ENERGY AND CLIMATE CHANGE. NUCLEAR, PROS AND CONS

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Abstract: *It's needless to say that nuclear is a hot subject. It arouses public imagination, suspicion, and fear. It has always animated scientists' minds and souls and after they discovered how to manipulate the atom, the public conscience has become aware of its dangers and its merits. Present paper aims to present why it is important to regard with optimism and trust the science of atoms, not without loosing our critical view concerning the risks inherently connected to it. Nuclear arms are a reality, but climate change is another. Mankind is facing both. It cannot ignore one of them without assuming greater risks in the future. In this context, nuclear can be regarded with hope and audacity. Its expansion, both in countries where it already is employed, and into newcomers (where it could be implemented), can bring benefits such as: reducing energy dependence on foreign interests placed under the umbrella of oil and gas producers, or transporters; rising energy security in a world where access to cheap and reliable energy would become more problematic; greater success in fighting climate changes and global warming through energy generated in a more environmentally friendly manner. Furthermore, over the energy aspect of peaceful nuclear energy, there is another economic and technological benefit: nuclear researches could be involved simultaneously in electricity generation, heat production, agricultural and industrial rising's potential, water desalinization and providing in arid areas, and application in medical researches and treatment. But nuclear has its weak points: it is connected to military researches and programs, while offering the needed technical ground for UN Security Council permanent members to have and maintain prestige in international politics; it looms over mankind, as a menace which hunts our conscience after Hiroshima and Nagasaki… Its minuses have to do with international context, too: if we connect the highest level in technology with strongest religious sentiment than we can face a terrifying drama. A nuclear nuke in the hands of a terrorist organization is the worst nightmare mankind could face. Countries with nuclear arms (Russian Federation and Pakistan) were courted by dangerous organizations, which searched to gain access to fissile material. But there is a hope, and the paper presents it in an indirect manner: if public conscience activates in direction of nuclear disarmament, nuclear could become the hope for a better future. Nuclear disarmament would mean a safer world, while peaceful nuclear expansion will mean cleaner energy and greater access to electricity in more areas, all of them creating a better world and a civilization proud of its name.*

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Energy sector must be changed; this is an unquestionable matter. But this change have to be a dramatic one in decades ahead in order to relax fears connected to energy security, and those facing climate changes. Present civilization in based in such measure upon energy resources' consumption that it cannot work without them. But one can easy note that the direction humankind chose two and a half centuries before could head directly to a dead end for human civilization. The way we consume resources today points to the fact that humankind is the biggest enemy of itself.

But each decision regarding changing the way energy is consumed and how is realized the energy mix involves decisions with great importance, with strong political connotation; as energy consumption is in an inextricably manner connected to transportation sector – both, energy and transportations being strategic aspects in all states – there is a need to see and treat them with greatest care.
Civilization is not contemporary with the human being's appearance on the planet Earth. Civilization appeared when towns appeared, but the level of civilization has risen only when man succeeded in multiplying his weak power with different sources of energy; in this way man started to master in some way the nature. Man transformed through different technologies different elements provided by nature in order to master it; but the extraction of the carbon from the Earth (in the form of energy resources) and their burning to produce energy, has generated more and more carbon in the atmosphere.
One of the most significant indexes of civilization degree hit by a specific society is per capita energy *production* and *consumption*. Man is a very weak being, but amplifies its fragile forces through energy resources' consumption. For example, the world in 2004 consumed energy resources which generated cca. 15 TW, with oil representing 5,6 TW, natural gas 3,5 TW, coal 3,8 TW, while water and nuclear sharing the same position: 0,9 TW; the remaining 0,3 TW was produced using other energy sources (Maliţa, 2009a).
But the effects generated by the rising concentration of CO2 in the atmosphere have started a process known as *climate change*, with visible effects starting in the '60s, when some species of birds have started to change the way they migrated and how they behaved. In that moment to the sensitive security concerns connected to the control over energy resources and the routes used for their transportation, there was added a new and the most complex one in all human history: *climate change*. Even if since 1965 the US President L B Johnson received the first dossier containing information concerning the consequences and dangers brought by the climate changes (Victor et al., 2009), only after Cold War ended the nations started to agree over the fact that there is present a big problem for humankind – climate change.
Moreover, 86% of energy is obtained through the process of burning non-renewable resources such as oil, gas, and coal (Maliţa, 2009b) showing that we live in an unsustainable manner in a civilization captured by nonrenewable and polluting resources… In this regard, at the beginning of the 3rd millennium, the Earth must breed not 6 bn. peoples, but this number 24 times many over, meaning 144 bn. people (Maliţa, 1998); this is due to man force's multiplication through energy consumption. But the way man consumes resources and produces energy is made in a clearly unsustainable way.
Rising energy security and emissions' reduction could be simultaneously attained if there is registered a rising efficiency for energy sources' use, and changing the energy resources mix in a radical and irreversible manner. The expansion of renewable resources (water, wind, sun-power, geothermal) and of resources with an unlimited potential (atoms), coupled with the reduction of nonrenewable sources' consumption would provide simultaneously a stronger energy security and the prevention of dramatic climate change. To do this, there are needed both *wise decision* at highest political echelons in all countries, and a *new attitude* from the part of citizens of developed countries, and emergent economies; there is needed a new mentality for all citizens of the planet Earth.
The renewable and atoms have not only strong points; there are minuses, for them, too, while their implementation brings heat political debates (Froggatt and Levi, 2009). Political leadership has to *lead* the de-carbonization process of world economy in a tense environment, taking account of *climate change* and *energy security*, and of public opinion and social trends. For political leaders the decision vice has two components: one is objective, containing energy security and climate change, while the other is subjective, political parties looking closely to the public opinion trends and desires,

searching to size any opportunity which would bring a greater voting share for them, and looking to avoid any public position which would damage in electoral moments…
It is noteworthy to mention that we can look at *nuclear* with hope, and with fear. The discoveries in atomic field and the technological progress in this high-tech area gave the 20th century's man a huge power over matter and nature. This has been his long dream: to master the nature… And the atomic age placed him on the highest peaks. But this has brought with it enormous risks for his fellows, and for him: there appeared for the first time in human history the possibility to annihilate human civilization, and even the whole life on the Earth, as a consequence of an all-out atomic war. There appeared the balance of terror, looming over all of humankind. A nuclear war between nuclear powers would have meant the end of history. And this is the case with all human inventions. As pointed Kapitza (in Epstein and Webster, 1983: 59), "*[T]he society which created these things is modeled by them, finding that it is extremely difficult to have an objective and responsible attitude towards them*".
The problem for humankind and for the of the pillars present civilization is based upon is the way resources are exploited and consumed in order to produce energy, which only promote proud and vanity. The signals regarding climate changes – detectible starting in the '60s – have become more and more visible as we close to present days; and present trends and future's perspective must activate in our conscience the menaces humankind will surely face.
Over the high volatility of international system, new poles of power fighting for dethroning old ones complicating furthermore geopolitical equations at global level, humankind must face a new challenges, rising the complexity for decision-making.
Aspects such as *food, water, energy, and environment* have become the heat subjects on the agenda of influential international think-tanks (RIIA, CFR, CoR, CEIP), and these elements have a great potential to generate huge tensions in the future, both at domestic, and at international level.
If the food, water, and the environment are the key-elements for the life on the planet Earth, *energy* and the control over nature using energy sources provided man's ascension to the position of dominant specie on Earth. But this brings with it a great responsibility, which man hasn't proved yet that he was totally aware. This has brought overt political crises, ending in military conflicts, when man killed his fellow. Furthermore, energy resources – and especially *oil*, after it has become the key-element for transportation and car industry – became the gold which brought states in a state of war against one another. While the trade of oil has become extremely militarized, even there aren't overt political or military clashes; in this context, oil and arm transfers are inextricably linked, with oil being the *enemy* of freedom.
Entering into nuclear age opened new opportunities for mankind: the control over the atom has provided a new energy source with enormous potential. The sin where man stepped in immediately he had discovered how to manipulate the atoms, was exactly the discoveries which gave man the knowledge to use the atoms to destroy his fellows, and the environment. He created the most destructive weapon in human history: the nuclear bomb. The great sin of this discovery resides in *military applicability* of the knowledge from atomic field. History teaches us the effects of the two atomic explosions in Japan; and today they are labeled as low-power thermo-nuclear mechanisms…
Using nuclear energy on a greater scale to produce energy has clear advantages face to face with other energy resources, both classical, and unconventional ones, but imminent risks which could harm life, people and environment's health, and the states which are developing nuclear programs,too.
Rising people's number globally overlapping the rising emerging economies will surely bring fiercer competition for access to energy sources, and for control over their transportation routes. Rising consumption brings higher prices for energy, but their

burning vents in the atmosphere greenhouse gases. In this angle, *nuclear* appears as a constant source of energy, having a great capacity, and providing energy without producing CO2 emissions.

There are other green energy sources, each one has its weak points; and world economy's de-carbonization could be attaint with only these green sources. But the costs for such an action would be far greater than in the case nuclear is present in the global energy mix in a significant percentage. Any try of de-carbonization of energy and transportation systems *must* have the nuclear on the agenda, together with green energy sources' expansion. Peaceful nuclear expansion brings benefits such: it provides energy in a relatively constant manner; big installed capacity; lowest CO2 emissions; energy sources' diversification both in developed and in emerging economies. If transport system de-carbonization would simultaneously be attained, electricity which would be produced in atomic power plants could provide the necessary energy for road and rail transportation.

Developing high-speed railways and trains for small and medium distances, coupled with electrical cars or hybrid-cars would reduce transportation's dependence on oil, and CO2 emissions due to transport activities. When transportations aren't dependent on oil, there will be reduced the influence oil exporting countries over oil consumption markets, bringing great social and geopolitical effects: there will be registered a radical reorientation in international relations, bringing irreversible changes at domestic level in oil exporting countries such as a deeper democratization and a greater role for women in society and in family.

Reducing gas dependency is an important matter, too. The natural gas resources are concentrated in a lower number of countries in comparison with oil possessing countries, while it is transported using pipelines, rising importing countries' *vulnerability*. Gazprom giant is a strong example, and Moscow influence using this energetic arm could be felt repeatedly since 1991. The dependency on gas brings with it strategic vulnerability, while a massive orientation toward gas in the context of economy de-carbonization means greater gas consumption, and higher price for this commodity, lowering economic competitiveness and rising food prices (natural gas is a key-element for fertilizers' production).

Nuclear power's expansion could simultaneously reduce the vulnerability given to a higher price for gas, and to the dependency on gas exporting countries. *This means a greater freedom in foreign policy for consuming state*. The existence of the energetic base which could not be influenced by countries which export energy resources or by those which control access to them brings reduction in greenhouse gas emissions together with the reduction of the influence those countries could exert. How would look like such a world, and what role would be reserved for countries such as Russia, Venezuela, Nigeria, Angola… The benefits could be identified in lower CO2 emissions, and at the international system's level, too.

France's example can be brought here: due to the most successful nuclear program in the world, Paris succeeded to endow France with an energy amount equivalent to 80 mil. tones of oil (Wiesenfeld, 1998). Today in France there are 58 nuclear reactors in use, providing 78% of its electricity, while 40% of primary energy is France is based upon nuclear (Lester and Rosner, 2009: 25).

In the US almost 90% of emissions generated in energy production are due to coal, while it counts only for 52% in electricity production balance (*The Future of Nuclear Power: An Interdisciplinary Approach*, 2003: 18). And as coal's burning hits most the environment, it has the lowest energetic capacity, related to installed capacity. But is has a large base at global level – a lot of countries having great coal reserves – and for this reason decision regarding energy systems took account of coal, as a major energy source for heat and electricity generation.

But in the context of climate changes, coal menaces our future the most, and identifying and spreading new technologies for carbon capture and stocking, together with nuclear expansion could be viable solutions both for diversification, and CO2 emissions' reduction; and this is a remarkable point in a historical moment when China connects to its national grid two new coal power stations each week (Burton, 2010: 185).
Expecting new political solution at international level aiming at CO2 emission's taxation, reducing dependency on fossil fuels and reorientation to alternative energy sources, bring a new force for decisions concerning *nuclear energy*.
Nuclear addresses simultaneously to numerous items written on states' agenda (Lauvergeon, 2009: 91): it is sustainable (it vents the lowest amount of CO2 emissions/kWh in comparison all other energy sources, making it attractive in the context of climate change debates); it is competitive (Lauvergeon, 2009: 92), even in the absence of tax imposed on CO2 emissions; it provides energy security, because uranium reserves are located in politically stable countries, the uranium reserves being 200 times many over the present necessity (Lauvergeon, 2009: 92), while the global market for uranium works smoothly.
Furthermore, the uranium (the fuel) represents only 10% of the total costs of electricity generation, while in the case of coal the share is 77%, and for natural gas, it rises to 93% (Rowe, 2009: 86).
Other advantages of nuclear expansion overcoming the framework of energy generation are connected to medical care, agriculture, and hydrology. Countries located in areas known for long and severe droughts, but having seashore could contemplate peaceful nuclear projects in order to provide both electricity, and desalinized water, rising agricultural potential for those areas, too. And the know-how in the nuclear field in the agriculture could create a scientific base for rising agricultural potential in the context of climate changes, as new knowledge could provide resilient seeds and types of harvest; while the applicability of nuclear researches in medicine has positive uses. Of course, there could appear in time secondary effects of irradiation used in medical treatment (nausea, radio-generated sarcoma).
But as Cirincione sais (2008), the biggest sin of nuclear technology resides in the fact that big problems come in small packages; it is necessary only a small quantity of fissionable material (Uranium 235 or Plutonium 239). As peaceful nuclear researches (could) overlap the military researches, the nuclear expansion could give to a greater number of states in the possession of knowledge in this important scientific field knowledge with military applicability. There are some parts of nuclear fuel cycle with civil applicability and military application which overlap (Yudin, 2010): mining and milling, which gives Uranium 308, which is passed through a conversion process, after which there is obtained Uranium hexafluoride (UF6), material which is passed to enrichment process. The same knowledge and installations used to enrich Uranium at low levels (4-5%), preparing it to be used as fuel in nuclear reactors to produce electricity, could be used to enrich it up to the level of 80% U235; in this moment it has become fissile material with direct military applicability. Furthermore, when over Uranium enrichment, there is the other part of nuclear fuel cycle: it concerns the separation the Plutonium from the burned fuel used in peaceful nuclear reactors. This process has to do with the fissile material's reprocessing and the separation of Plutonium from this material; in that moment this Plutonium could be used in military direction. But if there are needed 25 kg U235 to build an atomic weapon, in the case of Pu239, there is needed only the small quantity of 5 kg, but this plutonium based weapon has a much greater destructive force (practically as great as one wants), because of adding tritium (Jackson, 2009: 1163).
The vice pressing on developing countries which don't have peaceful nuclear reactors – reducing the vulnerability connected to energy resources and cutting greenhouse gas emissions – makes them to look with optimism to it. But nuclear expansion at global

level aiming at cutting emissions through nuclear expansion brings risks at international security level: peaceful nuclear programs and researches could in time be redirected to military programs (Jackson, 2009: 1157), rising the instability in the areas which already are known for their *instability*.

This is a very important reason why nuclear expansion to developing economies which don't have already nuclear reactors is regarded with suspicion. Even nuclear has unquestionable merits it has some characteristics which hinders its expansion.

As the expertise, material, scientific, and human bases employed in peaceful nuclear researches could be redirected to military applicability, making these states potential candidates for the club of nuclear armed states Rauf (in Brener-Maerli and Lodgaard, 2007: 274), with complex implication in the field of international security, the expansion of peaceful nuclear could meet real barriers, or to encounter those risen by public opinion (or by some political currents, having as key-figure the debate over nuclear, hoping to gain in this way political capital, as is recently the case in Germany).

There are real fears connected to nuclear energy and nuclear reactors' operation, and the notable accidents from Three Mile Island (1979), Cernobil (1986), and Fukushima (2011) could signal us the real dangers of nuclear energy… Even if the odds of a nuclear accident is very small, nuclear expansion to new states, and its multiplication in states already possessing it would rise the probability of nuclear accidents.

Until nuclear reactors are 100% sure – until the moment that a nuclear accident will not generate radiations at all – the possibility of a catastrophe floats over peaceful nuclear programs (Feiveson, 2009: 65), over places where nuclear reactors operate, and in the nearby area, and over whole humankind.

Although mankind posses a cumulated experience of about 13000 years/reactor (Meserve, 2009: 105), the risk associated with an accident at an active nuclear power plant must not be underestimated. And any accident somewhere in the world would surely reopen the already heated debates related to peaceful nuclear energy, the safest plant or the best operating system becoming in this way prisoner to the weakest link and most vulnerable plant in this truly global nuclear chain.

To this risk, there is wise to add the possibility of a criminal act oriented against an active nuclear power plant, coming from a terrorist organization, a very zealous employee believing to much in the "green" color's merits, or from some other state which – due to war state of affairs – could search to hit peaceful nuclear installation in its rival state, affecting quickly and irreversibly the *targeted state* (through cutting its energetic base, simultaneously with public and military morale's sapping), the *region at large*, and the conceptions regarding international security.

Furthermore, terrorist organizations are looking tirelessly to gain access to fissile material, in order to us it in an atomic explosion, or in a dirty bomb. Peaceful nuclear expansion means a rising number of places where they could found the much desired material; and this is a major and real risk for the West, because it connects a very sophisticated technology with boiling religious fanaticism.

Russian Federation and Pakistan are most weak links in this chain; many times in the past, terrorists searched there to obtain fissionable material. But there is a difference between them: while in Russia terrorists searched to "buy" the material – and we can note here the Snejinsk incident and precarious guarding system at Seversk (Bunn, 2009: 118) – in Pakistan there exists the possibility that well organized and armed extremists would enter the deposits where are Pakistani nuclear nukes, with devastating consequences at global level. The determination of terrorists organization in this direction noted in the past and connected to this risk makes us aware about it (Bunn, 2009: 118).

And over nuclear reactors and the places nuclear stockpiles are located, the places where used nuclear fuel is located could become the object of a terrorist attack, rising the risks of contamination over larger areas.
Public opinion could be in its turn a hindrance for peaceful nuclear programs; there are states where nuclear energy is regarded with suspicion. As a consequence of Three Mile Island accident, Sweden (in 1980) passed a law forbidding new nuclear reactor's construction and a gradual elimination of nuclear power; after Cernobil (1986), Italy decides in 1987– after there was initiated a *referendum* – to close all its four nuclear reactors (Joskov and Parsons, 2009: 45).
If states with tradition in centralization (China and Russia) could pass relatively quickly on the path of nuclear expansion without caring much about the public opinion, countries having more democratic systems take decisions with public opinion in mind. And as nuclear gains quickly public attention – due to *public* and *personal* perceptions related to it – any incident or accident rise heat public debates and this can be captured by the nuclear opponents, rising their importance and presence in public conscience, with direct consequences for them, especially if there follows election.
But the greatest minus of peaceful nuclear energy has to do with its connection to the *nuclear bomb*. The peaceful nuclear expansion to new states could take place only there is manifesting a real disarmament process, nuclear armed states engaging in good faith negotiations with this sincere aim in mind.
A disarmament process stared by the most powerful nuclear states (Russia and USA), expanded thereafter to all other nuclear armed states in a multilateral framework, could become the strong base for the peaceful nuclear expansion, eliminating the risk of horizontal proliferation while there is taking place the nuclear expansion; it is an important step forward on the way to renounce to *national* control over nuclear programs by nuclear states (Socolow and Glaser, 2009: 41), over national enrichment facilities and/or plutonium reprocessing.
Such a process could bring great benefits to mankind both *directly* due to a gradual, and a definitive and irreversible nuclear disarmament, and *indirectly* through the creation of preconditions aimed at peaceful nuclear expansion to new states, without fearing the uncontrolled nuclear proliferation.

In conclusion
Rising importance of climate changes debates on international agenda without taking account of all aspects concerning the de-carbonization of world economy and transportation, could be a cure more dangerous to global system, to society and the environment than the disease brought upon mankind by climate changes: *massive expansion of peaceful nuclear energy in present international context and domestic politics of peculiar states could be greater risks to mankind than climate changes effects. But if there will be some positive (and irreversible) changes concerning military applicability of nuclear researches, peaceful nuclear expansion must be reconsidered, with the greatest attention, and seriousness*

References:
Bremer-Maerli, M. and Lodgaard, S.,eds., (2007) *Nuclear Proliferation and International Seciruty*, New York: Routledge.
Bunn, M. (2009) 'Reducing the greatest risks of nuclear theft & terrorism', *Daedalus*, Fall, pp. 112-123.
Cirincione, J. (2008) *Bomb Scare. The History and Future of Nuclear Weapons*, New York: Columbia University Press.
Feiveson, H. A. (2009) 'A skeptic's view of nuclear energy', *Daedalus*, Fall, pp. 60-70.

Froggatt, A. and Levi, M. A. (2009) ,Climate and energy security policies and measures: synergies and conflicts', *International Affairs*, vol 85, no. 6, pp. 1140-1148.
Epstein, W. and Webster, L., eds., (1983), *We Can Avert a Nuclear War*, Cambridge: Cambrigge Massachusetts, Oelgeschlager, Gunn & Hain, Publishers, Inc.
Jackson, I. (2009) 'Nuclear energy and proliferation risks: miths and realities in the Persian Gulf', *International Affairs*, vol. 85, no. 6, pp. 1157-1172.
Joskow, P. L. and Parsons, J. E. 'The economic future of nuclear power', *Daedalus*, Fall, pp. 45-59.
Kapitza S. (1983) 'Learning to think in a new way' in Epstein, W. and Webster, L. (eds.), *We Can Avert a Nuclear War*, Cambridge: Cambrigge Massachusetts, Oelgeschlager, Gunn & Hain, Publishers, Inc.
Lauvergeon, A. (2009) 'The nuclear renaissance: an opportunity to enhance the culture of nonproliferation' *Daedalus*, Fall, pp. 91-99.
Lester, R. K. and Rosner, R. (2009) 'The growth of nuclear power: drivers and constraints' *Daedalus*, Fall, p.19-30.
Maliţa, M. (1998) *Zece mii de culturi, o singură civilizaţie. Spre geomodernitatea secolului XXI*, Bucureşti: Editura Nemira.
Maliţa, M. (2009a) *Minţi sesine, minţi învolburate. Eseuri şi evocări*, Bucureşti: Editura Scripta.
Maliţa, M. (2009b) *Mintea cea socotitoare. Eseuri*, Bucureşti: Editura Academiei Române.
Meserve, R. A. (2009) 'The global nuclear safety regime', *Daedalus*, Fall, pp. 100-111.
Rauf, T. (2007) 'Export Controls and Multilateral Nuclear Arrangements' in Bremer--Maerli, M. and Lodgaard, S. (eds.), *Nuclear Proliferation and International Seciruty*, New York: Routledge.
Richter, B. (2010) *Beyond Smoke and Mirrors. Climate Change and Energy in the 21-st Century*, Cambridge: Cambridge University Press.
Rowe, J. W. (2009) 'Nuclear power in a carbon-constrained world', *Daedalus*, Fall, pp. 81-90.
Socolow, R. H. and Glaser, A. (2009) ,Balancing risks: nuclear energy and climate change', *Daedalus*, Fall, pp. 31-44.
Victor, D. G., Morgan, M. G., Apt, J., Steinbruner, J. And Ricke, K. (2009) ,The Geoengineering Option. A Last Resort Against Global Warming?', *Foreign Affairs*,
Vol. 88, no.2, March/April, pp. 64-76.
Wiesenfeld, B. (1998) *L'atome ecologique*, Paris: Les Ulis, EDP Sciences.
Yudin, Y. (2010) *Multilateralization of the Nuclear Fuel Cycle. The Need to Build Trust*, Geneva: UNIDIR.
*** *The Future of Nuclear Power: An Interdisciplinary Apporach* (2003), MIT.