Knowledge, Sustainability, and Corporate Strategies[1]

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1. Introduction: Corporate Social Responsibility Documents on Knowledge Production

Knowledge matters in the official declarations of the political bodies of the European Union and the European governments as well as the mission statements of large corporations. Although, these public statements – like „[k]nowledge and innovation are the beating heart of European growth," „[i]n advanced economies such as the EU, knowledge, meaning R&D, innovation and education, is a key driver of productivity growth," „[i]nvesting in the knowledge should increase the capacity of the EU to innovate and to produce and use new technologies,"[2] „BP is progressive, responsible, innovative and performance driven,"[3] „E.ON is committed to being a driving force in shaping a sustainable energy future,"[4] and so forth – do not necessarily bring about the reorientation of the national research and development policy of the EU member states, or the redeployment of the budgetary priorities of large corporations.

Briefly, there is an enormous gap between these public statements and the actual policy followed by the EU member states and the European large corporations. While the public awareness of the environmental issues is growing, the long-term ecological impacts of the massive reliance on nonrenewable energy sources are acknowledged, and laws, codes of practices, international treaties and conferences concerning sustainable development are copious the public and private R&D expenditures in the energy sector in terms of GDP and corporate revenues have been shrinking in Europe for decades.

Despite the common conviction that there are technological solutions to solve or at least mitigate our energy and environmental problems, knowledge and information concerning energy-related researches are not particularly considered in a comprehensive way; for example, what kinds of knowledge; whose knowledge and information; the acquisition, possession of or exclusion from knowledge and information; the social, economic and cultural preconditions of the invention of new knowledge; the control and monopolization of knowledge and information; the perplexity of differentiation between robust and fallible knowledge; the positive and negative externalities of knowledge on the environment, the economy and society; productive versus destructive knowledge; and the latter's detrimental effect on society and so on. Knowledge in a knowledge-based economy and society is simply regarded as the calculated, unproblematic and effective use of its different – epistemic, technical and practical – manifestations, whose validity claims are robust and well-founded. A knowledge-based economy as the result of the production, use and distribution of more and more knowledge and information is supposed to operate as a self-contained autopoietic system. With respect to social and economic development, knowledge and information are generally assumed to improve economic and social circumstances by creating new resources of growth and increasing overall social welfare. Since knowledge and information

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[2] Communication to the Spring European Council, Working together for growth and jobs: A new start for the Lisbon Strategy, Brussels, COM (2005) 24, 4, 21, 30.

[3] BP Sustainability Review, 2009

[4] E.ON Company Report: Annual Report, 2009

appear to generate huge positive externalities, their importance in production processes and social formation is believed to stand firmly without further qualification.

As a result of this belief, there is very little discussion about the significance of knowledge, information, innovation and R&D in corporate business strategies in the basic international documents of corporate social responsibility. The EU Green Paper (2001) merely quotes the political declarations of the Lisbon European Council without providing standards and benchmarks for evaluating corporate performance or stipulating the social and political expectations of the corporate engagements in the production, use and dissemination of knowledge and information.[5] Sustainability is neither considered in the context of the accumulation, distribution and effective utilization of intellectual capital and knowledge assets, nor the environmental consequences of faster economic growth. Meanwhile, the scope and dimension of corporate social responsibility for working conditions, human rights and environmental issues are quite clearly defined a result of extensive government regulations, the commitments of many business organizations, and the evolving civic participation in lawmaking processes and monitoring of corporate compliance with the rules and standards of business conduct. The corporate role of intellectual capital formation on behalf of the whole society is far from being settled, and the relationship between public and private knowledge is at stake.

The Global Reporting Initiative's (GRI's) Sustainability Reporting Guidelines (2000–2006) stress that the intangible assets such as intellectual capital, innovative ability and investment in R&D have paramount importance for measuring and depicting the value, sustainability and financial prospects of a company; however, they do not rank the production, use and dissemination of knowledge, technology and innovation among the major performance indicators of the productive capacity of corporations. While intellectual capital and knowledge assets are the main sources of the value creation processes, the GRI's Sustainability Reporting Guidelines do not imply any determination of the appropriate level of corporate expenditure on innovation, technology, R&D, or non-financial indicators and support mechanisms for intellectual capital formation. They merely go into details about how to give account of investment grants and R&D grants incurred by government in the economic report of a company. The other elements of intangible assets that are also supposed to be important resources of knowledge economy are not particularly specified.[6]

In a similar manner to the above-mentioned documents, the 2000 revision of the OECD Guidelines for Multinational Enterprises also sets the general principles and makes official declarations in Chapter VIII concerning the R&D activities of multinational corporations for the purpose of improving the innovative capacities of the host countries, and of contributing to their long-term development prospects, and science and technology policies. The OECD Guidelines set out the institutional and procedural mechanism for the investigation of the implementation of these principles. They assign authority to the newly created governmental offices of the OECD member states – the National Contact Points (NCPs) – to supervise and promote the adherence of multinational corporations to the OECD Guidelines. The NCPs are entitled to investigate individual cases, to impose sanctions for non-compliance, and to submit an annual report on their activities to the OECD's Investment Committee. However, the OECD Guidelines do not contain any standards or benchmarks, and fail to specify what would be the proper measures – territorial, sector, size, activity-specific and so on – for compliance. It is hardly surprising that there has not been any sign of communication, analysis, investigation or action carried out by the National Contact Points concerning the implementation of the principles and standards elucidated in Chapter VIII: Science and Technology since 2000. While a few cases have been investigated because of alleged breaches of

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[5] Commission of the European Union, *Promoting A European Framework for Corporate Social Responsibility: Green Paper*, Luxembourg: Office for Official Publications of the European Communities, 2001.
[6] Global Reporting Initiative, *Sustainability Reporting Guidelines*, Ver.1-3. (Boston, MA-Amsterdam: GRI, 2000-2006)

various chapters of the OECD Guidelines, corporate compliance with Chapter VIII has not yet been scrutinized.[7]

The lack of a complete enumeration of performance indicators relating to knowledge assets and intellectual capital formation, and their impacts on social welfare, shed light upon theoretical and methodological difficulties. For the reason that intellectual capital and knowledge assets are regarded as a mixture of heterogeneous – narrative and quantifiable – elements in the process of corporate value creation; for example, R&D, information and communications, intellectual property rights, patent portfolios, securities, trademarks and brand names, corporate and managerial culture, human resources, employee training and education, and other kinds of intangible assets that do not depend on physical embodiments, they are susceptible to different interpretations that cause further conceptual ambiguities and quantitative uncertainties. They also frequently lead to the inaccurate description of the economic realities and prospects of corporations.[8]

In addition to the above-mentioned theoretical and methodological difficulties of measuring and evaluating private and public investments in intellectual capital and knowledge assets, many experts discuss critically the effectiveness of the voluntary principles and vague standards of these political documents for responsible business conduct in the formation of corporate business strategies and economic decision-making.[9] They are convinced that the positive impacts of policy statements, legally not binding principles and standards on corporate practices are negligible. In brief, policy statements, at most, reflect the political commitments of governments and international political bodies, which may appeal to the public but do not boost private investment in knowledge and information. Few corporations are inclined to incorporate noble social aims into their business strategies if they do not serve their short-term economic interests and payoffs. To determine the veracity of this skeptical view, we shall examine the impacts of the normative pronouncements of these documents on both governmental and corporate strategies and decision-making processes concerning the formation of a knowledge-based economy and society.

2. The European Performance on Knowledge Production before and in Time of Economic Downturn

In spite of the favorable and unique economic climate for social and economic development, the overall economic performance of the EU member states and the European corporations remained meager during the 1990s. Meanwhile, a few EU countries – especially Finland, Sweden, Denmark and the United Kingdom – were able to keep pace with the high level of labor productivity and capital intensity growth of the United States, the majority of the EU member states failed to follow the growth patterns of the most dynamic countries and experienced a persistent economic slowdown from the beginning of the 1990s.

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[7] *The OECD Guidelines for Multinational Enterprises: Text, Commentary and Clarifications*, (Paris: OECD, 2001); OECD Watch, *Five Years On: A Review of the OECD Guidelines and National Contact Points*, (Amsterdam: SOMO - Centre for Research on Multinational Corporations, 2005) 52.

[8] Olufunmilayo B. Arewa, „Measuring and Representing the Knowledge Economy: Accounting for Economic Reality under the Intangibles Paradigm”, *Buffalo Law Review,* 54, 1, May (2006) 66-79.; Margaret M. Blair and Steven M. H. Wallman, *Unseen Wealth: Report of the Brookings Task Force on Intangibles*, (Washington, D.C.: Brookings Institution Press, 2001); Clark Eustace, *The Intangible Economy: Impact and Policy Issues, Report of the European High-Level Expert Group on the Intangible Economy,* (Brussels: the Commission of the European Communities, 2000); Baruch Lev, *Intangibles: Measurement, Management, and Reporting*, (Washington, D.C.: Brookings Institution Press 2001)

[9] David Barnhizer, „Waking from Sustainability's 'Impossible Dream': The Decision-making Realities of Business and Government”, *Georgetown International Environmental Law Review*, Vol. XVIII Issue 4 (Summer 2006)

The impressive figures of overall economic capital intensity and productivity growth as well as the low levels of unemployment and inflation in the United States were generally attributed to the positive spillover effects of the spread and use of the new information and communication technologies in all segments of economic and social activities which continuously opened up new business opportunities for further technological investments, new products and services, and a higher potential for profit. While the exceptional constellation of the high rates of labor productivity and capital intensity growth as well as the declining rate of unemployment and inflation in the United States during the 1990s recently went through a critical re-examination, the majority of the EU member states were unable to shift their economic and human resources from traditional and medium-level manufacturing industries to high productivity, knowledge-intensive sectors of the economy and to set up a proper institutional structure for managing this economic and social transformation.[10] Additionally, aggregate corporate spending on R&D declined in most of the EU member states during the 1990s. Thus capital intensity and labor productivity growth remained stagnant and declining, with a slight increase in the rate of employment, which caused an additional decline in labor productivity in Europe.[11] As a result of their relatively weak capacity to innovate and the less efficient use of capital and labor in production processes, the majority of EU member states and corporations could not capitalize effectively on the emergence and diffusion of the new information and communication technologies. In the context of ambitious political statements made regularly by the European policy-makers about the outstanding importance of the knowledge production, use and dissemination for future growth and social welfare, the decennial downturn of public and private R&D expenditures accelerated from 1991 was particularly disappointing. As a result of misguided economic and R&D policies, the productivity gap between the United States and the EU member states widened further during the 1990s.

The persistent divergence between the economic performances of the United States and the majority of the EU member states during the 1990s was the core reason why the Lisbon European Council of 23–24 March 2000 initiated a comprehensive economic and social policy reform for the recent decade. The poor performance of the European economy appeared to mobilize and unite the European policy-makers to act. The Presidency Conclusions enumerated some obvious (and less obvious) social, economic and institutional instruments – such as tax allowances for private investment in R&D; financial assistance and other preferential treatment for innovative enterprises; removing obstacles to the mobility of researchers; community-wide patent protection and European patent office; an efficient intellectual property rights regime and management; fostering a European network for electronic scientific communications; promoting joint research projects between business enterprises, universities and other public research centers and so on – which were supposed to be the important factors of the production, use and dissemination of knowledge; however, it did not set down specific targets regarding overall R&D expenditure in terms of GDP. The European Union and the national governments regularly appeal to the European business community to increase its private contribution to innovation and R&D in order to create a knowledge-based economy and society. Because knowledge and information are the preconditions for fostering a democratic culture as well as a sustainable economy, they regard a knowledge-based economy and society as the outcome of the joint efforts of business and society at large.

Two years after Lisbon, the Barcelona Summit indicated an exact figure of public and private expenditure on R&D for the EU member states. According to the Presidency Conclusions of the Barcelona

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[10] Alberto Alesina and Roberto Perotti, „The European Union: A Politically Incorrect View", *Journal of Economic Perspectives*, Vol. 18. (2004) 4, Fall, 27-48.; Moses Abramovitz and Paul A. David, *Two Centuries of American Macroeconomic Growth From Exploitation of Resource Abundance to Knowledge-Driven Development*, SIEPR Discussion Paper No. 01-05 (2001); Robert Brenner, *The Boom and the Bubble: The US in the World Economy*, (London: Verso Press, 2002)

[11] Kieran Mc Morrow and Roger Werner, „An Analysis of EU Growth Trends, with A Particular Focus on Germany, France, Italy and the UK", *National Institute Economic Review*, No. 199 (2007) 82-98.

European Council of 15 and 16 March 2002, „[i]n order to close the gap between the EU and its major competitors, there must be a significant boost of the overall R&D and innovation effort in the Union, with a particular emphasis on frontier technologies. The European Council therefore […] agrees that overall spending on R&D and innovation in the Union should be increased with the aim of approaching 3 per cent of GDP by 2010. Two-thirds of this new investment should come from the private sector."[12]

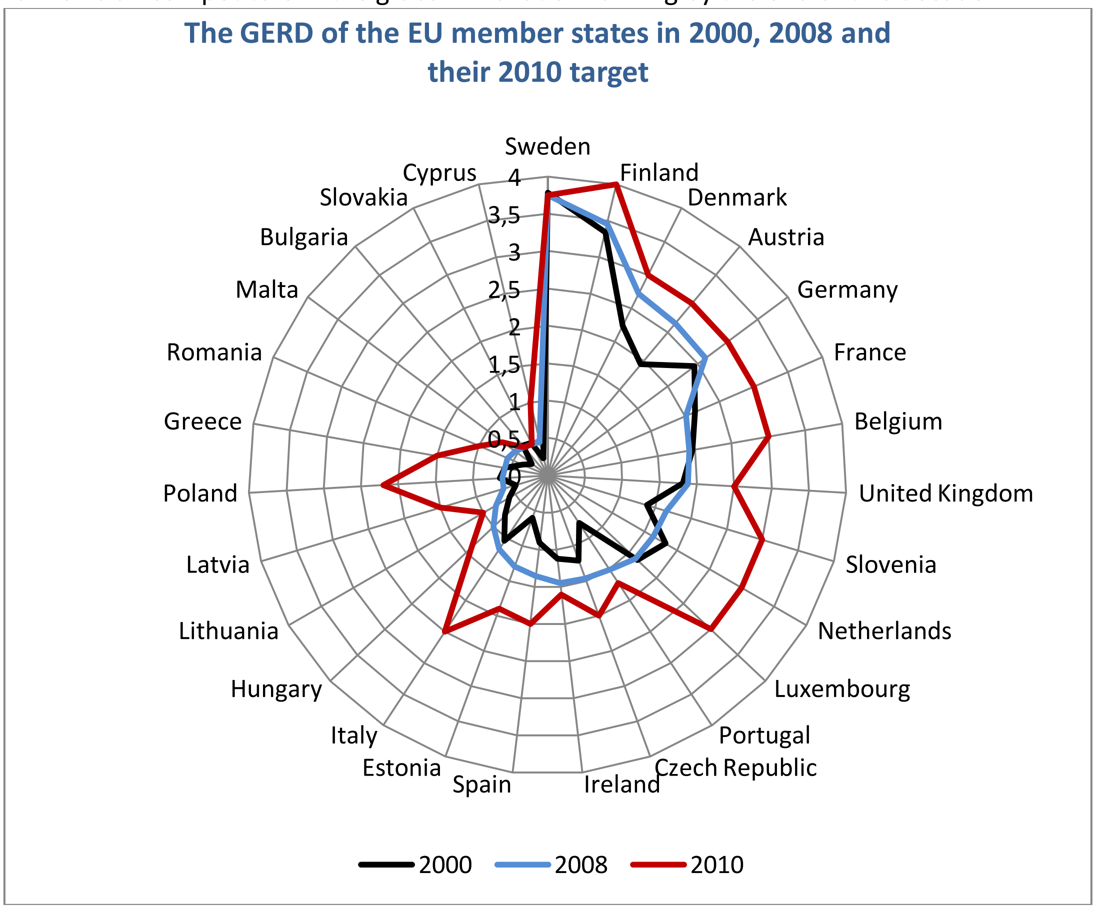
The Lisbon Strategy could not bring about any noticeable change in the European innovation landscape, indeed. While, the most innovative countries, like Sweden and Finland, have managed to keep and advance their distinguished position, and few countries, like Austria, Denmark, Portugal and Estonia, have made considerable efforts to improve their overall research and development intensity, the mediocre and feeble positions of the majority of the EU member states have remained unchanged in the global ranking of innovation performance since 2000. In 2007 the gross domestic research and development expenditure of the EU-15 was exactly as low as it had been in 2000 that is 1.91 per cent in terms of GDP. The research and development intensity was reduced in France, the United Kingdom, Belgium, the Netherlands, Luxembourg, Greece, Poland, Slovakia and Bulgaria during the same period. Compared to the OECD average of 2.276 per cent of research and development expenditure in terms of GDP, the EU-15 is also outperformed by a significant margin in 2007 because of the higher research and development intensity of the most dynamic global competitors. In addition, the research and development intensity of a few non-OECD economies, like Israel's, Singapore's, and Taiwan's, is substantially above the OECD average. Particularly high rate of economic growth was not matched up to comparable high increase in research and development intensity in countries which have shown very impressive economic performance in the recent decade. Starting from a very low base of innovation performance, the figures of public and private research and development intensity have shown certain improvement in some of the new EU member states, like the Czech Republic and Estonia, since their accession, but due to the modest size of their annual GDP and the wide gap of innovation, research and development intensity between the EU-15 and the EU-10 it was not enough to make any statistically significant impact on the stalled trends of the EU-27.

In any case, the 3 per cent of public and private research and development expenditures in terms of GDP would not be sufficient to declare in 2010 that the European Union is the most competitive and dynamic knowledge-based economy in the world unless the research and development performance of the most innovative global competitors remains stagnant or even declining in the coming years. The Lisbon strategy simply disregarded the fact that there are quite a few countries among the global competitors like South Korea, Taiwan, and Singapore were close to approach the 3 per cent research and development expenditures during the first decade of 2000, and they have had good opportunity to reach and surpass it by 2010. For instance, South Korea's gross domestic expenditure on research and development has already exceeded 3 per cent of GDP in 2006, and it aims at increasing its public and private research and development expenditures to 5 per cent of GDP by 2012. Israel also plans to maintain 5 per cent research and development expenditure in terms of GDP for the coming years.[13] In addition, China more than doubled its research and development expenditures from 0.6 per cent to 1.44 per cent of GDP from 1995 to 2007. The Chinese governments intends to increase research and development intensity to 2 per cent of GDP by 2010 which means that China will catch up with and outmatch the EU-27 by the end of the present decade if the governments of the EU member states and the European business

[12] Presidency Conclusions: Barcelona European Council on 15 and 16 March 2002, para 47.

[13] *Israel 2028: Vision and Strategy for Economy and Society in a Global World*, Ed. by David Brodet, US - Israel Science and Technology Foundation, 2008, 132.

community fail to take a more knowledge-driven growth path in the near future.[14] Be that as it may, long-term economic forecasts and analyses have not indicated the probability of the long-term stagnant or even declining research and development performance of the global competitors of the European Union, yet. Therefore, it would have been more pragmatic to announce that the European Union makes all efforts to catch up with the research and development intensity of the most innovative countries, like Israel, Sweden, Finland, Japan, South Korea, Iceland, the United States, Switzerland, Taiwan and Singapore. For sure, if the recent trends continue the European Union will lose its position to China and the most dynamic Asian competitors in the global innovation ranking by the end of this decade.



Recently, the European Commission reasserts the outstanding importance of the increase of public and private research and development expenditures and recommends the countercyclical investment strategy in time of economic crisis in its European Economic Recovery Plan issued on 26 November 2008. [15] Nevertheless, endogenous growth theory demonstrates that the optimal path for innovation is countercyclical for the countries where the firms face tight credit constraints due to the financial crisis. However, there is no conclusive view in the economic literature about the genuine public and corporate research and development strategy which would be valid for all of the countries and of the enterprises in

[14] *OECD Reviews of Innovation Policy: China*, Paris: OECD Publications, 2008, 111.; Minder, Raphael (2005) „EU fears China's rising R&D spending", Financial Times, October 9 2005 22:00; Laitner, Sarah (2007) „China closes in on Europe's R&D spending", Financial Times, June 11 2007 19:19

[15] Communication from the Commission to the European Council. *A European Economic Recovery Plan.* COM(2008) 800 final, Brussels, 26.11.2008.; For the legal basis of the statement of the European Commission see Consolidated Versions of the Treaty on European Union and the Treaty on The Functioning of the European Union, Brussels, 15 April 2008, 6655/08, 441-442.; See also IMF (2009) „Can Policies Play a Useful Counter-cyclical Role?" In. *World Economic Outlook April 2009: Crisis and Recovery*, IMF: Washington, D.C. 113-123.

time of economic crisis: the question is whether the governments and the business enterprises should choose a procyclical or a countercyclical path of investment strategy. In theory, countercyclical budgeting and macroeconomic policy would be desirable to bring under the control of booms and busts in the economy and to undertake countercyclical fiscal measures in the fields of innovation, research and development, especially, in time of economic crisis in order to keep up and reallocate human and economic resources for the future development.[16] Therefore, it is not so difficult to give a definite answer to this question if we are aware of the fact that discounting the future economic and social development of a country or the long-term economic prospect of a corporation is not particularly creative idea. To economize on the investment costs of producing new knowledge for the future is not only a shortsighted business and public policy, due mainly to the failure of reallocating limited resources to the most productive uses and of taking advantage of lower opportunity costs of diverting more resources from production to research and development activities in time of economic downturn, but it exhibits an unfair distribution of human and economic resources from the point of view of inter- as well as intragenerational equity. For the above-mentioned reasons, the Schumpeterian growth theory is all about the countercyclical investment strategy of the countries and the corporations in innovation, research and development; it provides the foundation of dynamic economic system.

Some current economic surveys conjecture an optimistic outlook concerning the behavior of the most innovative, leading-edge enterprises; the majority of them rather endeavor to increase or at least sustain their research and development activities in order to strengthen their competitive advantages in the forthcoming upturn than to hibernate or take some defensive strategy through the recent downturn.[17] In opposition to these optimistic views on the behavior of the large corporations, the recent quarterly reports of the publicly traded corporations in US stock markets signal a procyclical trend. The current survey of 2097 large publicly traded corporations shows that the corporate research and development expenditures are significantly reduced in the first quarters of 2009. The decline of corporate research and development spending is especially apparent in semiconductor industry, information and communication technologies and services which are generally grouped into high and medium high research and development intensive sectors.[18] While, it is quite obvious that the countercyclical behavior of the firms and the governments in the fields of innovation, research and development would be beneficial due to its long-term positive impact on corporate performance as well as the economic and social development of the countries; it is particularly difficult to implement this countercyclical strategy in time of tight credit and budgetary constraints.[19]

To sum up, the theoretical arguments for the long-term advantages of countercyclical investment strategy in innovation, research and development are sound and quite convincing. In time of economic crisis, as Philippe Aghion states, „…a natural prediction is that the lower the level of financial development, that is, the tighter the credit constraints faced by firms, the more growth-enhancing such

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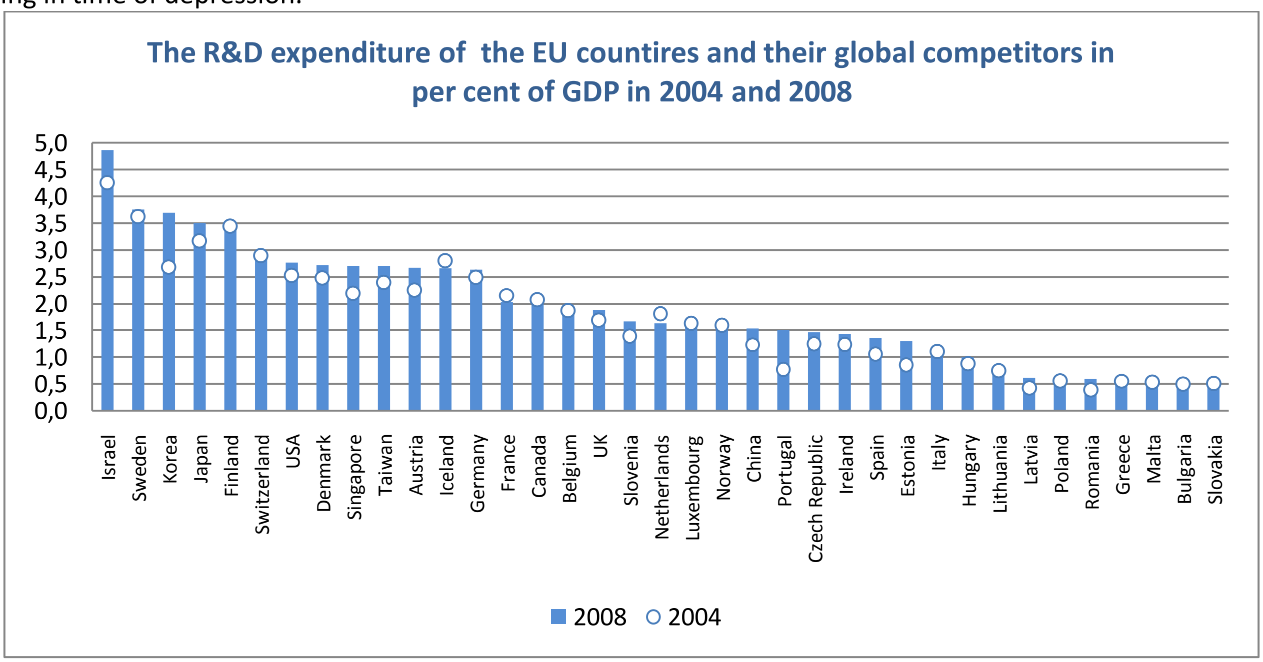
[16] Bradley, Bill et al. (2009) „The Crisis and How to Deal with It”, *The New York Review of Books*, Vol. 56, Nr 10, June 11; Baumol, William J. and Alan S. Blinder (2009) *Economics: Principles and Policy,* 11th Ed. Mason, OH: Thomson South-Western, 345-349.

[17] Chuck Frey and Renee Hopkins Callahan, *Innovation Strategies for the Global Recession: A Special Report, InnovationTools.com and Innosight*, December 8, 2008.; Charles Leadbeater and James Meadway, *Attacking the Recession: How Innovation Can Fight the Downturn,* NESTA Discussion Paper: December 2008 ; *Innobarometer 2009: Analytical Report, conducted by the Gallup Organization upon the request of DG Enterprise and Industry*, Flash Eurobarometer Series #267, May 2009.

[18] *OECD Science, Technology and Industry Scoreboard 2009*, Paris: OECD, 2009. 22-23.

[19] Peter Voigt and Pietro Moncada Paternò Castello, *The global economic and financial downturn: What does it imply for firms' R&D strategies?* IPTS Working Paper on Corporate R&D and Innovation, No. 12/2009, 19-24.

countercyclical policies should be."[20] However, the empirical evidence attests that neither the majority of the EU member states, nor the European enterprises follow the Schumpeterian growth model in their research and development investment strategy for the future development. The Schumpeterian model of strategic adaptation under recession appears to be the exception rather than the rule among the European business enterprises and the EU member states. The behavior of the majority of the EU member states as well as the European enterprises is patently procyclical, that is to say, they usually invest a bit more in time of economic upturn, and less in time of economic downturn in innovation, research and development which will presumably widen or at most keep up the innovation gap between them and their most innovative global competitors if the latter choose countercyclical investment strategy. A recently published IMF study also demonstrates that the procyclicality of government expenditure in the new EU member states, especially, Hungary, Romania, Lithuania and Latvia between 2003 and 2007 reduces their ability and fiscal space for countercyclical fiscal policy to get out of the downturn.[21] After all, the countercyclical behavior seems to be the privilege of the most innovative enterprises as well as the most innovative countries in order to create and ensure their position in new markets and generate competitive advantage for the forthcoming upturn. In the last decade, only the most innovative EU member states, Sweden, Finland and Denmark (and Ireland) could produce considerable amount of budget surplus and keep their public debt ratios quite low which provide financial sources for maneuvering in time of depression.



Therefore, regarding the stalled public and private research and development expenditures of the majority of the EU-27 between 2000 and 2008, it is hard to figure out the countercyclical behaviors of the European business enterprises and the governments in order to spur economic recovery and accommodate in this way to the forthcoming upturn. In most countries and most European corporations, the public and private budgets seem to be kept too tie to realize any significant change in innovation, research and development policy for the future development. Although a profound economic transformation toward knowledge-driven and high-technology industries and structural reforms in different poli-

[20] Aghion, P. (2006) „Interaction Effects in the Relationship between Growth and Finance", *Capitalism and Society,* 1(1), Art. 2. 17.
[21] Rahman, Jesmin (2010) *Absorption Boom and Fiscal Stance: What Lies Ahead in Eastern Europe?* IMF Working Paper, WP/10/97

cy domains are even more compelling in time of recession. Up to now, the expanded roles of the governments of the EU member states have been rather manifested in short-term countercyclical economic measures to mitigate the direct and immediate consequences of the economic crisis, particularly, in the banking sector and automotive industry than in long-term fiscal projections on behalf of the future growth and prosperity. The distribution of public spending in many EU member states has displayed long-term rigidity and the lack of willingness to bring about dynamic change in the composition of budget and macroeconomic policy in order to give an impulse to innovation, research and development before and after Lisbon. In spite of the recommendations of the European Commission, the governments in a few EU member states have already announced the intention of cutting down on the public research and development expenditures as well as higher education spending for the 2010 and 2011 budgetary years, therefore, it is not early to predict even on the basis of scattered data, uncertain political projects, and newspaper articles that the majority of the EU governments under the pressure of enormous budget deficit, public and private debt burden, and zero or negative economic growth are forced to follow procyclical investment strategy in this policy domain.[22] For sure, public and private innovation, research and development expenditures will not remain intact after the procyclical retrenchment measures of the governments of the EU member states. Procyclical innovation, research and development policy will result that convergence in terms of income per capita between the high and the low research and development intensive EU member states, especially, the new EU member states, will be presumably impeded even after the economic recovery begins. The economic recovery will bring about further concentration of research and development activity across Europe and increase regional differences on behalf of the most innovative countries. In the long run, the lack of the adaptation of innovation-enhancing strategy, low research and development intensity, and the recent cut down on the investment costs of innovation, research and development and higher education budget condemn the economy of these countries to a nonconvergence trap. Without the fundamental changes in the distribution of economic resources, economic structure, policy objectives, institutions and education system the new EU member states will not be able to reduce their distance to the global innovation frontier in the coming years.[23]

The European Commission also outlines a particularized innovation strategy of the future for the governments of the EU member states as well as the European corporations. In *A European Economic Recovery Plan* (2008), the European Commission opts for the reallocation of public and private research and development expenditures, above all, to the energy, automotive, construction, and manufacturing sectors which are supposed to bring about a major structural transformation towards the low carbon or green economy in the near future. Interestingly, energy, construction and materials, and manufacturing sectors belong to the low and medium research and development intensive sectors in Europe. The research and development expenditures of the largest European corporations in terms of revenues are 0.2-0.6%, 0.5%, and 2.6%, respectively, which are by and large lower figures than their global competitors'. While, the European automobile industry has considerable competitive advantages with its 4.6% research and development expenditures in comparison to its global competitors. Phrasing the Schumpete-

[22] Curtis, Polly (2009) „'Pointless' university studies to be weeded out by new government panel", The Guardian, Wednesday 23 September, 4.; Shepherd, Jessica (2010) „Universities tell Gordon Brown: cuts will bring us to our knees", The Guardian, Monday 11 January.; Kitching, John et al. (2009) *Business Strategies and Performance during Difficult Economic Conditions*, URN 09/1031, 17-18., 23.; Theil, Stefan (2008) „'It Doesn't Exist!' Germany's outspoken finance minister on the hopeless search for 'the Great Rescue Plan'", *Newsweek*, Dec 15, 2008.; Le Billon, Véronique (2009) „Le grand emprunt Sarkozy ne sera lancé qu'en 2010", *LesEchos.fr*, 29/06/09; Schaeffer, Frederic (2009) „Avec le grand emprunt, Nicolas Sarkozy veut réussir l'après-crise", *LesEchos.fr*, 15/12/09 ; Les dépenses de l'Etat «gelées» en 2011, 2012 et 2013, *Liberation.fr*, 06/05/2010.

[23] Acemoglu, D., P. Aghion and F. Zilibotti (2006), „Distance to Frontier, Selection, and Economic Growth", Journal of the European Economic Association, 4(1), 37-74.; Aghion, P. and P. Howitt (2006), „Appropriate Growth Policy: An Integrating Framework", *Journal of the European Economic Association*, Vol. 4, 269-314.

rian fear, the European Commission undertakes to chart the uncharted seas of technological possibilities for the future development.[24] In the above-mentioned and other recent official documents of the European Union, there are fewer talks about knowledge-based economy, and generally the social preconditions of the production, use, and distribution of knowledge in society; the notions of the low carbon economy and green economy seem to be substituted for these former catchwords as if those would have fallen out of fashion. In this way, the dynamic transformation toward a green economy seems to be rather technological than social process directed by committees and experts. Even though, making a breakthrough in greening the European economy mainly relies on the change of a way of life on a scale which presumes the basic alteration of long-term social and economic objectives.[25] However, the Lisbon Strategy does not imply this profound alteration.

3. Knowledge, Innovation and Corporate Strategies in the Energy Sector

In this section we shall take a closer look at the energy sector and examine its R&D activities. The energy sector was selected for the reason that the corporations of the energy sector should take a particular responsibility for offsetting the long-term impacts of the intensive exploitations of the scarce natural resources on the natural environment and the welfare of the future generations by using their capacity, financial means and expertise for the development and proliferation of new, clean technologies. In addition, as it was argued in *A European Economic Recovery Plan* (2008), the energy sector should promote green technologies and the development of energy-efficient systems.

Humanity is facing a major challenge at present: that of climate change. The rising global temperature may, already in the twenty-first century, cause major restructuring of the global climate, including the distribution of rainfall, the wind direction and the ocean currents. The medium-term and in particular the long-term consequences of climate change are uncertain, but even conservative predictions forecast substantial economic losses and dramatic social effects caused by a rising sea level, accelerated desertification, and other ecological damage caused by altered weather conditions.[26] On the more radical side, some experts, such as world-famous biologist James Lovelock, argue that climate change is virtually impossible to stop and that it will soon cause a major catastrophe for humanity as a whole.[27]

The mainstream scientific position, as reflected in the Intergovernmental Panel on Climate Change (IPCC) report or the Stern Review, holds, however, that climate change can be stopped and its effects managed – but this needs immediate action from governments, businesses and people all around the world, since climate change is proved to be caused by human activities. According to IPCC estimates, the atmospheric greenhouse gas (GHG) concentration is some 35 per cent higher than it was in pre-industrial times. The atmospheric concentrations of CO2 and CH4 now exceed by far the natural range in place over the past 650,000 years. Global increases in CO2 concentration are primarily the result of fossil fuel use. In order to stop a global temperature rise of around 2°C, projections imply that global GHG emissions should peak at some point before the year 2020, and after this a steady decrease of 1–5 per cent per year will be necessary. According to the Stern Review, this would cost approximately 1 per cent

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[24] Joseph A. Schumpeter, *Capitalism, Socialism and Democracy*, 3rd ed. (New York: Harper and Row Publishers, 1950) 118.

[25] As Lars Josefsson, the CEO of Vattenfall, put it: the change in the use of clean and renewable energy sources „…is not a question of money or technology. It requires a redesign of society." Quoted by Fischetti, Mark (2009) A report from the M.I.T. Energy Conference The future of clean energy is... coal? Scientific American, Mar 9, 2009

[26] Like the IPCC's (Intergovernmental Panel on Climate Change) *Fourth Assessment Report* (downloadable from www.ipcc.org), or the *Stern Review on the Economics of Climate Change* by Nicholas Stern, (London: HM Treasury, 2007).

[27] Jeff Goodell, „The Prophet of Climate Change: James Lovelock", *Rolling Stone Magazine*, November 1, (2007).

of global GDP – an important, but affordable, amount, which is much lower than the possible losses and damage caused as a result of climate change. However, given the time needed for developing and adapting new – or already existing, but so far not widely applied – technologies, effective policies must be put in place now.

Currently, energy-related GHG emissions, mainly from fossil fuel combustion for heat supply, electricity generation and transport, account for around 70 per cent of total emissions, including carbon dioxide, methane and some traces of nitrous oxide. Since both the supply of and the demand for energy is still increasing, fighting climate change urgently needs substantial changes in the production and the use of energy. According to the Stern Review, without the rapid introduction of supportive and effective policy actions by governments, energy related GHG emissions, mainly from fossil fuel combustion, are projected to rise by over 50 per cent by 2030. Energy efficient technologies and clean energy production methods should be developed further, and renewable energy sources must play an increasing role in supplying much-needed energy. But also, carbon dioxide capture and storage technologies should be developed alongside these and used to reduce the present atmospheric GHG concentration.

Climate change alone would justify a great emphasis on intensive R&D in the energy sector. Energy R&D provides enormous leverage through its ability to furnish technologies that can reduce the costs of complying with emissions reduction and meeting atmospheric stabilization targets. For example, Jae Edmonds, James J. Dooley and Marshall A. Wise demonstrated in 1996 that deploying an advanced generation of cleaner energy technologies around the world would reduce the cost of stabilizing the atmosphere by more than two orders of magnitude over the course of twenty-first century.[28]

The European Commission's Strategic Working Group (SWOG) of the Advisory Group on Energy (AGE) made an even firmer declaration: „Although other instruments (such as taxes, subsidies or regulations) may be helpful, by accelerating market diffusion of recently developed energy technologies, SWOG believes that the only route to a sustainable energy system is through new or improved energy technologies that will have to be found through research and development".[29]

However, strangely enough, both public and private energy R&D expenditures have been steadily falling since the early 1980s in most of the developed countries. As James J. Dooley and Paul J. Runci pointed out: „The U.S. federal energy R&D program has fallen by 36% over the 1985–1998 period, a decline of more than U.S. $1.2 billion in real terms from the level in 1990. The energy R&D programs of the European Union declined at a similar rate, falling 37% in real terms over this same period. The deepest reductions were seen in Germany and the United Kingdom, where public investments in energy R&D fell in real terms by more than 73% and 88%, respectively, from 1985 to 1998. The Japanese government might represent the only bright spot, as its investments in energy R&D increased a very modest 1% over the course of this same 14-year period."[30] Since just nine OECD countries perform more than 95 per cent of the world's public sector energy R&D and, consequently, nearly all the world's long-term energy R&D. If these countries reduce their R&D efforts, this will have – without exaggeration – a gloomy effect on the world's energy future. The SWOG position paper argued that „[i]t is SWOG's firm conviction that it is

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[28] Jae Edmonds, James J. Dooley and Marshall A. Wise, „Atmospheric stabilization: The role of energy technology", In *Climate change policy, risk prioritization, and United States economic growth,* Eds. Charles E. Walker, Mark A. Bloomfield, and Margo Thorning, (Washington, DC: American Council for Capital Formation, 1996) 71-94.

[29] *Key Tasks for future European Energy R&D. A first set of recommendations for research and development by the Advisory Group on Energy*. Directorate-General for Research Sustainable Energy Systems, (Brussels: Euro-pean Communities, 2005), 9.

[30] James J. Dooley and Paul J. Runci, „Developing Nations, Energy R&D, and the Provision of a Planetary Public Good: A Long-Term Strategy for Addressing Climate Change", *Journal of Environment and Development,* 9(3), (2000), 215-229.

now reckless to maintain such a low level of energy R&D funding. It believes that the level should be restored in real terms to the levels of 25 years ago – that is, increased by at least a factor of four.”[31]

Since the start of the twenty-first century, after a drop in the 1990s, public energy R&D spending in most of the OECD countries, and particularly in the European Union, has more or less stabilized, but has not grown. This might be seen as a problem in itself – given the challenge of climate change – but also because public spending cannot offset the ever-falling private R&D budgets. (Whether public R&D expenditure can effectively substitute at all for the private one is another open question.) The European Commission at least recognizes the depth of the problem: „Under the 7th Framework Research Programme, annual spending on energy research over the next 7 years at EU level will increase by 50%, but even this will not provide the progress needed.”[32] Unlike public R&D expenditure, private spending did not stabilize after the 1990s and continued its downward trend through the 2000s. In the USA between 1980 and 2005, annual private R&D plummeted from USD 4 billion to USD 1 billion.[33] Major Japanese utility companies reduced their R&D spending by almost 30 per cent between 2000 and 2006.[34] In Europe energy companies significantly reduced their R&D spending in the 2000s. Alessandro Sterlacchini (2007) argues that between 2000 and 2006 a R&D spending reduction of close to 60 per cent happened in the case of the major European energy companies. Since their sales have practically been stagnating, the R&D intensity of these companies has also fallen by some 60 per cent. Olivier Grosse and Benoît Sévi reviewed a different group of companies, therefore they provide slightly different figures, but the downward trend is undisputable for them as well.[35]

This means billions of euros are lost for energy R&D. Sterlacchini’s and Grosse and Sévi’s studies omitted oil companies. Sterlacchini provided data about ENEL, ENI, EDF, RWE, E.ON, Suez-Energy and Gaz de France. Grosse and Sévi’s list included: ENEL, EDF, Gaz de France, Scottish Power, British Energy, Edison, Vattenfall, Norsk-Hydro, Union Fenosa, Areva, SUEZ, Scottish and Southern. The difficulties of obtaining reliable R&D data from companies is described by Dooley and Runci as follows: „The two principal reasons that private sector energy R&D data are hard to come by and interpret are that (a) often companies refuse to report these data, citing business confidentiality concerns, and (b) many national governments simply do not collect information on private sector investments in energy-related R&D.”[36] According to data, a number of large energy companies have stabilized or slightly increased their R&D spending on a very low level since 2007. Therefore, if we compare the average R&D spending of the

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[31] *Key Tasks for future European Energy R&D. A first set of recommendations for research and development by the Advisory Group on Energy*. Directorate-General for Research Sustainable Energy Systems, Brussels, 2005, p. 9.

[32] *An Energy Policy for Europe,* Communication from the Commission to the European Council and the Europe-an Parliament. Brussels, 10.1.2007, COM(2007) 1 final

[33] Danie M. Kammen, „The Rise of Renewable Energy”, *Scientific American*, Vol. 295, (2006) Issue 3.

[34] Alessandro Sterlacchini, „Minding the R&D drop of European utilities: relevance, explanations, remedies”, Paper presented at the International Conference on Innovation and Competition in the New Economy, Milan, May 4-5, 2007.

[35] Olivier Grosse and Benoît Sévi, *Déregulation et R&D dans le secteur énergetique européen*, Cahier N° 05.07.59, (Montpellier: CREDEN, 2005). Sterlacchini’s, Grosse and Sévi’s studies omitted oil companies. Sterlacchini provides data about ENEL, ENI, EDF, RWE, E.ON, Suez-Energy, and Gaz de France. Grosse and Sévi’s list includes: ENEL, EDF, Gaz de France, Scottish Power, British Energy, Edison, Vattenfall, Norsk-Hydro, Union Fe-nosa, Areva, SUEZ, Scottish and Southern. The difficulties of obtaining reliable R&D data from companies is de-scribed by James J. Dooley and Paul J. Runci (2000: 223) as follows: „The two principal reasons that private sec-tor energy R&D data are hard to come by and interpret are that (a) often companies refuse to report these data, citing business confidentiality concerns, and (b) many national governments simply do not collect information on private sector investments in energy-related R&D.”

[36] James J. Dooley and Paul J. Runci, „Developing Nations, Energy R&D, and the Provision of a Planetary Public Good: A Long-Term Strategy for Addressing Climate Change”, *Journal of Environment and Development,* 9(3), (2000), 223.

companies reviewed by Sterlacchini (2007) for the years 2007–8 to the data of the beginning of the decade, the drop is only about 17 per cent. However, this still means that the R&D intensity of major European energy companies has fallen by almost 50 per cent.

The 2008 EU R&D Investment Scoreboard also stresses that since 2007, some large companies in the energy field showed high annual R&D growth rates, and increasing their R&D investment. For example, AREVA increased its R&D expenditure by 1.7 times over this period. Even higher growth rates are found among some companies in the field of alternative energies. In wind technology, Vestas Wind Systems increased R&D by 2.2 times and Nordex by 3 times. In the solar photovoltaic field, Q-Cells entered the Scoreboard in 2008 for the first time after increasing its R&D by 15.4 times in three years. Whether this is indeed a sign of the end of a long-lasting trend and the beginning of a new one, or is just a momentary fluctuation, limited to a small number of leading-edge companies, is yet to be seen.

Revenues and R&D expenditures of the major European energy companies, 2000-2009

	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	Change % 2000/09
E.ON - DE											
Revenue € bn	38,37	36,04	35,30	44,11	46,74	56,40	64,09	68,73	86,75	81,87	**113,35**
R&D exp. € bn	0,66	0,51	0,38	0,07	0,06	0,02	0,05	0,08	0,11	0,11	**-84,11**
Revenue/R&D	**1,72%**	**1,42%**	**1,08%**	**0,16%**	**0,12%**	**0,04%**	**0,07%**	**0,12%**	**0,12%**	**0,13%**	**-92,55**
GDF Suez - FR											
Revenue € bn					38,06	41,49	44,29	71,23	83,05	79,91	**109,97**
R&D exp. € bn					0,09	0,08	0,09	0,10	0,20	0,22	**156,47**
Revenue/R&D					**0,22%**	**0,20%**	**0,19%**	**0,14%**	**0,24%**	**0,27%**	**22,15**
EDF - FR											
Revenue € bn	34,42	40,72	48,40	44,92	46,93	51,05	58,93	59,64	64,28	66,34	**92,70**
R&D exp. € bn	0,47	0,40	0,40	0,38	0,40	0,40	0,39	0,38	0,42	0,44	**-6,01**
Revenue/R&D	**1,35%**	**0,97%**	**0,82%**	**0,85%**	**0,84%**	**0,79%**	**0,66%**	**0,63%**	**0,65%**	**0,66%**	**-51,22**
ENEL - IT											
Revenue € bn	25,11	28,78	29,98	31,32	31,54	35,88	39,02	43,69	61,18	64,04	**155,03**
R&D exp. € bn	0,12	0,10	0,10	0,02	0,02	0,02	0,02	0,03	0,04	0,09	**-30,65**
Revenue/R&D	**0,49%**	**0,35%**	**0,33%**	**0,05%**	**0,06%**	**0,06%**	**0,06%**	**0,07%**	**0,06%**	**0,13%**	**-72,81**
RWE - DE											
Revenue € bn	52,00	33,30	46,66	43,88	42,13	39,49	44,26	42,51	48,95	47,74	**2,31**
R&D exp. €bn	:	:	0,44	0,39	0,11	0,06	0,07	0,07	0,11	0,11	**-74,71**
Revenue/R&D	**:**	**:**	**0,93%**	**0,89%**	**0,27%**	**0,14%**	**0,16%**	**0,17%**	**0,21%**	**0,23%**	**-75,28**
Vattenfall - SE											
Revenue SEK bn	31,70	69,00	101,0	111,9	113,4	129,2	135,8	143,6	164,5	205,4	**548,07**
R&D exp. SEK bn	0,48	0,56	0,48	0,48	0,53	0,65	0,76	1,02	1,53	1,32	**174,84**
Revenue/R&D	**1,52%**	**0,82%**	**0,48%**	**0,43%**	**0,47%**	**0,50%**	**0,56%**	**0,71%**	**0,93%**	**0,64%**	**-57,59**
Sources: Annual Reports of the E.On, GDF Suez, EDF, ENEL, RWE, and Vattenfall, 2000-2009											

With 0.38 per cent of R&D per sales, the European oil, gas and electricity sectors are still classed as being among the low R&D Intensity sectors and lag behind most of the company on the EU R&D

Scoreboard, the average being 2.7 per cent.[37] One could argue, however, that the composition of that R&D is also important: maybe both public and private R&D focus more on the challenge of climate change and use the resources in a more efficient way. For example, the number of energy-related patents shows a continuous growth from the end of the 1990s.

[37] European Commission (2007) *Monitoring Industrial Research: The 2007 EU R&D Investment Scoreboard* (Luxembourg: Office for Official Publications of the European Communities); European Commission (2008) *Monitoring Industrial Research: The 2008 EU R&D Investment Scoreboard* (Luxembourg: Office for Official Publications of the European Communities).

Revenues and R&D expenditures of the major European oil and gas companies, 2000-2009											
	2000	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**Change % 2000/09**
Shell - UK											
Revenue USD bn	149,15	135,21	163,45	198,36	266,39	306,73	318,85	355,73	485,36	278,19	**86,52**
R&D exp. USD bn	0,39	0,39	0,47	0,58	0,55	0,59	0,89	1,17	1,23	1,13	**189,20**
Revenue/R&D	**0,26%**	**0,29%**	**0,29%**	**0,29%**	**0,21%**	**0,19%**	**0,28%**	**0,33%**	**0,25%**	**0,40%**	**55,05**
TOTAL - FR											
Revenue € bn	114,56	105,32	102,54	104,65	122,00	143,17	153,80	158,75	179,98	131,33	**7,65**
R&D exp. € bn	0,69	0,70	0,66	0,67	0,64	0,51	0,57	0,59	0,61	0,65	**2,36**
Revenue/R&D	**0,60%**	**0,66%**	**0,65%**	**0,64%**	**0,52%**	**0,36%**	**0,37%**	**0,37%**	**0,34%**	**0,49%**	**-17,35**
BP - UK											
Revenue USD bn	148,06	174,22	178,72	232,57	203,30	239,742	265,91	284,37	361,14	239,27	**61,60**
R&D exp. USD bn	0,43	0,39	0,37	0,35	0,44	0,50	0,40	0,57	0,60	0,59	**35,25**
Revenue/R&D	**0,29%**	**0,22%**	**0,21%**	**0,15%**	**0,22%**	**0,21%**	**0,15%**	**0,20%**	**0,16%**	**0,25%**	**-16,30**
ENI - IT											
Revenue € bn	47,94	48,93	47,92	51,49	58,38	73,73	86,11	87,20	108,08	83,23	**73,61**
R&D exp. € bn	0,23	0,20	0,18	0,24	0,26	0,20	0,22	0,21	0,22	0,21	**-11,54**
Revenue/R&D	**0,49%**	**0,41%**	**0,37%**	**0,46%**	**0,44%**	**0,28%**	**0,26%**	**0,24%**	**0,20%**	**0,25%**	**-49,05**
DONG Energy-DK											
Revenue DKK bn	11,67	12,72	13,73	14,27	14,21	18,49	36,56	41,63	60,78	49,30	**322,34**
R&D exp. DKK bn	:	:	:	:	0,01	0,08	0,18	0,33	1,09	1,04	**7357,14**
Revenue/R&D	:	:	:	:	**0,10%**	**0,44%**	**0,48%**	**0,78%**	**1,80%**	**2,12%**	**2049,26**
Repsol YPF - ES											
Revenue € bn	45,74	43,65	36,49	37,21	40,29	51,05	55,08	55,92	60,98	49,03	**7,19**
R&D exp. €bn	0,10	0,13	0,13	0,05	0,06	0,07	0,08	0,09	0,10	0,08	**-14,17**
Revenue/R&D	**0,21%**	**0,30%**	**0,37%**	**0,13%**	**0,16%**	**0,14%**	**0,15%**	**0,15%**	**0,16%**	**0,17%**	**-19,93**
Neste Oil - FI											
Revenue € bn	10,61	10,41	11,15	11,39	11,67	9,97	12,73	12,10	15,04	9,64	**-3,39**
R&D exp. €bn	0,02	0,01	0,04	0,04	0,03	0,01	0,02	0,03	0,04	0,04	**164,29**
Revenue/R&D	**0,18%**	**0,08%**	**0,34%**	**0,31%**	**0,22%**	**0,14%**	**0,17%**	**0,23%**	**0,25%**	**0,38%**	**173,56**
OMV - AT											
Revenue € bn	7,45	7,74	7,08	7,64	9,83	15,58	18,97	20,04	25,54	17,92	**140,35**
R&D exp. €bn	0,02	0,02	0,02	0,02	0,02	0,01	0,01	0,02	0,01	0,01	**-23,37**
Revenue/R&D	**0,25%**	**0,27%**	**0,32%**	**0,30%**	**0,19%**	**0,08%**	**0,07%**	**0,08%**	**0,05%**	**0,08%**	**-68,12**
BG - UK											
Revenue £ bn	2,27	2,51	2,61	3,56	4,05	5,61	7,14	8,29	12,57	10,21	**349,52**
R&D exp. £ bn	0,03	0,01	0,01	0,01	0,01	0,01	0,01	0,01	0,01	0,01	**-70,59**
Revenue/R&D	**1,50%**	**0,52%**	**0,42%**	**0,22%**	**0,25%**	**0,18%**	**0,14%**	**0,10%**	**0,09%**	**0,10%**	**-93,46**
ORLEN -PL											
Revenue PLN bn	18,60	17,04	16,90	24,41	30,57	41,19	52,87	63,79	79,53	67,93	**122,24**
R&D exp. PLN bn	:	:	:	:	0,02	0,01	0,01	0,02	0,02	0,01	**-39,66**
Revenue/R&D	**:**	**:**	**:**	**:**	**0,07%**	**0,03%**	**0,03%**	**0,03%**	**0,03%**	**0,02%**	**-72,85**
Sources: Annual Reports of the Shell, TOTAL, BP, ENI, DONG Energy, Repsol, Fortum/Neste Oil, OMV, BG and ORLEN 2000-2009											

Indeed, throughout the 1990s, the importance of energy efficiency grew steadily in public R&D; however, as Dooley and Runci argue, „perhaps the most significant trend in renewable energy research is the relatively flat budgets of these programs throughout the course of the 1990s, a decade that saw increasing rhetoric from national governments pledging to do their best to reduce carbon dioxide emissions through, in part, the increased use of renewable energy systems".[38] Observing the trends from 2000 for both public and private research, Daniel M. Kammen and Gregory F. Nemet stress that neither renewable energy nor energy efficiency have increased their share from R&D spending – but at least, by stagnating, these topics have not lost resources, unlike research related to coal or nuclear energy.[39] In the corporate budgets of the majority of the large energy corporations, the share of alternative R&D expenditures and energy investments is quite insignificant. In case of the British Petrol which is called as Beyond Petrol in its corporate advertising campaign, its R&D expenditure and alternative energy investment were only 0.25 percent and 0.38 per cent in terms of sales and other operating revenues in 2009, respectively.

Energy related R&D is generally considered to exhibit deep problems, not just through its shrinking size, but also by its very nature. The corporate figures clearly demonstrate that the European oil, gas and electricity corporations with the exceptions of the Danish DONG Energy have lower R&D expenditures than their global competitors. Grosse and Sévi (2005) characterize the R&D activity of European energy companies as exploitative. James G. March introduced a distinction between exploitation and exploration in innovation and corporate learning.[40] Exploitation happens when a company tries to use its knowledge base it in a more efficient and rational way. Exploitation, if successful, leads to more efficient operation, better quality and reduced costs. By contrast, exploration is about introducing radically new technologies, products and methods of operating – it is about enlarging and changing the knowledge an organization uses and relies upon. Grosse and Sévi argue that not only R&D budgets have shrunk, but the focus of R&D activities have changed towards more efficiency, and a client and application orientated direction, at the expense of basic, explorative research. We shall come back to the possible causes. But let us deal first with the question of energy related patents.

Grosse and Sévi (2005) call attention to a striking contradiction: while corporate R&D spending has been shrinking steadily, the number of energy related patents has increased sharply since the end of the 1990s in both the USA and Europe. This might suggest that perhaps R&D funds are smaller, but better utilized. However, Grosse and Sévi's argument is that the growing number of patents is not necessary a sign of intensive innovative activities, but it rather reflects a new attitude towards the protection of intellectual property rights, not independent from the evolution of the international intellectual property rights regime under the auspices of the World Trade Organization (WTO).[41] Patents are seen as a strategic resource, as a defense against litigation – or, conversely, as causes to sue other companies. As Kimberley A. Moore puts it nicely, „Patents may be valuable for defense rather than offense either standing alone or in large numbers. The defensive patenting strategy, like the arms race, focuses on a deterrent theory. Don't sue me on your patents or I'll sue you on mine. This often results in cross licensing."[42] Patenting is also used to increase the value of corporate assets, so the increasing number of corporate patents is not necessarily a sign of intensive R&D activity, but rather of strategic behavior and asset management.[43] Although, the energy companies usually have quite small patent portfolios in comparison to

[38] James J. Dooley and Paul J. Runci, (2000) 227.
[39] Daniel M. Kammen and Gregory F. Nemet, „Reversing the Incredible Shrinking Energy R&D Budget", *Issues in Science and Technology,* Vol. 22, (2005) Fall, 84-88.
[40] James G. March, „Exploration and exploitation in organizational learning", *Organization Science,* 10(1) (1991) 71-87.
[41] Paul J. Heald, „Mowing the playing field: Addressing information distortion and asymmetry in the TRIPS game", *Minnesota Law Review*, 88, (2003) 249.; Peter K. Yu, „TRIPs and Its Discontents", *Marquette Intellectual Property Law Review,* Vol. 10,2 (2006) 369-410.
[42] Kimberley A. Moore, *Worthless Patents*, George Mason Law & Economics Research Paper No. 04-29. (2004) 2.
[43] Gideon Parchomovsky and R. Polk Wagner, „Patent Portfolios", *University of Pennsylvania Law Review*, 154(1), November (2005), 1-77.

the other, especially technology sectors of the economy; they rarely record how many patents are filled or maintained in their annual reports.

Now the causes of this new attitude might be the same as caused the shrinking R&D budgets: deregulation, privatization and liberalization on the energy market, and seen from the ethical point of view, the habitual negligence of the interests of future generations. A general observation is that the privatization of previously state-owned companies leads to the reduction as well as the reorientation of R&D activities towards topics with expected short-term benefits.[44] This was also confirmed for the energy sector: since the energy sector is not a R&D intensive sector, increased competition leads not towards the intensification of R&D, but towards cost reduction.[45] Cost reduction may mean cutting R&D budgets, but also restructuring R&D activities aiming at finding immediate efficiency improvements: „This conclusion is borne out by our analysis of national (public and private) energy R&D programs …whereby available data corroborate the assertion that the private sector tends to focus on energy R&D areas that offer the promise of near term payoff (e.g., energy efficiency and conventional fossil power technologies), whereas the public sector focuses on areas that are on average more high risk and long term (e.g., fusion power, renewable energy)."[46]

Grosse and Sévi (2005) identified three R&D related strategies under competitive pressure that were not mutually exclusive. One is the above-mentioned reorientation of R&D activities towards short-term objectives. This also means the dropping of R&D topics that are not directly related to the core activity of the company. Finally, companies may try to build strategic alliances, or look for external resources and knowledge to fill the gap between innovation need and financial constraints. The two authors then analyzed the possible effects on corporate profitability as well as social welfare in both the short and the longer term as follows:

Corporate and social effects of R&D strategies

		Efficiency orientation	Eliminating basic research	Reliance on external resources
Effects on corporate benefits	on the short run	positive	positive	positive
	on the long run	positive	potentially negative	potentially negative
Effects on social welfare	on the short run	positive	potentially negative	neutral
	on the long run	positive	potentially negative	potentially negative

Adapted from Grosse and Sévi (2005: 15).

It is obvious that realizing efficiency gains is positive, from both a corporate and a social perspective. If a company utilizes its resources and technology better, or manages to offer new, improved ser-

[44] Federico Munari, „The effects of privatization on corporate R&D units: Evidence from Italy and France", *R&D Management* 32(3), (2002) 223-32.

[45] James J. Dooley, „Unintended consequences: Energy R&D in a deregulated energy market", *Energy Policy* 26(7), (1998) 547-55.

[46] James J. Dooley and Paul J. Runci, „Developing Nations, Energy R&D, and the Provision of a Planetary Public Good: A Long-Term Strategy for Addressing Climate Change", *Journal of Environment and Development,* 9(3), (2000), 223.

vices or better quality for a lower price to its customers, this certainly has positive effects on corporate profitability and stakeholder welfare, and even the environment. However, the other side of the coin is that by reorientating R&D activities towards short-term objectives, companies may lose a longer perspective on innovation: exploitation may totally prevail over exploration. And this may have a negative effect on long-term corporate competitiveness. It goes without saying that eliminating certain types of research already has potentially negative effects on social welfare in the short run, since knowledge production loses resources and means.

An interesting question is why and how the reliance on external resources, alliances and knowledge import may have negative corporate and social effects. Grosse and Sévi (2005) argue that, while in the short run a reliance on external resources and knowledge may counterbalance the effects of budget cuts, in the long run corporations may become dependent on others and lose their innovative capacity. This may be debated, but the potentially negative effect on social welfare is also raised by a study that modeled the effect of spillovers on knowledge production. As Valentina Bosetti and her co-authors summarized their findings as follows: „Our analysis shows that international knowledge spillovers tend to increase free-riding incentives and decrease the investments in energy R&D. The strongest cuts in energy R&D investments are recorded among High Income countries, where international knowledge flows crowd out domestic R&D efforts."[47]

To sum up, the energy sector performs rather poorly in terms of R&D expenditures, as it is among the lowest R&D-intensive sectors. While the energy sector was never among the high-tech industries, the sad reality is that the majority of the European energy companies have reduced their R&D spending substantially since the 1980s. In spite of their nice mission statements, for sure, their contribution is barely adequate to foster, as the official documents of the European Union emphasizes, „a resource efficient low-carbon economy". Analysts argue that budget cutbacks have been accompanied by a reorientation of R&D activities towards short-term objectives, efficiency improvements and low-risk projects. The main reasons seem to be the intensification of global competition and the deregulation of the energy market. Cuts in R&D activity happened despite the fact that, compared to revenues, R&D expenditures had always been very moderate (well under 1 per cent of total turnover) and large companies had used many other, more effective ways to reduce operative costs, such as laying off employees, outsourcing certain activities, reducing energy losses and so on. The possibility of a global climate catastrophe casts a shadow on the future of humanity, and in order to avoid this happening, a radical ecological turnaround is needed in the way energy is produced, used, and its environmental effects are treated. It is legitimate to argue that corporate social responsibility would imply that large energy companies should devote substantial resources to R&D in order to promote innovation for a sustainable energy system.

4. Conclusions: The Limits of Economic and Environmental Sustainability

The public and private efforts of building a knowledge-based economy and society, or „a more resource efficient, greener and more competitive economy" steadily fall short of what were agreed in Lisbon and Barcelona in 2000 and 2002. Despite a few EU member states' impressive figures – for example, Sweden, Finland and Austria – public R&D expenditures have remained stagnant in the majority of the EU member states. The private contributions to knowledge production and innovation, as the energy sector' meager innovative performances demonstrate, have rather declined and stayed at a very low level during the course of the 2000s, while it could significantly increase its revenues. In this respect, the statistical figures for the new EU member states as well as the Central and Eastern European private corporations are particularly disappointing. None the less, the commitments of financial and human re-

[47] Valentina Bosetti et al., *International Energy R&D Spillovers and the Economics of Greenhouse Gas Atmos-pheric Stabilization*, CESifo Working Paper No. 2151 (2007) 1-26.

sources to promoting a knowledge-based economy and society, strengthening the intensity of innovation, R&D occupies more and more space in the communications and declarations of the major political bodies of the European Union and the national governments, as well as the sustainability reports and corporate social responsibility reports of the corporations. In spite of the substantial gap between the political aspiration and actual achievement, the political communications and documents issued by the European Commission and the European Council regularly have recourse to the Lisbon Strategy as the blueprint of future policy and economic actions.[48] Recently, the Lisbon Strategy as a brand name of the political ineffectiveness serves as a panacea for economic recovery in time of economic crisis and deep recession.[49]

If we study the decennial trends of public and private R&D expenditures on the company and country levels rather than the hermeneutics of the declarations and the mission statements of the corporate and political actors, we do not run a great risk in predicting that neither the majority of the EU member states, nor the European business enterprises will gear up their R&D investments and innovative intensity to the higher level that would be necessary to achieve the main objectives of the Lisbon Strategy and the 3 per cent Barcelona target by the end of 2010. Thus, the knowledge-based economy and society project still remains a remote and elusive horizon for most of the EU member states.

Apart from the economic and social problems of the innovation deficit of the European Union, the meager and declining private expenditures in the energy sector also raises crucial ethical dilemmas which necessarily link to the questions of intergenerational justice. According to the phrasing of basic political as well as corporate CSR documents, R&D is taken to be part of corporations' social responsibility; however, the details are far from being explained fully. If we are convinced that there are technological solutions to our far-reaching environmental problems we should define the ethical responsibility of corporations in terms of knowledge production, use and dissemination, too. Our essay has aimed at raising such basic questions which, we believe, need much more attention from business ethicists.

[48] *Working together for growth and jobs: A new start for the Lisbon Strategy.* Communication to the Spring European Council. Brussels, 02.02.2005, COM (2005) 24

[49] *A European Economic Recovery Plan*. Communication from the Commission to the European Council, Brussels, 26.11.2008, COM(2008) 800 final