions including (a) making the modes of transport, which are capable of replacing the car, safe and appealing; (b) encouraging co-modality; (c) encouraging walking and cycling and developing the infrastructure for these methods of travel; (d) optimizing car use by carpooling and optimizing "virtual mobility" (tele-working, tele-shopping, etc.); (e) implementing a parking policy designed to reduce traffic; (f) encouraging follow-on connections with public transport; (g) optimizing existing infrastructures; (h) introducing urban charges, as seen in London or in Stockholm; (i) encouraging the introduction of Intelligent Transport Systems (ITS) to enable better trip planning; (j) encouraging the use of cleaner and smaller vehicles for making deliveries in and around towns; and (k) improving the integration of freight distribution in urban areas within local policy-making and institutional settings.

Reduce pollution

Although technological progress has made it possible to produce vehicles emitting lower levels of pollution, urban areas remain a major and increasing source of CO_2 emissions. Pollution emissions have been reduced, particularly as a result of the progressive application of EURO emission standards. A legislative framework also exists for the use of biofuels. Nevertheless, the situation remains unsatisfactory. The Commission proposes to:

- Support research and technological development of vehicles using alternative fuels (biofuels, hydrogen, fuel cells);
- Encourage the introduction of new technologies in the market by means of economic incentives;
- Encourage the exchange of good practices between Member States in the area of urban transport;
- Encourage a public procurement policy that respects the environment;
- Internalize external costs associated with energy consumption and pollution for a vehicle's entire life from its introduction on the market;
- Encourage "eco driving" to enable energy consumption to be reduced, as part of training given by driving schools; encourage the use of traffic management systems (which will be improved, particularly as a result of the Galileo programme); support the development of more "intelligent" cars;
- Apply traffic restrictions in certain cases.

Intelligent urban transport

The Galileo programme will permit the development of various applications for Intelligent Transport Systems (ITS). These already exist but sufficient use has yet to be made of them. The Commission proposes (a) the use of smart charging systems, (b) dynamic management of existing infrastructures using better information, and wider dissemination of good practice in the area of ITS.

Elderly and disabled people, as well as people with reduced mobility, are calling for easy access to urban transport infrastructure. The parties involved in the Green Paper also consider that

co-modality deserves more attention and that greater support should be given to integrated solutions.

In large built-up areas, there are trends towards suburbanization and urban sprawl. If interlinking of the transport network does not take place, certain areas are at risk of social isolation. The Commission proposes the following points for consideration: (a) improve the quality of collective transport; (b) coordinate urban and suburban transport with regional planning; and (c) better integration of passenger and goods transport in urban planning.

Safety and security

In 2005, 41,600 people were killed on the roads in the EU. Two thirds of these accidents and one third of deaths occurred in an urban area. More often than not, the victims are the most vulnerable people, namely cyclists or pedestrians. Furthermore, the issue of public transport safety often puts people off using certain modes of transport. From a range of possible options, the Commission proposes (a) the improvement of vehicle safety using new technologies, (b) the improvement of the quality of infrastructures, especially for pedestrians and cyclists, and (c) the encouragement of people to be more aware of their behavior with regard to road safety.

Towards a new culture for urban mobility

The Green Paper also stresses the need to elicit an urban mobility culture by means of education, training and raising awareness. The EU could initiate training and discussion activities, such as organizing a European campaign to raise public awareness of urban mobility; strengthening the harmonization of statistics from the various Member States and implementing common definitions; and setting up an observatory aimed at collecting, harmonizing and using the necessary data for policy-makers and for the general public which is also aimed at promoting the exchange of good practice.

The Green Paper proposes several options for financing the proposed measures: (a) more consistent use of existing financial instruments, such as the Structural Funds and the Cohesion Fund, for the development of an integrated and sustainable urban transport system; (b) establishment of market-based mechanisms, such as the Emissions Trading Scheme; (c) contributions from the traveller, the private sector, and from public-private partnerships to the financing of urban and suburban collective transport.

4.3 Sustainable Mobility: Current Situation in the Greek Cypriot Community

The current situation concerning sustainable transportation/mobility in Cyprus is quite disappointing. Cyprus is currently lacking the necessary infrastructure for efficient use of public transportation. The main reasons behind this situation are the following [385]:

(a) Most of the town-building development during the '80s and the '90s was made based on different to today's priorities and needs. This led to a rash development without too much order and without taking into account neither the principles of sustainable transportation nor the efficient use of public transportation means. Town zones were opening but their access was only designed for the use of private cars.

(b) The old buses which have been in use until recently, the limited number of routes, the non-punctual time-schedule and the lack of infrastructure, have been the reasons for the development of a negative culture of Cypriots against public transport.

The main principles of sustainable mobility providing for (a) reasonable access to other people, places, goods and services, (b) health and safety, (c) pollution prevention, (d) efficient land and resource use, and (e) fuller cost accounting, are still not adopted in full neither by legislation nor in practice by citizens. It is understood that in order for Cyprus to fully implement the principles of sustainable transportation, there should also be a change in the mentality and behavioural habits of Cypriots (use of public transport, use of bicycles, purchase of hybrid cars, etc.).

4.3.1 Public transportation

The Cyprus government is currently concentrating in the promotion of the access principle with the adoption of a series of measures: (a) gradual renewal of the fleet of buses; (b) increase of the bus-routes within the towns; (c) introduction of night routes for the servicing of tourists but also for Cypriot citizens; (d) introduction of peripheral routes within towns; (e) more frequent and punctual time-schedules; (f) frequent connections between the towns and the suburbs; and (g) frequent routes between towns [386].

A necessary ingredient for the success of public transportation is the public confidence in the frequency, punctuality and time efficiency (as a fast means of transportation) of the public transport system. These parameters would require the creation of bus lanes, which currently do not exist.

One of the major reasons why the public transport system in Cyprus has failed in the past is because of the low population density of the island, which makes it difficult to achieve economies of scale.

[385] Cyprus 2015 interview, Eleni Mavrou, Mayor of Nicosia Municipality, Nicosia, 8 January 2010.
[386] Nicos Nicolaides, "Green Paper on Public Transport", Ministry of Communications & Works, 21 May 2009.

The first attempt for the upgrade of public transportation was made with the adoption of bus routes between the airport and the towns as well as the adoption of school buses. Both actions are very successful at the moment servicing thousands of students and local and foreign travellers. Although this has been a good start, the future success of these programmes will depend upon maintaining the proper functioning of the routes and the good state of the buses (i.e. clean and comfortable transport means).

Other means of public transportation are also on the current agenda of the Ministry of Communication & Works. Demand Responsive Transport (DRT) is an alternative public transport which acts similarly to taxis but is much cheaper. DRT does not compete with bus routes but rather completes this service. Additionally, a light-rail network connecting Limassol, Nicosia and Larnaca is also under discussion [387].

The development of a public transportation network covering a whole district is a very costly project. That is why Cyprus authorities are considering the development of networks connecting the centre of the towns with large bus stations right outside the town centre. That would be easier and faster to implement. One of the ideas currently being discussed is the development of transport systems for public employees working in nearby buildings. Instead of the government trying to construct large parking places within the town centre to serve these employees, it is more convenient for employees to park their cars at the bus stations (with large parking spaces) outside the centre and get to their working places by bus. That would discharge the centre from traffic and parking needs.

Another issue in deploying efficient public transportation networks is the need for coordination between various authorities since routes need to cross over many municipalities. The ultimate party in charge for the development of such networks is the town-planning department of the Ministry of Interior [388].

4.3.2 Environmental protection

Presently, little is done on the protection of the environment when it comes to transportation. The only environmental effect is the indirect benefit to the environment by the efforts for promoting public transportation means that would result to the reduction of use of private cars. There have only been some sporadic efforts by municipalities to introduce transportation means that do not emit CO_2 (use of RES, electric cars, hydrogen cars) but there has not been any coherent policy towards this direction. Since the majority of these authorities do not need to make routes outside the towns, the use of these cars does not impair their functionality; on the other hand they benefit the environment (by not harming it) as well as giving the good example to citizens in adopting such technologies. The lack of the necessary infrastructure is a major drawback for the deployment of such systems.

On the principle of "greener" transportation, the EU has set a minimum target to each Member State for replacing 10% of transport fuel with renewable ones (biofuels, hydrogen, 'green' electricity, etc.) by 2020. Biofuels must meet agreed sustainability criteria. European Commission, in its Renewable Energy Roadmap and Biofuels Progress Report (2009), shows that Cyprus has made 0% progress towards the national 2010 target of replacing petrol and diesel in transport with renewable energy, which was set at a percentage of 5.75%.

[387] Cyprus 2015, stakeholder panel, Nicosia, 4 march 2010.
[388] Cyprus 2015 interview, Eleni Mavrou, Mayor of Nicosia Municipality, Nicosia, 8 January 2010.

4.4 Sustainable Mobility: Current Situation in the Turkish Cypriot Community

As far as the transportation system in the northern part of Cyprus is concerned, there is a widespread belief among the experts that there is much that needs to be done on the management side of the issue. For instance, in an interview published in daily Kibris, highlighting the lack of traffic education, the insufficiency of traffic controls, and flaws in traffic engineering, Taner Aksu, a veteran traffic engineer concludes that 'our traffic system is a failure [389]'. Similarly, Metin Kunt, the head of the Traffic Education and Research Center at the EMU, points out that there are 'no formal' management of infrastructure; congestion management or traffic management [390]. 'Management of infrastructure, congestion management and traffic management are taking place as a reaction to the immediate problems, not as a well established formal process,' he says [391]. In a similar vein, Şenay Kebapçı, the director of the traffic branch of the Police Department, identifies 'the lack of coordination' as the biggest problem in traffic [392].

4.4.1 Public Transportation

Public transportation in the northern part of Cyprus is far from living up to the expectations of a modern city dweller. As Metin Kunt points out in a recent conference paper, 'an aged fleet of vehicles, unreliable timetables, limited routes, insufficient bus stops, [393]' are what we observe when we talk about public transportation within cities in the northern part of Cyprus. Inter-city bus services, which are provided solely by the private sector, are not any better. Furthermore, the transportation services in different cities are not in harmony [394].

4.4.2 Increasing Number of Private Cars

In the absence of a comfortable and reliable public transportation system, the number of private cars is rising with a tremendous speed. The number of motorized vehicles per capita is much higher than the EU average [395]. Between 1999 and 2004, 40,000 new vehicles were registered, 71 percent of which were private cars and motorcycles [396]. In 2007 alone, almost 15,000 joined the fleet [397]. 'The rising number of private cars and insufficiency of public transportation' are factors worsening the traffic problem, according to Şenay Kebapçı [398].

Obviously, the increasing number of private cars is also leading to a rise in the consumption of fuel. Although, the quality of regular petrol used in the northern part of Cyprus complies with EU standards, the type of diesel fuel used is far below the standard in the EU according to the PFAA [399]. 'For the widespread use of euro diesel, which is a higher quality diesel fuel'

[389] Cited in Aral Moral: Trafikte Denetim Sıfır, Kıbrıs, 14 April 2008.
[390] Mehmet Metin Kunt: Transportation System in Northern Cyprus: Infrastructure, Operation and Management, in Integrating Transport in a Reunified Cyprus, Nicosia: Reconstruction and Resettlement Council, 2009, p. 42.
[391] Ibid.
[392] Cited in Özgül Mutluyakalı (TAK): İşte 2007'nin trafik bilançosu: 47 ölü, 1378 yaralı, Kıbrıs, 22 January 2008.
[393] Mehmet Metin Kunt: Transportation System in Northern Cyprus: Infrastructure, Operation and Management, in Integrating Transport in a Reunified Cyprus, Nicosia: Reconstruction and Resettlement Council, 2009, p. 40.
[394] Ibid.
[395] Kıbrıs Türk Ulaşım Ağı ile İlgili Fizibilite Araştırması, Final Raporu: Trafik Güvenliği Araştırması, p. 3.
[396] Kıbrıs Türk Ulaşım Ağı ile İlgili Fizibilite Araştırması, Final Raporu: Trafik Güvenliği Araştırması, p. 3.
[397] Özgül Mutluyakalı (TAK): İşte 2007'nin trafik bilançosu: 47 ölü, 1378 yaralı, Kıbrıs, 22 January 2008.
[398] Cited in Özgül Mutluyakalı (TAK): İşte 2007'nin trafik bilançosu: 47 ölü, 1378 yaralı, Kıbrıs, 22 January 2008.
[399] PFAA, 2009: 406.

the Programme notes, 'it is required to increase the number of new technology diesel engine vehicles using this fuel [400]'.

4.4.3 Air Pollution

The rising number of private cars on the one hand, and the poor quality of diesel fuel on the other, is inevitably making another problem, air pollution, worse. The research conducted by the Environment Department in 2009 revealed that the level of air pollution in the northern part of Nicosia is 45% above the EU standard. According to Hülya Altan, the director of the Environment Department, traffic is one of the main reasons of this situation. 'Introduction of compulsory exhaust emission tests in 2008' to address this problem proved successful, she adds, at least in alleviation of the problem if not in solving the problem once and for all [401].

4.4.4 Road Safety

A recent study conducted on traffic safety found that the rate of traffic fatalities and injuries in the northern part of Cyprus is far above the EU average [402]. The number of people who lost their lives in road accidents in the northern part of Cyprus in 2003, for instance was 24.4 per 100,000 residents, while the EU 15 average stood at 10.4. Despite the severity of the problem, the study stated, 'no comprehensive plan or strategy has been devised to reduce road accidents and fatalities' [403]. The only concrete step, taken a few years after this study had been completed, was the introduction of speed cameras. According to Şenay Kebapçı, this helped in reducing the number of road accidents with fatality by 25 percent compared to a year earlier [404].

4.4.5 Walking and Cycling

As one of our stakeholders put it, there is a 'cultural prejudice' against walking, and cycling [405], which are considered as the healthiest forms of mobility. Furthermore, motorists do not respect the pedestrians and cyclists in traffic, making it quite dangerous for the ones who prefer to walk or cycle.

Inadequate infrastructure is another problem. Sidewalks are insufficient; not continuous (i.e. there are gaps in the network); blocked by parked vehicles; and generally in a poor state of repair.

As long as infrastructure for cycling is concerned, we see that the only town with bike lanes, Kyrenia, falls short of being a success story, as the route is too short, and parked cars are blocking some parts of the bike lane most of the time, rendering widespread adoption of cycling as an alternative mode of transportation almost impossible.

[400] PFAA, 2009: 406.
[401] Cited in Gözde Süreç: Lefkoşa'da hava kirliliği, AB standartlarına göre hala yüzde 45 oranında fazla, Kıbrıs, 30 November 2009.
[402] Kıbrıs Türk Ulaşım Ağı ile İlgili Fizibilite Araştırması, Final Raporu: Trafik Güvenliği Araştırması, p. 4.
[403] Kıbrıs Türk Ulaşım Ağı ile İlgili Fizibilite Araştırması, Final Raporu: Trafik Güvenliği Araştırması, p. 4.
[404] Cited in Mutluyakalı 2007.
[405] Cyprus 2015 interview, 26 January 2010.

4.5 Sustainable Mobility: Future Directions for Cyprus

Several meetings of mobility stakeholders, including Greek Cypriot and Turkish Cypriot town planners, mobility experts, and others with an interest in mobility issues, were convened by the Cyprus 2015 initiative in February and March 2010. The stakeholders were presented with the research findings of Cyprus 2015 staff in relation to global trends, EU polices and current situation in Cyprus, and were asked, on the basis of this situation, to formulate relevant policy recommendations for the future of Cyprus. The following is a summary of their recommendations, and accompanying rationale:

4.5.1 Accepting sustainable mobility as a social good

It is important to acknowledge that mobility is not just a technical matter to be resolved at a technical level by the appropriate bureaucracies, but also a social good with significant impact on the daily life of citizens and their overall quality of life. In this respect, it can be likened to health and education, sectors which state authorities routinely supervise to ensure quality, access, and equity. This culture of treating mobility as a social good, where state planning and investment efforts deserve to be directed, must begin to permeate public opinion and the policy making process in Cyprus if the necessary steps for change are to be undertaken.

4.5.2 Moving beyond the private car culture: Some alternative means to achieve mobility

Improving the conventional public transport system

Though there is a maximum ceiling to the percent of the population that can be expected to use public transport in Cyprus even under the best of circumstances, even a small percent improvement in the use of public transport will imply significant improvements as regards congestion and carbon emission challenges. Increasing the use of public transport is contingent on making the system more attractive, comfortable, accessible and reliable. Converting to a Bus Rapid Transit or Tram system could be considered as a method for achieving all these challenges simultaneously.

Demand Responsive Transport as a complement to conventional public transport modes

For the case of Cyprus, a smart complement to conventional public transport would be the development of intra-urban Demand Responsive Transport (DRT) grids in all major cities. DRT combines elements of both a bus network and a taxi service: Individual users can call ahead to book a route, which they will then share with several other users on similar routes, enjoying the benefits of a taxi service but paying a fee that is closer to a bus ticket.

DRT grids would work best if they are integrated within each city, while individual participating companies can be responsible for different routes within the grid. Such a scheme could gain wide appeal both with work commuters and with school / afternoon lessons commuters, thus contributing to the de-congestion of urban areas and greater energy efficiency / lower carbon footprint per passenger transported.

Plugging the holes in pavement grids

Currently, opting to be a pedestrian in Cypriot urban areas is not a workable proposition, given that pavement grids are in most locations incomplete, or disjointed, or made impassable by the presence of parked cars and overgrowing vegetation, and other obstacles. This problematic situation is due to shortcomings in relevant rules and legislations, since the responsibility for developing pavements rests with the owners of individual properties to which the planned pavement would be adjacent. This may save some money for the state, but it also means that until an owner chooses to develop a plot – if ever – the pavement grid will display a gap adjacent to the undeveloped property.

To have a functional pavement grid, it is essential that planning offices take full responsibility for its development in accordance with a mobility strategy and in line with established quality standards [406]. Individual property owners can still be asked to cover the cost of the pavement network, since they would also stand to benefit, but this could take the form of a tax, levied on owners of adjacent properties as a pavement is being developed.

Once the mechanism is thus in place to control the quality and flow of pavement grids, then all sorts of possibilities can be considered: Including bicycle routes as well as pedestrian routes on the pavements, ensuring that cars will not be able to mount pavements, ensuring that overgrown vegetation does not block pedestrian or bicycle flow, ensuring access for individuals with limited mobility etc. Walking and cycling are both activities where the rule that "supply generates demand" very much applies.

4.5.3 Enhancing mobility to increase contact between the two communities

In the specific case of Cyprus, mobility issues are not only linked to sustainability concerns, but are an integral part of the Cyprus Problem. Even though some crossing points have been open since 2003, contact between the two communities remains low and is mostly limited to areas immediately adjacent to the crossing points. Thus, enhancing physical mobility between the two communities is a fundamental prerequisite for increasing contact and thus raising levels of trust between the two communities. In this regard, the following proposals are hereby submitted:

Planning for an island-wide road network

If Cyprus were to be united tomorrow, there would be severe problems in road circulation and especially highway / ring road connectivity. Just like the Nicosia Master Plan allowed joint planning of the road network for the centre of Nicosia, so could an island-wide mobility master plan allow joint planning for highways, ring roads, and the road network in general, with a view to being prepared for the day when there will no longer be a buffer zone limiting the mobility of citizens. The design process should not just be about connecting the grid, but also about establishing island-wide quality standards for better road safety.

[406] The Limassol Municipality tree-planting on pavements policy (http://www.limassolmunicipal.com.cy/trees/index.html) is a local authority initiative in the direction of improving the pavement grid. In the context of a mobility strategy such policies would need to be implemented at an island-wide level.

Multi-lingual road signs

Having road signs in both Greek and Turkish across the island was actually one of the proposals formally agreed by the inter-communal technical committees, tough it is as yet unclear when exactly this decision will be implemented. Indeed, when this measure is implemented it will have a very powerful impact on mobility levels island-wide. Currently, people who frequently cross to the other community resort to using maps with translated place names in order to find their bearings, given that the names that the 'other community' uses for villages, towns, and even large cities, bear little resemblance to any name by which the visitor could recognize such locations.

From a road safety viewpoint, it is important to ensure that the increased amount of information on road-signs does not lead to the distraction of drivers. A way to achieve this would be if for each language there is a specific background colour code, with which drivers will quickly become familiarized, thus quickly identifying the information that is relevant to them from such multi-lingual road signs.

A light rail island-wide network

The concept of a light rail network linking major towns in the south is already under consideration in the Greek Cypriot community. However, there are concerns that, initially at least, such an undertaking might be unprofitable financially.

If however such a light rail network is designed to include all major cities in Cyprus, starting with Nicosia-Lefkosa and from there branching out north towards Girne-Kyrenia, south towards Larnaca, west towards Limassol and east towards Gazimagusa-Famagusta, then the increased traffic by visitors from the other community could increase the overall financial viability of the project. Beyond the gains in terms of enhancing sustainability by reducing motorway passenger and freight traffic, such a light rail network would revolutionize inter-communal contact by creating opportunities to comfortably visit the other community well beyond the "usual suspect areas", in the vicinity of the crossing points.

For the light rail network to be successful, the location of city stations must be considered strategically. A way to maximize demand would be if the stations are located in the vicinity of major cities, close to large shopping malls and other such developments if their owners are willing to contribute financially, but then also linked with a tram or BRT service leading into the historic centre of each town.

4.5.4 Designing the future of mobility together

A Joint Transport Research Centre

A research centre for sustainable mobility issues, with participant researchers from both communities, would make a vital contribution in the process of further developing some of the above or other proposals for sustainable mobility, by collecting data and conducting studies that will inform the decision making process in the context of a cohesive Mobility Master Plan that can then be implemented by the appropriate authorities.

A Technical Committee for Mobility and Transportation issues

Such a technical committee , under the auspices of the leaders of the two communities, could supervise the implementation of an island-wide mobility master plan, especially in elements that will require close co-operation between the two communities, such as synchronizing the highway grid and developing an island-wide light rail network.

[407] The work proposed here could also be subsumed under an existing Technical Committee, if such an approach is seen as more practical and feasible

PART V

Conclusions and Recommendations

5.1 Catching Up with the Global Paradigm Shift: Some Critical Priorities

Over the last few decades, while the two communities in Cyprus have been pre-occupied with the complexities and challenges of their relationship and political future, the global community has quietly been undergoing a paradigm shift in social-economic affairs, at the centre of which has been the concept of sustainability. Initially as a response to the oil crises of the 1970s and 1980s, sustainable development has gradually grown to represent a comprehensive way of looking at the world and relating to resources.

While Cyprus can reasonably plead extenuating circumstances for not having been able to contribute so far to this global agenda, the time to act is now: A combination of unsustainable, inefficient and wasteful patterns of energy and resource use, with a total reliance on fossil fuels at an age when oil supplies might be peaking with producers becoming increasingly reluctant to share resources that they need for their growing populations, means that Cyprus and its economy are at a very precarious position – not to mention the obvious environmental and social effects of unsustainable development practices, that have long been having a negative impact on the island.

For many in Cyprus, it may seem that solving the long standing political dispute between the two communities is the central existential issue, on which everything else hinges and on which therefore all political efforts should be focused. Without wishing to minimize the significance of working to achieve a political settlement, we emphasize the point that achieving sustainability is also a critical issue, if the survival and wellbeing of both communities on this island is to be guaranteed in the long term. Moreover, the challenge of sustainability also represents an opportunity for the two communities to work together, in a set of issues in which more efficient and effective solutions can be achieved through inter-communal collaboration than through unilateral action. In the context of a peace process all too frequently dominated by confrontational and zero sum game narratives, the confidence building potential of working together and achieving demonstrable progress in sustainability related issues becomes both a need and an opportunity that should not be underestimated.

In the domain of energy sustainability, it is of vital importance for both communities to begin the transition to renewable energy sources, in a manner that is both dynamic and ambitious. Cyprus is extremely well situated, as a Mediterranean country within the EU, to further research and develop solar energy systems. CSP technology – concentrated solar power – is already mature, and it does hold the promise of not only covering Cyprus' electricity generation needs, but also contributing significantly to the resolution of Cyprus' chronic water shortage, as CSP technologies can produce desalinated water alongside the generation of electricity, all free from the use of fossil fuels. A CSP power plant, suitably located along the buffer zone near the coastline, is a potential pilot project of high symbolic and practical value, which the two communities could implement together.

Regarding water sustainability, it is essential to acknowledge the drastic impact on the climate of Cyprus that unsustainable water use practices – especially drilling from and depleting permanent aquifers – can have. In this regard, the emphasis should be placed on farming practices, which currently consume more than 70% of water supplies through inefficient watering methods and inappropriate, water-intensive choices of crops. To address these issues a participatory dialogue process is called for, which should include farmers, water experts and other appropriate stakeholders from both communities, leading to a comprehensive water strategy which adequately addresses the challenge of desertification.

Working towards sustainable construction practices is also a vital component of any sustainability strategy for Cyprus. Over-construction in both communities, coupled with unsustainable construction practices, has led to a sharp increase in energy bills and an equivalent decrease in quality of life. A first step to remedy this situation should be the commissioning of a sustainable construction planning guide, which would integrate international best practices with Cyprus' architectural traditions. This planning guide – to be designed by architects, engineers and other appropriate experts from both communities – would then serve as the basis of an incentive management policy, a public awareness campaign and a professional accreditation system, all geared towards the successful implementation of sustainable construction principles in Cyprus.

In the domain of sustainable mobility, it should be noted that both communities are still firmly in the grip of the private car culture. Addressing this challenge also offers significant opportunities for co-operation between the two communities: Most notably, ideas currently being explored separately in each community for a light rail system linking the various cities, could be incorporated into a broader vision for an island-wide light rail network, from Limassol to Famagusta and from Larnaca to Kyrenia. Beyond the sustainability benefits of such a proposal, the fact that an island-wide light rail network would sharply increase daily contact between members of the two communities, also argues in favour of its implementation.

5.2 Towards a Sustainable Development Master Plan for Cyprus

Finding ways and mechanisms to agree on and then jointly implement policies, has been a major challenge for the two communities of Cyprus ever since the 1960s. One successful example of co-operation between the two communities has been the 'Nicosia Master Plan' which has been developed and periodically refined by successive mayors of the Greek Cypriot and Turkish Cypriot municipalities of Nicosia. The Nicosia Master Plan has made it possible for Nicosia to continue growing over the years as one city despite the dividing line that geographically separates the city right down the middle. Essentially, the Nicosia Master Plan is a commonly agreed but separately implemented blueprint for development. As such, it sets an important precedent which can be applied to the broader challenge of a Sustainable Development blueprint for the whole of Cyprus. In other words, it may be possible to commonly agree but separately implement a comprehensive and integrated Sustainable Development strategy for Cyprus, even under the current circumstances of division.

Specifically it is proposed that a suitably mandated technical committee [408], under the auspices of the two leaders, could serve as the central coordinating body responsible for the design of such a Sustainable Development Master Plan, in much the same way as the meetings of the Nicosia mayors and their teams have produced the Nicosia Master Plan. Once the Sustainable Development Master Plan has been designed, each community would be separately responsible to implement it through its own appropriate departments and authorities. If in the mean time a political settlement is reached, responsibility for the implementation of the Sustainable Development Master Plan will be transferred to the Federal government and the Constituent states.

Issues and themes that a Sustainable Development Master Plan for Cyprus might cover, include:

- A comprehensive energy strategy for Cyprus, detailing the mix of conventional and renewable energy sources that are to be aimed for, coupled with reliable projections on future energy use patterns and methods to encourage energy efficiency and conservation.
- A comprehensive water strategy for Cyprus, which will include plans for the appropriate use and/or rehabilitation of all surface waters and aquifers, with reliable projections on future water use patterns, administrative reforms to integrate water management systems within each community, and a plan to increase sustainable water supplies while avoiding waste at all levels.
- A comprehensive strategy for sustainable construction that will address issues of motivation, awareness and expertise in relation to sustainable construction practices, while instigating specific urban-level pilot projects as a way of showcasing the potential of sustainable construction and building up relevant know-how.
- A comprehensive strategy for sustainable mobility, that will on the one hand establish guidelines for intra-city mobility with a special emphasis on pedestrianization and the use of bicycles, whilst at an inter-city level ensuring compatibility across the two communities of the secondary road, ring road, and motorway networks even as an island-wide light rail network is being designed.

[408] The already functioning "Inter-Communal Technical Committee on the Environment" might, with appropriate modifications, be a suitable vehicle for the design of a Sustainable Development Master Plan for Cyprus.