

Basic Science for Sustainable Development: Solutions from National Associations

Edited by

Aleksander Zidanšek, Goran Bandov, Nebojša Nešković

Pathways to a Sustainable Future for Humanity
Volume 2, 2023

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Aleksander Zidanšek, Goran Bandov, Nebojša Nešković

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I) Introduction

Preface: Basic Science for Sustainable Development - Solutions from National Associations

Aleksander Zidanšek, Goran Bandov, Nebojša Nešković
Club of Rome National Associations of Slovenia, Croatia and Serbia

Last year, the first issue of the Pathways to a Sustainable Future for Humanity was published, devoted to Ivo Šlaus' vision for a sustainable future.

As the world is progressing ever faster, there is a need to develop new original and innovative solutions. This second issue of Pathways is therefore devoted to such solutions from participating National Associations that are related to the progress of basic sciences.

The publication starts with a short description of the history of the participating National Associations, Croatian, Slovenian and Serbian. A separate paper is devoted to the first President of the Slovenian Association Professor Robert Blinc, who would be 90 this year. His optimistic vision of scientific progress has been a shining light guiding the activities of the Slovenian Association, some of which are described in the next chapter.

As sustainable solutions must correspond to contemporary threats, these are described in detail by the Club of Rome Honorary Member and WAAS Honorary President Ivo Šlaus, who also offers reasonable solutions to these threats. A more personal view on how to support the transformation of society

into a sustainable society on a personal level is presented by the President of the Croatian Association, Goran Bandov. A powerful initiative to create the South-East European International Institute for Sustainable Technologies that would more closely connect the scientific efforts of the South-East European countries is presented by the President of the Serbian Association Nebojša Nešković. This chapter is concluded by the presentation of the President of the Slovenian Association, Aleksander Zidanšek and WAAS Honorary President Ivo Šlaus on Happiness in Nations and Governance, which has been reprinted from the SDEWES Conference in Dubrovnik 2011 due to the importance of this topic.

Many international plans for a transformation of contemporary society and its energy system to sustainability have been proposed. The enormous costs of this transformation represent the most important challenge to all of these plans, ranging from several trillion USD annually until the middle of the 21st century. Nuclear fusion is offered as the most suitable solution for reducing the costs of energy transformation as it has the best energy-to-mass ratio of any possible energy technology known today. The President of the Slovenian Association, Aleksander Zidanšek and Vice President Robert Repnik present recent developments, which could lead to the commercial fusion breakthrough in time to prevent catastrophic climate change, providing that sufficient financial and human resources are provided for nuclear fusion technologies research. The Slovenian Association proposed a new attractive vision to develop clean cheap nuclear fusion energy before the end of this decade, compared to the Apollo program in the 1960's. Although this vision lacked traction at international organisations, there have been many significant steps in this direction, both by innovative fusion energy startups and by courageous nations at COP28, including Croatia and Slovenia, who agreed to launch a declaration to triple nuclear energy capacity by 2050.

The consequences of the presented solutions are discussed in conclusions, and a possible path ahead is presented that will lead to a sustainable future for humanity.

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II) Development of National Associations

The Club of Rome: Croatian, Slovenian and Serbian National Associations

Aleksander Zidanšek, Ivo Šlaus, Nebojša Nešković, Goran Bandov
Club of Rome National Associations of Slovenia, Croatia and Serbia

In 1965 Aurelio Peccei, an Italian businessman, gave a talk which inspired several outstanding persons among them Alex King, Director General for Scientific Affairs at OECD, David Rockefeller, Elisabeth Man-Borghese and several others. Peccei emphasised that the problem of humankind – environmental deterioration, poverty, hunger, endemic illness and many others cannot be solved individually nor just by a few or several countries. All these problems are globally interdependent. It took three more years and a group of concerned and devoted scientists, businesspersons and politicians from many countries met in Villa Farnesina, Accademia dei Lincei, Rome and established a non-governmental organisation and hence the name ‘The Club of Rome’. To signify the complexity and global interdependence, Peccei suggested the concept of “*problematique*” and endeavour to solve these problems was called “*resolutique*.”

The Club of Rome (CoR) has about 100 full members, about 30 associate members, about 50 honorary members (among them Queen Beatrix of the Netherlands, Jacques Delors, Prof. Yehezkel Dror, Prof. Heitor Gurgulino de Souza, Horst Köhler, former president of Germany, Koichiro Matsuura, Federico Mayor, Manmohan Singh, former prime minister of India and Ivo Šlaus) and about 40 national associations, among them Croatian (established in 1994), Slovenian (established in 2000) and Serbian (established in 2015). Members of the CoR are from many different countries and from all continents. The first president of CoR was Aurelio Peccei (1968-1984), followed after his death in 1984 by Alex King (1984-1990) and then Ricardo Díez Hochleitner. Currently, the CoR has two co-presidents. Sandrine Dixson-Decleve and Mamphela Ramphele. The program of CoR is best summarised in five programs: Emerging new civilizations, Planetary

emergency, Reframing Economics, Rethinking finance and Youth Leadership and Inter-generational Dialogue. The CoR members issued many reports to the Club, the most famous 'Limits to Growth' published in 1972 with more than two million copies sold. Celebrating the 50th anniversary of 'The Limits', Ernst Ulrich von Weizsäcker and Anders Wijkman published the book 'Come on! Capitalism, Short-termism, Population and the Destruction of the Planet'.

In 1987 Ivo Šlaus, physicist from Yugoslavia, was elected member of the Club of Rome. The Executive Committee of the CoR was eager to establish the Yugoslav association of the CoR. In 1989 The Yugoslav Association of the CoR (YACoR) was established, including about 40 outstanding scientists and politicians from all republics and provinces of former Yugoslavia: among them Robert Blinc, Božidar Matić, Jordan Pop Jordanov, Z. Marić, Kruno Pisk, Z. Pravdić and Ivo Šlaus. Božidar (Božo) Novak, a leading journalist and director of the newspaper Vjesnik, which he led among the ten strongest media companies in Europe, was also a member. The foundation conference of the YACoR was attended by Alex King. Prof. Inge Perko-Šeparović was elected president of YACoR. During its first year YACoR established: i) The Yugoslav Association for the Advancement of Science; and ii) Inspired by International Federation of Institutes for Advanced Studies (IFIAS) Interdisciplinary Center for Advanced Studies was established and two of its most important projects initiated: i) including our compatriots working and living abroad in our R&D program, and ii) proposing Yugoslavia as a seat for international fusion project – ITER. YACoR collapsed in 1991.

Croatian Association of the CoR (CACoR) was established in 1993. Ivo Šlaus was elected president, Vlado Gotovac – head of the Liberal Party and Prof. Dalibor Brozović, a leading member of the Croatian Democratic Association (HDZ), were elected vice-presidents, academicians Boris Kamenar and Vlatko Silobričić, Prof. Kruno Pisk, Ms. Andrea Maceljlski and Prof. Asim Kurjak were elected members of the Executive Committee. The Statutes of CACoR specifies that the term of the president is two years, so in 1996 Vlado Gotovac was elected president of CACoR and then was followed by Boris Kamenar, Asim Kurjak, Vlatko Silobričić etc. A very significant role in the development of CACoR was played by Joža Manolić, then president of the Upper House of the Croatian Parliament and by General Anton Tus. CACoR organised regularly conferences and meetings each two months and occasionally published the proceeding of these conferences, e.g., one analysing the Dayton Agreement. CACoR intensively collaborated with the

South East European Division (SEED) of the World Academy of Art and Science (WAAS), played an important role in extending WAAS fellowship and in organising the WAAS Zagreb General Assembly in 2005. Collaboration between SEED and CACoR extended to the collaboration between the CoR and WAAS in general and resulted in organising several major conferences, e.g., in Delhi, India, on November 11, 2011, where the new WAAS Bylaws and leadership were inaugurated and in Almaty, Kazakhstan in 2015, including numerous NGOs. CACoR specifically collaborates with the Slovenian and Serbian national CoR associations.

COVID-19 pandemic, the earthquake in Zagreb and numerous calamities caused significant fluctuation in CACoR activities. In 2021 CACoR organised a hybrid international conference in the Inter-University Centre – Dubrovnik and its proceedings will be published.

The Slovenian Association of the CoR was established in 2000. Robert Blinc was elected president. The association organised regular meetings and conferences, the last one in September 2021, the workshop on the Pathways to Sustainable Future.

The Serbian Chapter of the CoR was established in 2015. Nebojša Nešković was elected president. The activities of the Chapter have included the organisation of the Serbian-Italian Meeting on the Sustainable Development Goals and the co-organisation of the Fourth International Conference on Future Education, both in 2019. In the spirit of good cooperation between the three national associations, the Serbian Chapter participated in the organisation of the Pathways to Sustainable Future workshop.

This publication is also a result of the fruitful cooperation between the national associations, which will continue also in the future, as the world is faced with difficult, urgent and important challenges that require all of us to focus our creative potential toward sustainable solutions to these challenges.

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From the Club of Rome to the Slovenian Association:

Historical overview

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Five decades ago, in 1968, Italian industrialist and humanist Aurelio Peccei and his Scottish friend Alexander King, the Head of Science at the OECD, invited to Rome colleagues concerned for the long-term future of humanity and the planet. From this meeting, a group of like-minded people emerged, today known as the Club of Rome. Their core ideas are still guiding the Club of Rome, namely a global and long-term perspective on how to define and address intertwined global problems in order to assure a better future for all.

Already in 1970, MIT Professor Jay Forrester presented an idea to use computer modelling for studying the global phenomena of development. From this initiative, a report entitled *The Limits to Growth* was presented to the Club of Rome in 1972. In this report, Donella and Dennis Meadows, Jorgen Randers and William W. Behrens III presented the results of a numerical solution of a system of ordinary linear differential equations linking population, agricultural production, resource depletion, industrial output and pollution. While the model was clearly oversimplified, it contributed to a changing public discourse regarding future development. This led to the concept of sustainable development, which was also recognised by the United Nations first in the famous Brundtland report in 1987 and then in Agenda 21 at the Rio meeting in 1992.

In these efforts, also Slovenian, Croatian and Serbian scientists played an important role. Ivo Šlaus has been a member of the Club of Rome and is now an Honorary member. Slovenia was represented by Academician Professor Robert Blinc who was a leading Slovenian physicist in the 20th century and Vice President of the Slovenian Academy of Science and Art. From Serbia, Mihajlo D. Mesarović has been an important member and Cady Staley professor of Systems Engineering and Mathematics at Case Western Reserve University. He wrote the second report to the Club of Rome entitled *The Mankind at the Turning Point*, co-authored with Eduard Pestel. While I had only a short meeting with him at the Club of Rome General Assembly in Norfolk, Virginia, in 2005, I had the honour of close cooperation with both Professor Ivo Šlaus and particularly Professor Robert Blinc, who had been my supervisor, mentor and close collaborator since my undergraduate degree studies in physics. He introduced me to the world of the Club of Rome by the founding of the Slovenian Association when tt30 was also established as a global group of young people sharing the values of the Club of Rome.

The memory of the founding of the Slovenian Association in 2000 in the Hotel Toplice in Bled is still very fresh. It was the strong determination of Professors Robert Blinc and Ivo Šlaus that made it possible. Already at its founding meeting, important thought leaders from Slovenia and other countries discussed possibilities for the sustainable development of Slovenia and the world. Some of these ideas were realised very soon with the establishment of the Jožef Stefan International Postgraduate School, which still serves as a role model in postgraduate education in the fields at the cutting edge of contemporary science for a sustainable future.

Soon thereafter, in 2001, the inaugural meeting of tt30 in Hamburg provided a stimulative environment for young leaders where these ideas were further developed under the wise guidance of the Club of Rome Secretary General at the time, Uwe Möller. In the tt30 leadership team, we had excellent cooperation with Tobias Lengsfeld, Ildiko Tulbure and Baker al-Hiyari. At the next meeting in Valencia in 2002, the expanded tt30 attempted to define the world problematique and the world resolutique. It was very clear already at that time that the defining issue of the coming decades would be the energy sources for human use. It is, therefore, sad that in the past 20 years, it was not possible to achieve more progress toward clean and cheap energy sources. The spirit of tt30 is, however, still alive and well as key members joined the Club of Rome and tt30 was consequently dissolved.

It is also worth noting excellent cooperation with the Austrian Association for the Club of Rome, which was then led by late Ivo Stanek, and the European Support Centre led by dr. Thomas Schauer. Many joint events in Vienna and Ljubljana contributed to the development of sustainability thought. These events were organised in close cooperation with the Council for Sustainable Development at the Slovenian Academy of Science and Art, which was led by Professor Robert Blinc. Among these, it is worth mentioning the workshop on Europe after Lisbon: intertwining sustainability and competitiveness in April 2008, which led to excellent ideas published in the proceedings of the conference that we edited together with Thomas Schauer. Another futuristic event was a workshop on Sustainability and space exploration, where many original ideas were captured in the proceedings that we edited together with Ivo Šlaus.

The third major international cooperation has been with the Sustainable Development of Energy, Water and Environment Systems (SDEWES) conference and SDEWES Centre. Following the idea of Professor Naim Afgan, the first SDEWES conference was organised in Dubrovnik in 2002 and has become biannual since 2003. Robert Blinc and Ivo Šlaus were strong supporters of the SDEWES conference since the first idea was presented. They both cooperated in the International Scientific Committee and Ivo Šlaus has also been the President of the Scientific Advisory Board. Following the success of the initial SDEWES conferences, Professor Neven Duić organised a SDEWES Centre in Zagreb, which is dedicated to the organisation of conferences and other sustainability-related activities. The Slovenian Association for the Club of Rome is a strong partner of the SDEWES Centre and regularly organises special sessions at the Dubrovnik SDEWES conferences, which I serve in the International Scientific Committee and in the Award Committee. Among the additional SDEWES conferences, we also organised one of them, the 2nd SEE SDEWES conference in 2016 in Piran. As SDEWES conferences typically attract about 700 sustainability-related scientists, they provide excellent opportunities to discuss and test novel ideas. Our last special session was organised in 2021 and was dedicated to 90 years of Ivo Šlaus.

When we discuss the Club of Rome ideas in Slovenia, the central person was Professor Robert Blinc, the founder and first President of the Slovenian Association for the Club of Rome. He was also the best Slovenian physicist of the 20th century who was an expert in condensed matter physics, following his postdoc in nuclear magnetic resonance with Professor John Waugh at

MIT. Ever since, he was devoted to introducing novel concepts in condensed matter physics to Slovenia and, at the same time, supporting sustainability thought and its introduction to Slovenia. Among these, he developed a unique perspective to the concept of limits to growth, which he popularised in Slovenia, to a large extent also within the Slovenian Association for the Club of Rome. Our member of the Slovenian Association, Margareta Srebotnjak Borsellino shares her thoughts about Professor Blinc in the next chapter.

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Academician Prof. Dr. Robert Blinc: Founder and First President of the Slovenian Association

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The opportunity to meet people who become great during their lifetime is rare. You can be immensely proud if you imagine that you know these people. Probably, the phrase "knowing a person" does not say enough and does not adequately define the knowledge that our colleagues at the Jožef Stefan International Postgraduate School shared with Academician Professor Dr. Robert Blinc.

To know a man means to understand at least most of his actions. Academician Blinc's activities, either his career as a scientist or his other various activities and thoughts, and scientific research work were only seemingly unrelated. You had to work with him to understand him.

I can still see his smile today, but every day I especially miss his clear and concise assessment of the situation, a clear and concise answer to a possible problem. But if you could cooperate with him, if he accepted and chatted with you, that remained in you forever. The human dignity and wealth that he carried within him marked you forever. Humour and sparkle, intelligence and culture of the heart alternated and complemented each other and together, as a whole, represented a man who outgrew his contemporaries and was sometimes unreasonable in his actions. But when we look into the past from the present, we see that there was a prophet many times in the land on the sunny side of the Alps.

He was an Academician, a Professor and a Doctor of Science. Still, above all, he was a man whose insightful words transcended decades, both in scientific research and in his assessment of the society in which he lived and surpassed it. He went so far that today, everyone, both his contemporaries and

the younger generation, speaks his name with respect, even when talking about the so-called "Blinč" school of science or about his assessment of social events.

He was born on October 31, 1933 in Ljubljana. He attended the Classical High School in Ljubljana. He graduated in 1958 and received his doctorate in 1959 at the Department of Physics of the Faculty of Natural Sciences and Technology of the University of Ljubljana. From 1958, he was also an associate of the Jožef Stefan Institute. In 1960-1961, he received postdoctoral training at MIT, Cambridge, Mass., USA. He was elected Assistant Professor in 1961, Associate Professor in 1965, and Full Professor in 1970 at the University of Ljubljana. The secrets of physics and research in its fields have placed him at the top of scientists in this field. International fame and foreign professorships in the USA, Switzerland, Austria, Brazil, the Netherlands, and Bucharest, in no way, deterred him from his love for his homeland. The homeland was one for him. He was aware of the importance of the nation and the uniqueness of Slovenian culture and science from the war years onward, which did not spare him as a child. Love for the homeland was the driving force that inspired him whenever he did scientific research abroad and at home when he lectured either at the faculty or held the position of Dean at the Jožef Stefan International Postgraduate School. Because of the developed European culture, he was also the founder of foundations and societies in Slovenia, and from 2000 until his death, he was also the president of the Slovenian Association of the Club of Rome.

He received almost all of the important awards in this field for his scientific work. He received the Kidrič Award in 1965 and 1971, the AVNOJ Award in 1978, the Science Ambassador Award in 1991, the Zois Lifetime Achievement Award in 2008, and the International Magnetic Resonance Association's Nuclear Hyperfine Interaction Award in 2004.

He was a member of the Institute of Physics and "ISMAR Fellow". He was elected an extraordinary member of SAZU in 1969 and a regular member in 1976. He was a member of III. SAZU class from 27. 2. 1978. From October 1980 to May 6, 1999, he was vice-president of SAZU. He was an external corresponding member of the Saxon Academy of Sciences in Leipzig, the Athens Academy of Sciences in Athens, a member of the European Academy of Sciences and Arts (Salzburg), a member of the European Academy (London), a member of Croatia, a member of the Macedonian and Polish Academy of Sciences and the International Academy of Engineering based in Moscow (from 1996 onwards). He was a member of the wider editorial

boards of the international professional journals *Ferroelectrics*, *Ferroelectrics Letters*, *Chemical Physics*, *Physica* (Section B), *Phase Transitions*, *Solid State Nuclear Magnetic Resonance*. Together with Boštjan Žekš, he wrote the book *Soft Modes in Ferroelectrics and Antiferroelectrics*, North-Holland, Amsterdam (1974), which was translated into Russian and Chinese. He is also the co-author of the book *The Physics of Ferroelectrics and Antiferroelectric Liquid Crystals*, World Scientific, Singapore (2000) and the book *Incommensurate Phases in Dielectrics*, World Scientific, Singapore (1986). His scientific opus is extensive and unique, so we highlight only the most prominent ones.

Research by Academician Prof. Dr. Robert Blinc thus covers the field of ferroelectrics with hydrogen bonds, liquid crystals, incommensurable systems, deuteron glasses, relaxors and magnetoelectric systems. The academician is one of the founders of the use of nuclear magnetic resonance in the research of structural phase transitions and liquid crystals. The aforementioned extensive research in the physical field led to the development of the tunnel model of ferroelectrics with hydrogen bonds, which is also known as the Blinc-de Gennes pseudospin model. He introduced the "soft mode" theory of phase transitions in nematic and ferroelectric liquid crystals. Together with Pincus, they were the first to experimentally demonstrate the existence of order parameter fluctuations in nematic liquid crystals by measuring the frequency dependence of the nuclear spin-lattice relaxation. Using nuclear magnetic resonance, he was the first to experimentally determine the density of solitons in incommensurable systems. He also proved the existence of phason and amplitude excitations in incommensurable crystals using nuclear magnetic resonance. He showed how the Edwards-Anderson order parameter of deuteron glasses can be determined using magnetic resonance, as well as the distribution function of local polarisation. In these systems, spontaneous polarization, the first moment of the distribution function of local polarization, disappears. The second moment of the local polarization distribution function is proportional to the Edwards-Anderson order parameter. Experimental research by Prof. Blinc and his colleagues also led to the so-called "spherical random bond-random field model" of relaxors. Here, elementary dipoles are polar nanoclusters of various orientations and sizes. The order parameter is therefore, not three-dimensional but has infinite dimensionality. With the help of nuclear magnetic resonance, Prof. Robert Blinc proved that the Edwards-Anderson order parameter can also be determined in relaxors. Prof. Blinc also investigated a series of magnetoelectric systems in which

spontaneous polarization and spontaneous magnetization exist simultaneously. This is not possible in classical crystals since magnetization is an axial vector and polarization is a polar vector. It should also be noted that Prof. Blinc and colleagues determined the nature of TDAE-C60, which has the highest magnetic transition temperature of all all-organic magnets.

The scientific opus of academician Prof. Blinc is awesome. He has published more than 600 articles, which have been cited more than 14,500 times in the scientific literature.

In addition to working in science, Prof. Blinc was interested in all questions related to the development of society, humanity, and our planet in general. He thus became active in all associations that were and still are dealing with such issues, as he was aware of the fact that the world has, in addition to physical, also social content. He understood this content with the soul of a scientist, thoughtfully and without excessive emotion.

Fifty years ago, in 1968, at the initiative of Italian industrialist Aurelio Peccei and Scottish scientist Alexander King, 30 successful entrepreneurs and scientists discussed the future of the world. A prominent association, the Club of Rome, was created, which then commissioned researchers from the American MIT University to study the future. The future seemed always close to Prof. Blinc who was always interested in it. With the help of revelations in science, will the world be able to overcome the contrasts between poverty and wealth, between different social arrangements, when the question is the existence of our planet? As a researcher and scientist, Prof. Blinc also founded a branch of the Club of Rome in Slovenia and has been its chairman since 2001. He thus attracted many Slovenian intellectuals to the Slovenian branch of the Club of Rome by regularly meeting at home and abroad with like-minded people and thus contributing to the prestigious work of this association at home and abroad.

Scientists from all over the world thus jointly prepared a system of ordinary differential equations and used them to describe properties such as natural resources, the number of people, and the growth of industrial production. So, they wrote these variables in computer language and thus created a program that calculated what would happen with these variables in different scenarios. The curves of this primitive program for today's man showed that if humanity does not change its behavioural pattern, it will only go down with our planet. For the first time 45 years ago, this program included the whole world as a whole and as one system in one framework.

For men, the quality of life (money, food, accommodation) increased until 1940, but then it started to fall sharply, and judging by the graphs, in two years, we will have a worse quality of life than in 1940. As the world population increases, the quality of life is decreasing, supplies and resources of natural goods are decreasing, and pollution is increasing, which will reach its peak by 2020. If we do not act, the situation will become critical in 2020, people will die, and the population will decrease so much that we will reach the state of 1900. It was clear from the computer curves that in 2040 or in 2050, the end of life as we know it. The computer findings alerted people to the danger, and they started looking for solutions.

In search of solutions, also for this reason, environmental conferences, various agreements, and protocols were adopted, and in 1987, a solution was born in the form of the word sustainable development, which was used for the first time - so that people with more knowledge and fewer natural resources could create a better quality of life. The importance of sustainable development for Academician Prof. Dr. Robert Blinc was such that he identified with him until the end of his life and made sure that the principles and, consequently the values that the importance of sustainable development brings became known and understandable to Slovenians as well.

Concern for the future and willingness to find appropriate solutions is the main driving force of the members of the Club of Rome, who gathered in Rome for the fiftieth anniversary. Among them was Prof. Aleksander Zidanšek, a physicist from the Jožef Stefan Institute, Professor at the Faculty of Natural Sciences and Mathematics of the University of Maribor and Secretary General of the Jožef Stefan International Postgraduate School. His research interests include electromagnetic sensors, ground-penetrating radars, synchrotron light, and magnetic resonance, and he is deeply interested in environmental protection, the future of the planet and man on it. For years, he was a close associate of Prof. Blinc, in many respects his student, and today, the one who most actively advocates for preserving the academician's legacy.

Members of the Club of Rome today study the present. The world is in the midst of rapid development; the capacity of computers doubled in two years, and we cannot even imagine what kind of devices we will have on our desks in 50 years. Experts predict that by the end of next year, computers should have intelligence comparable to that of humans. American futurist Ray Kurzweil (currently working with Google) expects that computers will be smarter than people even before 2030. With this pace of development, this

will soon be achieved and new interfaces between the machine and man will come. There will be an end to boxes and screens, our brains will directly cooperate and communicate with smart devices. Thus, the basic question today is where the border between human intelligence and machine intelligence will be. The basic question that arises during such technological development is the question of the education of individual values. The tradition of the members of the Club of Rome is that we must make sure that personal contact remains very important and that we take care of and learn good mutual relations from a young age. Young generations will need to be further motivated for learning, creativity and imagination so that they will be able to take advantage of all the opportunities that will be offered. According to forecasts, the healthcare system will develop the most. The professions of the future will be both caregivers and computer scientists, the former helping people and the latter helping machines. Machines should help people, they should be more and more useful to humans, and people should take care of each other. A person feels better when he is in human company. Happiness researchers have discovered and concluded that the only necessary condition for happiness is good social contact - that is, friends.

It is true that we live in a world characterised by the speed of exchange of mutual contacts and rapid technological development. Still, the Club of Rome predicted 45 years ago that in the year 2000, status symbols would be completely reversed: prestige would come from low consumption, and personal habits would follow. They say: "less is simply enough". But they added that for this (modesty) to be seen as prestige, radical rethinking by the wealthiest in society will be needed. When asked how we will live in 100 years, i.e. in 2070, the founder of the Club of Rome Peccei replied at the time: "You will have a smaller car, and you will use public transport more often, you will work fewer hours, you will have wider cultural opportunities, you will not be so burdened by basic goods, because the market and new technology will take care of them, you will love nature and try to protect it, because you will be afraid that the animals and greenery around you will disappear."

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III) Sustainable Solutions

Threats Facing Contemporary World and Possible Solutions

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Five years ago, I wrote - quoting Der Spiegel In the old days everything was worse and N. Kristof Why 2017 May Be The Best Year Ever – our world is the best ever [1]. Many indicators prove it: due to achievements in health care and agriculture the life expectance in 50 years increased from less than 40 to over 70 years on all continents and keeps increasing 3 months each year, in 1820 90% of the population lived in poverty, while in 2015 it is less than 10%, the world average caloric supply kcal/day increased from 2250 in 1960 to 2750, and even in developing countries from 2100 to 2600, some diseases are eradicated and many are overcome prolonging healthy, active and satisfactory lives. Political structure considerably improved. While the League of Nations barely lived 20 years, the UN system quite successfully developed for almost 80 years, and many international treaties are achieved, most notably the Montreal Protocol on the ozone hole – a splendid combined result of science, industry and politics. Biological and chemical weapons conventions are in place.

Today, November 23, 2023, I have to write: now is the worst, most dangerous time in the history of humanity: many wars in Europe, Asia and Africa – in less than two months, casualties in the Hamas-Israeli war are over 50,000 and almost total destruction of Gaza. During two years casualties in Ukraine are ten times larger, and food and energy supplies are destroyed. Almost as destructive are wars in Syria and Sahel. All these conflicts are interdependent and each opens opportunities for other conflicts (e.g., in Asia and Africa, as the war in Europe intensified the Middle East conflict). There have been many wars since the end of WW II. Still, these conflicts are the first time that two superpowers - capable of Mutually Assured Destruction (MAD) - are almost directly confronted by each other, not only in the proxy wars (e.g., Syria, Libya) or in the chain of wars involving superpowers, e.g., Afghanistan.

General Colin Powell in Istanbul in 2009 emphasized that no war since the end of WW II accomplished its goal, except possibly the Gulf I war, where the goal was to reestablish Kuwait and that was done efficiently and almost bloodlessly. Wars as a mechanism to change political regimes, specifically to ‘introduce so-called democratic system’ proved to be very unsuccessful. War, any war, is useless.

Why wars? The Seville Declaration in 1986 proved that war and violence are not part of human nature and that societies abandoned them when they became counterproductive. Our animal ancestors did the same. Warfare is not biologically rooted but created by our societies. ‘The same species that invented war [humans] is capable of inventing peace.’ [2]. It is clear that violence, war and conquest aimed to get resources result in more damage than any conceivable gain. Wars and even just preparing for war display and augment the worst features of our nature:

- stupidity: we cause damage and pain to others without any benefit for us and even inflicting damage to us. Nuclear bombs on Hiroshima and Nagasaki resulted in 150-300,000 deaths. Nuclear bomb tests were performed from 1945 to 1996, the last tests made by France and China. North Korea conducted nuclear tests in the 21st century. Eight countries performed 2121 (2056) tests involving 2476 nuclear devices. Most of these bombs were 100-1000 times more powerful than those used in Hiroshima and Nagasaki. Casualties due to nuclear bomb testing are over 200,000, and that number is increasing. Estimates of 340 - 690,000 deaths from radioactive fallout

increases. Several states in the USA: New Mexico, Nevada, Arizona, Utah and a few others were test sites. The atmospheric pattern after the Trinity test caused in New Mexico an increase of cancer death for 35 children and inflicted Down-winders resulting in over 800 additional cancer deaths. Is it possible that our animal ancestors are cleverer than us humans, that we are that stupid? Three quotes are interesting: i) Axel Oxenstierna, chancellor of Sweden said to his son Johan (1648): “Do you know my son with how little wisdom the world is run.” ii) Dietrich Bonhöffer: “Stupidity is a more dangerous enemy than malice.” and iii) Italian economist Carlo M. Cipolla published in 1976 an essay elaborating five laws of stupidity: Law #3: ‘A stupid person is a person who causes losses to another person or a group of persons while himself deriving no gain and possibly incurring losses.’ And #5 ‘A stupid person is the most dangerous type of person.’

Most of those working today in laboratories devoted to nuclear bomb production argue that it is necessary to continue testing to keep existing bomb stock in function and to develop new bombs. The development of nuclear weapons is a permanent threat to humankind.

Global Peace Index, using 24 indicators covering 163 countries, lists nuclear weapon states among the worst: India 126, the USA 131, North Korea 149 and the Russian Federation (RF) 158. Preparing for war does not guarantee a country’s security or peace.

- greed: many countries produce various weapons and sell it to countries which typically give ‘old’ weapons to states in war. The largest weapon producer and exporter is the USA (about 40%) followed by RF, France, Germany and China. According to SIPRI weapons producing companies generated over \$600 billion from weapon industry. The weapon industry keeps increasing, and it peaks in 2022-2023.

A few weeks before Gulf II war started, the market of antique objects sent information around the world that many unique objects from Iraq can be bought at much lower prices.

- killing civilians: the bombing of Coventry and London, of Hamburg and Dresden are done by killers. Should those ordering the bombardment of Dresden be considered war criminals? The same is true of many other orders and the destruction of many cities throughout the world. During the last phase of WW II, the USA bombarded 67 Japanese cities, killing 350,000 persons.

In several wars following WW II, killing of civilians continues. One of the worst is bombardment of Cambodia, Laos and Vietnam. Operations during 1969-70 are referred as 'madman' theory'. Performed atrocities were designed to convince civilians that they should surrender and keep American citizens to still believe that their president is sane to conduct a 'legal' war. Of course, this approach was used throughout WW II.

Selfishness: Many 'politicians' aim to grab and keep power and actually do not care for the needs and/or benefits of their countries. Many of them are ready to initiate wars just to get or keep their power.

Present wars in Europe and the Middle East could lead to the use of weapons of mass destruction (WMD). Though some argue that it is possible to use 'small' WMD, tactical WMD and keep such wars 'under control' – at levels that would never escalate to MAD - this is very unlikely. If any adversary is threatened to be defeated, it will sooner or later use their full WMD capacity. Therefore, Sir Joe Rotblat is quite correct when he said in his speech on November 11, 2002: "Not only a war-free world is desirable, it is now necessary, it is essential if the world is to survive." Two decades earlier - in 1984 - Aurelio Peccei wrote: "To ensure the development of humankind, it is necessary to banish war and any military and non-military violence from our culture. Violence and its ideology are remnants of the past, social pathologies incompatible with the new era." Erasmo compared Caesar with common robbers and stated, "The only difference between them is that Caesar killed many more persons". The same is true for Alexander the Great, Genghis-kan, and Napoleon, Also for Churchill, Roosevelt and Truman? Wars are results of activities of a rather small number of politicians abusing power. If we want to survive, a new political paradigm should eliminate such pathological, criminal persons from any power. Bishop Mandell Creighton in his letter to Lord John Acton in 1887 wrote: "Power tends to corrupt, absolute power corrupts absolutely. Great men are almost always bad men even when they exercise only influence and not authority." Maybe not all – Gandhi?

Major threats and challenges can be aggregated into three groups: One, war and violence. Two, the destruction of natural and human capital. We have barely a few decades to remedy the damage we already did to our natural capital. Three, emerging not fully understood technologies as Artificial intelligence and synthetic biology. These threats are interdependent and

immediate. We require humanity-centred, creative, and out-of-the-box ideas and actions to overcome the second and third threats.

Now is the most dangerous time in the history of humankind. The survival of humankind is at stake and therefore, we, the people, demand:

- 1) Immediate cessation of all wars throughout the world. These wars cannot have victors, only losers – these wars are all useless.[4] As we argued earlier, wars between two countries possessing WMD inevitably lead to MAD.
- 2) Any production, selling, export and dissemination of all weapons: from mines, tanks, cyber, drones, airplanes to nuclear weapons and other WMD should be immediately stopped everywhere and forever.
- 3) Achievement of Sustainable Development Goals (SDG).

Human security for all should be the aim in finding peaceful resolutions of all existing and potential conflicts therefore assuring permanent peace as proclaimed in many UN documents. We call all citizens, all religious leaders, all academies, all civil society organizations, all sovereign states:

REMEMBER YOUR HUMANITY AND FORGET THE REST!

On July 7, 2001 110 Nobel laureates issued in Oslo Statement concluding:

TO SURVIVE IN THIS WORLD, WE MUST LEARN TO THINK IN A NEW WAY. AS NEVER BEFORE THE FUTURE OF EACH DEPENDS ON THE GOOD OF ALL.”

We will be held by humanity to be responsible if we do not act. Economic and military superpowers have more potential and are more responsible. Therefore, it is the duty of the G-20, BRICS, and especially PR China, RF and the USA to secure the implementation of the above demands. Those refusing to act will be damned forever. The UN should control each sovereign state so that the realisation of these demands is properly and timely fulfilled. Clearly, the first action is to end wars! This requires the UNSC unanimous decision to stop all wars and enforce this demand on all fighting parties.

As Russell-Einstein Manifesto (REM) written in 1955 states, we have to assure the survival of humanity and forget the rest: original borders before

hostilities started, even justice and freedom. Stop the fighting immediately and release all hostages. This action can be initiated by a Manifesto written and signed by 11 (or 22) persons – to follow the REM pattern. The above text in italics can be the basis of such a manifesto. While REM aimed to point out the danger of a possible nuclear war and this is why among its signatories are only nuclear experts, this Manifesto addressing the present threat to human survival invites signatories from a broad domain. Ideally, signatories should involve present and former heads of UN organizations, heads of state, leaders of religions and important civil societies, outstanding scientists and artists. These personalities should act as individuals. This action can be done within a few weeks. People are killed and we will all be murderers if we do not act immediately. It is instructive to analyze the effect of REM. Maybe it helped to achieve peace during the Cuban crisis. It certainly led to an establishment of two civil society organizations: Pugwash Movement in 1957 and World Academy of Art and Science (WAAS) in 1960. A proposed Manifesto will support any action for peace, particularly those of UNSG. It gives support to Pope Francis pointing out the responsibility of weapons exporters. Exporters of weapons are among the most responsible for wars.

Of course, it can be criticized that no concrete solutions are outlined. This is not quite correct since this Manifesto links present wars with two other threats facing humankind. It points to an extremely negative influence of weapon exporters, and it states what should be done. One could argue that such a massive elimination of the military industry will have numerous negative effects. However, during WW II, a successful transition from nonmilitary to military and then back to nonmilitary industry was accomplished quickly and without negative effects.

Nevertheless, we appreciate that some specific solutions have to be suggested. For instance, civil societies can and should be collective signatories, but we realize that to get unanimous or at least significant majority support will take many weeks. Specific proposed solutions for each of the above-mentioned wars should be formulated as individual contributions as J. Sachs did by his recent excellent address to the UN. We propose these actions to be the second step interconnected with very active diplomatic activities. The entire process should be strictly controlled by the UN until a permanent stop of all hostilities and permanent peace is reached.

Threats facing humanity and proposed solutions look as mission impossible. Not true! Humankind already successfully accomplished enormous tasks using the Golden Rule “Love thy neighbour as you love thyself.” expressed in game theory language as tit-for-tat or in religions: “Love all other persons as God loves you.” We encounter these behaviours each time we go to hospitals and are helped by the entire health-care system, from nurses to physicians and researchers, when we go to schools from teachers to researchers, when we go to restaurants and enjoy our meal in the production of which not only farmers and cooks participated but a full food system. Empathy is essential for our survival, and we have to use it constantly and suppress hatred, violence, greed, selfishness and stupidity.

This conference presented the first volume in a series ‘Pathway’, which was entitled “Ivo Slaus’ Vision”. My vision, our vision is the world of peace and sustainable development based on creativity, empathy, love and knowledge. Since that volume was dedicated to my 90th birthday, to what extent my life has been dominated by empathy and creativity? It is always good to receive recognitions, awards, and orders, but the one that I got now from the President of my Fatherland ‘Order of Duke Trpimir’ is and always will be special and particularly dear to me and to all my friends. ‘President of the Republic of Croatia Mr. Zoran Milanović decorated Ivo Šlaus on April 26, 2023 with ‘The Order of Duke Trpimir with Necklace and Danica (Morning star) for special merits in the field of science, research, international relations and exceptional contribution to the reputation of the Republic of Croatia and its international position in the world.’ (Fig.1) This Order was presented on October 25, 2023.



Fig 1. Order Duke Trpimir

Proposal to receive this order came from the Croatian Pugwash Society (CPS). International Pugwash was founded in 1957 following the REM and already in early 1960 CPS organized a conference in Dubrovnik attended by many Nobel laureates. A sequence of activities where we played a role follows with the foundation of the European Physical Society in 1969, Academia Europaea (AE) in 1988 and the election of all Nobel laureates in physics in 1990/91 while Ivo Šlaus was head of the Physics-engineering division of AE. All of these contributed to an appeal of more than 130 Nobel laureates 'Stop the war in Croatia'. The five terms in the International Pugwash Council, the foundation of the Croatian, Slovenian, Serbian and Bosnia&Herzegovina National Associations of the Club of Rome, European Leadership Network and most significant, WAAS is not an individual result, but an effort of numerous institutions, .e.g. Croatian Academy of Sciences and Arts, "Rudjer Bošković" Institute, Inter University Center Dubrovnik including over 100 universities throughout the world, "Jozef Stefan" Institute and University of California Los Angeles, Georgetown University, Duke Univ., Kyoto Univ., Univ. Louvain, Univ. Tübingen, Univ. Laval, North Carolina Central University, Los Alamos National Laboratory, Naval Research Laboratory and TRIUMF, Vancouver. My fatherland made these collaborations possible.

Progress humankind achieved through millennia is spectacular. Can we successfully accomplish tasks facing us: recover natural and human capital and assure that emerging technologies are beneficial and not destructive. Technologies typically have positive and negative effects starting from fire and irrigation to nuclear energy and humankind has always succeeded in assuring that benefits overwhelm damage. Can we achieve the same for artificial intelligence (AI) and synthetic biology? The most significant difference between AI and all other technologies is that while building nuclear bombs taught us how to make larger bombs, it was us – humans who had to do it. For the first time in humankind history our product can itself produce more developed 'machines' by AI. The only possibility to secure that emerging technologies are beneficial and not destructive are knowledge, research, science, art, creativity, empathy and love. These are the features we have to emphasize! While many technological and scientific developments were initiated by a relatively small number of persons, the tasks facing us require the involvement of many almost all of us. We have to change ourselves.

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- 2) The Seville Declaration in [1] Chapter 3
- 3) First test of fission bomb was done in Alamogordo, New Mexico – Trinity test on July 16, 1945. The USA did the first H-bomb test in 1952. The USSR tested its first fission bomb on August 29, 1949 and the largest H-bomb test ‘Tsar bomba’ on October 1, 1961).
- 4) As we argued earlier wars between two countries possessing WMD inevitably leads to MAD. Some speak of possible victories, defeat of the adversary. The defeat of one adversary with WMD creates chaos. (Remember what happened after the collapse of the USSR) leaving the possibility that a huge stock of WMD can be obtained by terrorists.

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Transition to sustainable society

How to support the transformation of society into a sustainable society on a personal level?

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Sustainable development emerged from a political and environmental struggle. Today, there is almost no actor of international public law and international relations who is not involved in the process of transition to a sustainable society, from governments to non-governmental organizations, universities, companies and citizens.

The transition to a sustainable society represents the process of moving from the current social system to a sustainable social system that would be in harmony with nature and would ensure the sustainability of the entire global society. This transition is a very complex and multifaceted issue that requires a joint action from all stakeholders. According to the European Environment

Agency sustainability is about meeting the world's needs of today and tomorrow by creating systems that allow us to live well and within the limits of our planet (EEA:2023). That means that a sustainable global society will require a fundamental shift in production and consumption systems.

Achieving a global sustainable society requires the joint engagement of a number of individuals, governments, companies, academia and non-governmental organizations. There are a number of ways to contribute to the creation of an appropriate framework for a sustainable society. The key is the implementation of the goals of sustainable development, adopted by the United Nations (UN: 2023). Each individual can actively commit to one or more of them, such as poverty, inequality, improving health, climate change or environmental protection. At the same time, one must not lose sight of the fact that only by simultaneously implementing all 17 SDGs and all 169 targets can the global society be improved into a society that will be sustainable in the long term.

Columbia University Climate School suggests that to achieve the transition to environmental sustainability, we must undertake the following five actions: research, measure and understand the current state of environmental degradation, understand the causes of environmental degradation, develop a strategy for reducing pollution and growing a renewable-resource-based economy (Cohen : 2021). These are primarily the tasks of governments, non-governmental organizations and the academic community. However, each individual can take certain actions and measures to contribute to the transition to a sustainable society.

There are a number of smaller actions and measures that can be taken by individuals, in order to directly influence a globally sustainable society, such as reducing energy consumption, using public transport, recycling, buying locally grown food, reducing the use of single-use plastics, reducing consumption and waste, investments in renewable energies, investments in sustainable agriculture, promotion of sustainable transport and sustainable tourism (Center for Biological Diversity : 2023; Vishnubhotla : 2023).

Reducing personal consumption and waste is certainly an important step towards achieving a sustainable society. This can be achieved by adopting sustainable practices such as recycling, reducing the use of single-use plastics and composting. In addition, reducing the temperature in the spaces where

we stay at a lower temperature around 17 degrees, can make a big difference and save your energy costs (Vishnubhotla : 2023).

However, energy sustainability is achieved through investment in renewable energy such as solar energy, wind and hydropower are measures that can be taken by individuals. Renewable energy sources are clean, abundant and do not contribute to climate change. At the same time, the government's support for this process is crucial, because they can influence the availability of renewable energy. In addition, they can encourage investments in renewable energies with favorable tax policies. Of course, in addition, the academic community and non-governmental organizations contribute with their analyzes and research to the promotion and implementation of renewable energy in the society of the future.

Supporting sustainable agriculture is essential from the aspect of sustainability, but also safety and security. Without drinking water and available food there is no life at all. Sustainable agricultural practices such as organic farming, agroforestry and permaculture can help reduce the impact of agriculture on the environment. These practices promote soil health, biodiversity and reduce the use of harmful chemicals. At the same time, the implementation of sustainable agriculture is crucial for the sustainability of global climate migrations. If there will be no sustainable agriculture in some regions of the world due to climate change, climate migration will occur, which could be in smaller numbers if agriculture is sustainable. In addition, reducing the use of drinking water is essential to achieve a sustainable society. Some easy fixes to reduce water consumption could be taking quick showers, using just the required amount of water while cooking and turning off running taps when unused even for seconds (Vishnubhotla : 2023).

One of the actions that can be taken by individuals, in order to contribute to the transition to a sustainable society, is related to the implementation of sustainable transportation in everyday life. Promoting sustainable transport such as walking, cycling and public transport can help reduce greenhouse gas emissions and air pollution. Governments and local governments should commit to investing in infrastructure such as bike lanes, footpaths and public transport systems. Some countries, such as Luxembourg, have made public transport available to all citizens without additional fees, which has made transport throughout the country more sustainable (Research Luxembourg : 2021). The only exception are tickets and subscriptions for the 1st class,

which still have to be paid for (Calder : 2020), which enables individuals who want more comfort or, for example, work while driving, to participate in covering the costs of public transport, which enables fairer redistribution resources and social equality.

Also in the field of tourism, individuals can play a very active role in the transition of society to a sustainable society. Every individual who participates in tourism can influence the sustainability of tourism, whether he is a tourist or a provider of some of the tourist services. Sustainable tourism can be understood as the responsible disposal of tourist resources, from cultural values to natural resources. Sustainable tourism implies: optimal use of natural resources while preserving ecological processes, natural heritage and biological diversity; respecting the social and cultural values of the community, and preserving cultural heritage and traditional values with cross-cultural understanding and tolerance; long-term planning to improve economic opportunities and alleviate poverty while constantly contributing to social opportunities within the community (Dobrota: 2015). If an individual wants to contribute to sustainable tourism, he will participate in the implementation of sustainable tourism practices such as ecotourism, rural tourism and responsible tourism. Through them, the individual promotes the preservation of the environment, preservation of culture, economic development and social equality.

The aforementioned actions and measures are only some that can be implemented and promoted by an individual in order to contribute to the transformation of society into a sustainable society. There is a whole series of measures with which an individual can contribute to sustainable development, such as the construction of energy-efficient houses or small actions in the household that can easily achieve savings, reduced consumption such as; turn off the lights when leaving a room, use LED lights, switch to efficient appliances, unplug devices, use smart automated devices, use double glazing doors, cook with the lid on, wash at low temperature (Vishnubhotla : 2023). With all these actions, an individual can very effectively help achieve a sustainable society.

Conclusions

Each stakeholder should contribute to the transition of society into a sustainable society. Every individual has an extremely important role in this process. There are a number of measures and actions that can be taken by individuals, in order to directly influence a globally sustainable society. Key measures are reducing personal consumption and waste, reducing energy consumption, supporting sustainable agriculture, recycling, buying locally grown food, reducing the use of single-use plastics, investments in renewable energies, investments in sustainable agriculture, promotion of sustainable transport and sustainable tourism. With these actions and measures, each individual contributes to the realization of a sustainable society, equality and environmental awareness.

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On the South-East European International Institute for Sustainable Technologies initiative

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In November 2016, the Board of Trustees of the World Academy of Art and Science (WAAS) accepted the initiative of Herwig Schopper, Trustee and the former Director-General of the European Organization for Nuclear Research (CERN), Geneva, Switzerland, to create the South East European International Institute for Sustainable Technologies (SEEIIST). Schopper's idea was to focus the SEEIIST program on the completion of construction of the TESLA Accelerator Installation, in the Vinča Institute of Nuclear Sciences, Belgrade, Serbia, and to establish a strong collaboration between the Vinča Institute, the Ruđer Bošković Institute, Zagreb, Croatia, and the Jožef Stefan Institute, Ljubljana, Slovenia, as the basis of the program. TESLA is a large scale facility for production, acceleration and use of ion beams in science, technology, medicine, and education. The initiative was strongly supported by Nebojša Nešković, the former Head of the TESLA Project, and Ivo Šlaus, from the Ruđer Bošković Institute, both of them Trustees of WAAS. In December 2016, the leadership of CERN accepted to help in carrying out the SEEIIST program.

Nešković sent to Schopper in January 2017 the concept of the project entitled Science and Technology for Sustainable Development of Southeastern Europe, as a part of the SEEIIST program, whose aim was to complete the construction of TESLA. The programs of use of TESLA would

be: research and development in materials science, radiation biology, chemistry and physics, physics of thin crystals, and neutron physics; production of radiopharmaceuticals for diagnostics and therapy; and proton therapy of eye tumors. Beside the Ruđer Bošković Institute and the Jožef Stefan Institute, the project would involve the Institute for Nuclear Research and Nuclear Energy, Sofia, Bulgaria, the National Centre for Scientific Research "Demokritos", Athens, Greece, and the Frascati National Laboratory, Rome, Italy.

The premiers of the Western Balkan countries decided in March 2017 in a meeting in Sarajevo, Bosnia and Herzegovina, to include the SEEIIST program in the Berlin Initiative, created by the European Commission for the Western Balkans, and to provide about EUR 200 million for the realization of the program.

Šlaus organized in April 2017 in Zagreb a meeting of the representatives of the Ruđer Bošković Institute, the University of Zagreb, the Jožef Stefan Institute, and the Vinča Institute devoted to the SEEIIST program. Aleksander Zidanšek and Uroš Cvelbar, from the the Jožef Stefan Institute, and Nešković were among the participants. In the meeting, the representatives of the Vinča Institute proposed a concept of the program that included the completion of construction of TESLA and the construction of a synchrotron radiation facility for materials science and technology in a wide sense in the region of Konavle, near Dubrovnik, Croatia. The latter part of the program, which was its larger part, would be realized with the main roles given to the Frascati National Laboratory and the Ruđer Bošković Institute. The participants of the meeting accepted the proposal in principle, and Schopper was informed about that. However, Schopper informed Nešković in May 2017 that he had been asked by the European Union administration to abandon the idea of focusing the program on TESLA, because Serbia could not play any significant role in South East Europe.

In October 2017, a meeting of the government representatives of nine South East European countries related to the SEEIIST program was held at CERN. The main outcome of the meeting was a declaration on the construction of a synchrotron radiation facility for research in physics, biology, archeology, nanotechnology, etc. or a hadron beam facility for research and treatment of tumors as the core of the program. TESLA was not mentioned in the document in any way. However, in November 2017, Nešković participated in a meeting coorganized by WAAS in Podgorica, Montenegro, with a contribution including a proposal to include in the

SEEIIST program the completion of construction of TESLA as its first phase and the construction of the synchrotron radiation facility or the hadron beam facility as its second phase. Schopper, who was present in the meeting, was not against the proposal.

The Vinča Institute and the Chamber of Commerce and Industry of Serbia organized in the middle of January 2018 in Belgrade a meeting on cooperation in science, technology and medicine in South East Europe. The central point of the meeting was Nešković's talk entitled the New TESLA Project: Science, Technology and Medicine for Sustainable Development of Southeastern Europe. He described the proposed first phase of realization of the SEEIIST program, devoted to TESLA. Šlaus participated in the meeting as a representative of WAAS, and fully supported the proposal. At the end of the same month in Trieste, Italy, the kick-off meeting on the SEEIIST program was held. It was focused on the two options for the program core – a synchrotron radiation facility or a hadron beam facility. Nešković was given 10 minutes in the general discussion at the end of the meeting to talk about technology transfer in South East Europe, rather than on TESLA. In spite of that, he presented the New TESLA Project, and that was the end of participation of the Vinča Institute in the program. Also, that was the end of the effort of the Vinča Institute, the Ruđer Bošković Institute, and the Jožef Stefan Institute to jointly participate in carrying out the program.

It was being tried after that to find an alternative accelerator center in South East Europe that would host SEEIIST but without success, and the initiative was declared extinguished during the World Conference on Basic Sciences for Sustainable Development, held in September 2022 in Belgrade.

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Happiness in Nations and Governance*

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Happiness in nations has been systematically followed by psychology researchers for more than two decades. It has been demonstrated by many authors that it is positively correlated with many different measures of well-being including the sustainability indicators. In this contribution we analyse possibilities to implement some measure of happiness as an additional or alternative indicator of well-being, which could compete with the GDP per capita to measure the quality of life in a given country.

* Reprinted with permission from the Proceedings of the 6th SDEWES Conference, Dubrovnik, 2011

Introduction

The first systematic measure of happiness in nations was introduced by Veenhoven who created a home page with a systematic review of correlations between happiness in nations and other indicators of well-being [1]. Among others it has been demonstrated that happiness in nations is positively correlated with different sustainability indicators [2]. Recently President of France and government of Britain decided to explore possibilities to collect national data on happiness [3] in a similar way as GDP per capita is measured.

This is a different approach than the Gross National Happiness (GNH) indicator, which is already measured in Bhutan in a role similar to GDP in other countries. It is however important to stress that the GNH indicators is a composite indicator from many different fields and is therefore only partially related to happiness. Another indicator more closely related to happiness is therefore required to compete with the GDP.

Happiness in nations is determined as average happiness of population of a given country. In this way it is directly related to individual happiness. Here the individual happiness is measured with a questionnaire, where the respondent can choose between different levels of happiness. Most studies offer either a 1-10 scale or a 1-4 scale answer where people can choose an appropriate level for their own happiness.

Happiness in nations has an important advantage against composite indices such as the Happy Planet Index [4] which contain more information but are not directly related to happiness of individuals. The disadvantage of happiness in nations compared to GDP per capita is that it is only measured every few years on a small sample of the population, and therefore has a relatively large statistical error.

The purpose of this contribution is to analyse possibilities to implement a possible happiness indicator as an additional or alternative indicator of well being, which could compete with the GDP per capita as a measure of quality of life in observed countries. Namely, GDP measures only the amount of economic activity and not its quality. In order to measure the quality of life, it is necessary to get more information. This information could either be based on objective indicators which measure some well-defined parameter in the real world, or based on subjective indicators which are obtained with a questionnaire. In this contribution we focus on subjectively measured

happiness. It is also possible to measure happiness objectively, for example with algorithms for analysis of facial expressions, which can measure the percentage of happiness for any given image of a face [5]. Although our analysis is based on subjectively measured happiness, it is also valid for objectively measured happiness. We analyse the possibility to regularly use a happiness indicator, which would measure happiness of people with a similar frequency as the GDP is measured, i.e., every month. There are many open questions. First it is interesting to estimate the costs of measuring for such an indicator as compared to the costs of measuring GDP. The question is also how strongly such an indicator is correlated to some important indicators related to the quality of life, and whether there are differences between developed and developing countries.

In this contribution we selected the indicator of extreme happiness, which measure the percentage of very happy people who answered the happiness questionnaire with the highest available grade. For comparison with other important indicators related to the quality of life we selected indicators on good governance. We build on the results of Jan Ott [6] who found that technical quality of governance correlates positively with happiness in nations both in rich and in poor nations more strongly than democracy. We analyse this relationship in more details in order to get additional insight on cause-and-effect relations between good governance and extreme happiness.

Good Governance

Good governance is one of those concepts that many people discuss but is not easy to define. While it is easy to spot bad governance, it is more difficult to define and measure good governance. There exist many indicators dedicated to measuring good governance. The World Bank has for example developed worldwide indicators of good governance [7]. This set of indicators measures six dimensions of governance: Voice and Accountability, Political Stability and Absence of Violence, Government Effectiveness, Regulatory Quality, Rule of Law, and Control of Corruption. Helliwell and Huang [8] were the first to compare the data about life-satisfaction from the World Values Surveys [9] with these World Bank indicators about good governance [7]. They found that indicators related to democracy are relatively more important for relatively poor nations, and that indicators related to the quality of government services are

more important for richer nations. Ott [6] expanded their analysis to a larger dataset, assessed the impact of culture and wealth on this relation, and inspected the relations between the government size, quality of governance on happiness. He found that people live happier in well governed nations, which seems to be at least partly because of the causal effect of good governance on happiness. It therefore seems that investments in good government could be a good method to make people happier.

Happiness in Nations

Happiness in nations has been intensively studied and measured by Veenhoven [1]. Also, happiness of individuals has been intensively studied by many researchers. Diener and Seligman [10] found that good social relations are the only necessary characteristic of very happy people. Lyubomirsky and Sheldon [11] found that sustainable gains in happiness can be achieved by changing one's actions, not the circumstances. Social impact of happiness has also been studied. Happiness in nations has been found to be positively correlated with wealth, educational level, and access to knowledge, personal freedom, equality, social position, marriage, and health [1]. Regarding wealth there is some controversy: While it is clear that for people with low income up to about 10.000 USD per year happiness grows significantly with increasing income, Easterlin found that the correlation between happiness and wealth becomes weaker at higher levels of income [12]. He therefore recommends strongly progressive tax system, so that the happiness would be optimised for a greater number of people. It has also been shown by Inglehart *et al* [9] that happiness has been increasing with time from 1981 until 2007.

While most happiness researchers are analysing the effects of the average happiness in a given country, we are in this paper interested predominantly in the indicator of extreme happiness as given by the percentage of people who respond to happiness questionnaire with the answer "very happy".

Happiness and Governance

We checked correlations between the percentage of very happy people from the last wave of the World Value Survey [9] and several indicators of good governance from the World Bank [7].

The percentage of very happy people was determined as the percentage of people who selected the best response (very happy) among the four offered answers: 1 Very happy; 2 Quite happy; 3 Not very happy; 4 Not at all happy very happy. The study included the following countries [with a 3-digit country code and the year of the survey in brackets]:

Andorra [ADO, 2005], Argentina [ARG, 2006], Australia [AUS, 2005], Brazil [BRA, 2006], Bulgaria [BGR, 2006], Burkina Faso [BFA, 2007], Canada [CAN, 2006], Colombia [COL, 2005], Cyprus [CYP, 2006], Chile [CHL, 2006], China [CHN, 2007], Egypt [EGY, 2008], Ethiopia [ETH, 2007], Finland [FIN, 2005], France [FRA, 2006], Georgia [GEO, 2008], Germany [DEU, 2006], Ghana [GHA, 2007], Great Britain [GBR, 2006], Guatemala [GTM, 2004], India [IND, 2006], Indonesia [IDN, 2006], Irak [IRQ, 2006], Iran [IRN, 2005], Italy [ITA, 2005], Japan [JPN, 2005], Jordan [JOR, 2007], Malaysia [MYS, 2006], Mali [MLI, 2007], Mexico [MEX, 2005], Moldova [MDA, 2006], Morocco [MAR, 2007], Netherlands [NDL, 2006], New Zealand [NZL, 2004], Norway [NOR, 2007], Peru [PER, 2006], Poland [POL, 2005], Romania [ROM, 2005], Russian Federation [RUS, 2006], Rwanda [RWA, 2007], Serbia [YUG, 2006], Slovenia [SVN, 2005], South Africa [ZAF, 2007], South Korea [2005], Spain [ESP, 2007], Sweden [SWE, 2006], Switzerland [CHE, 2007], Thailand [THA, 2007], Trinidad and Tobago [TTO, 2006], Turkey [TUR, 2007], Ukraine [UKR, 2006], United States [USA, 2006], Uruguay [URY, 2006], Viet Nam [VNM, 2006], Zambia [ZMB, 2007].

There are six World Bank indicators on good governance: voice and accountability index, political stability index, government effectiveness index, regulatory quality index, rule of law index and control of corruption index [7].

Correlations of each World Bank indicator on good governance with the percentage of very happy people are shown in Figures 1 – 6. The data points are shown as a 3-digit country code, and a trendline corresponding to a least square fit to a linear function is also shown in each Figure.

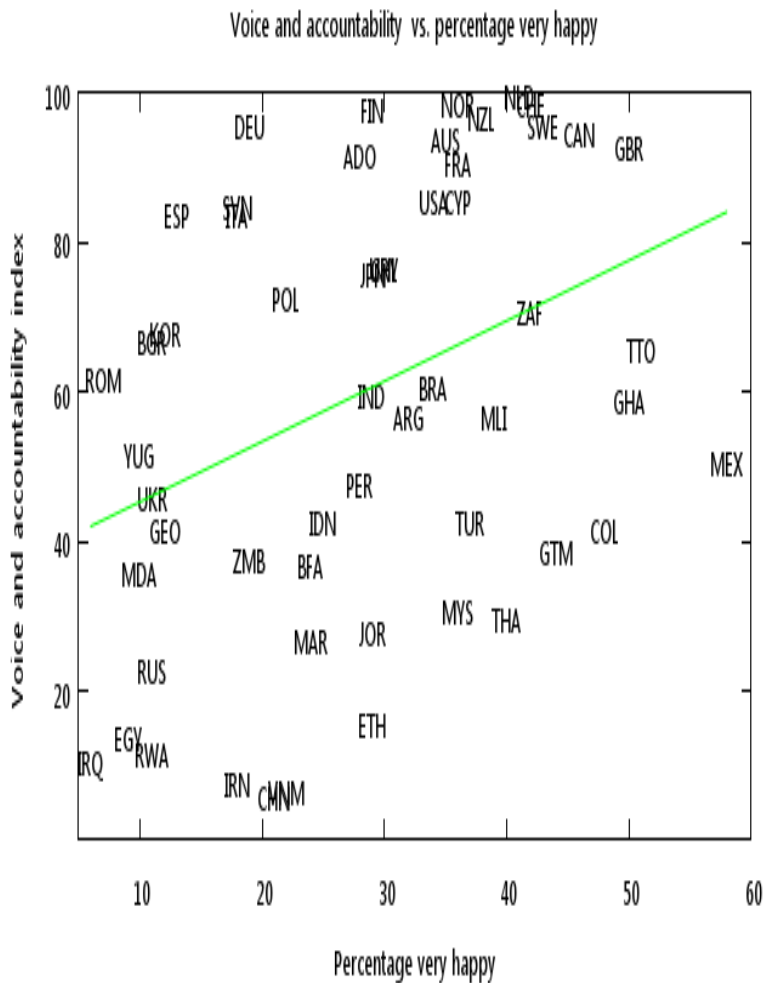


Figure 1. Voice and accountability index [7] as a function of the percentage of very happy people [9]

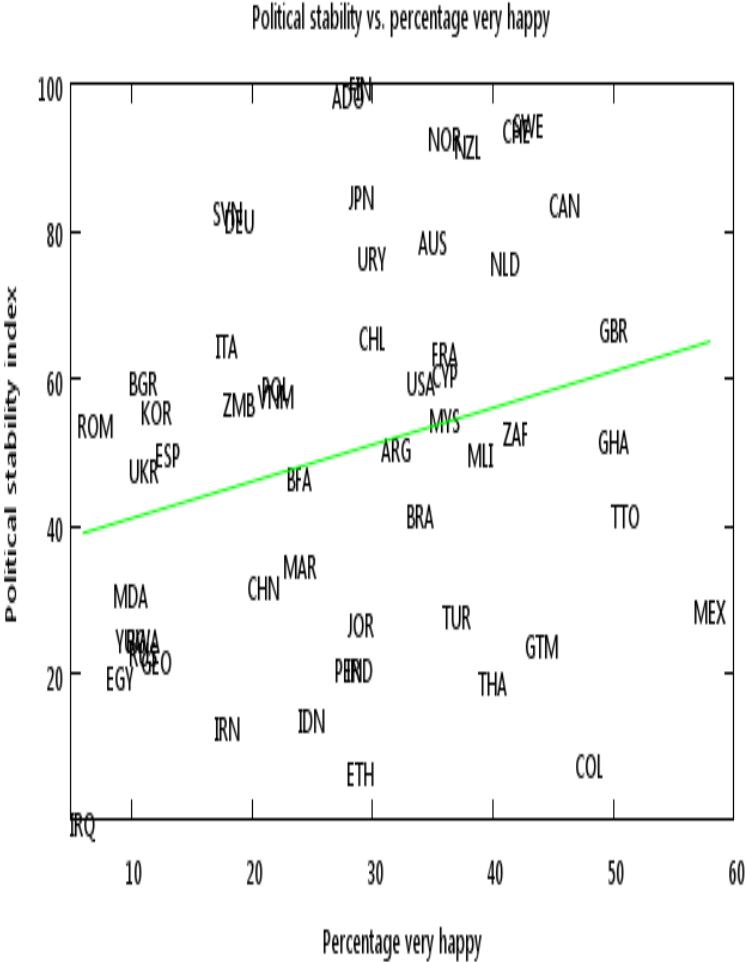


Figure 2. Political stability index [7] as a function of the percentage of very happy people [9]

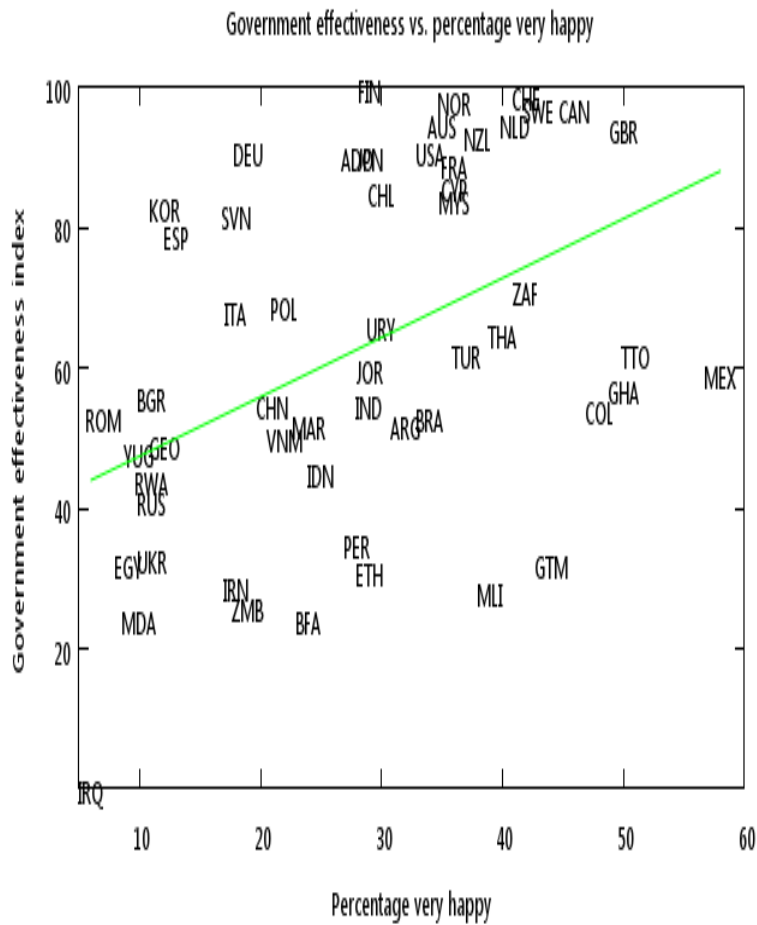


Figure 3. Government effectiveness index [7] as a function of the percentage of very happy people [9]

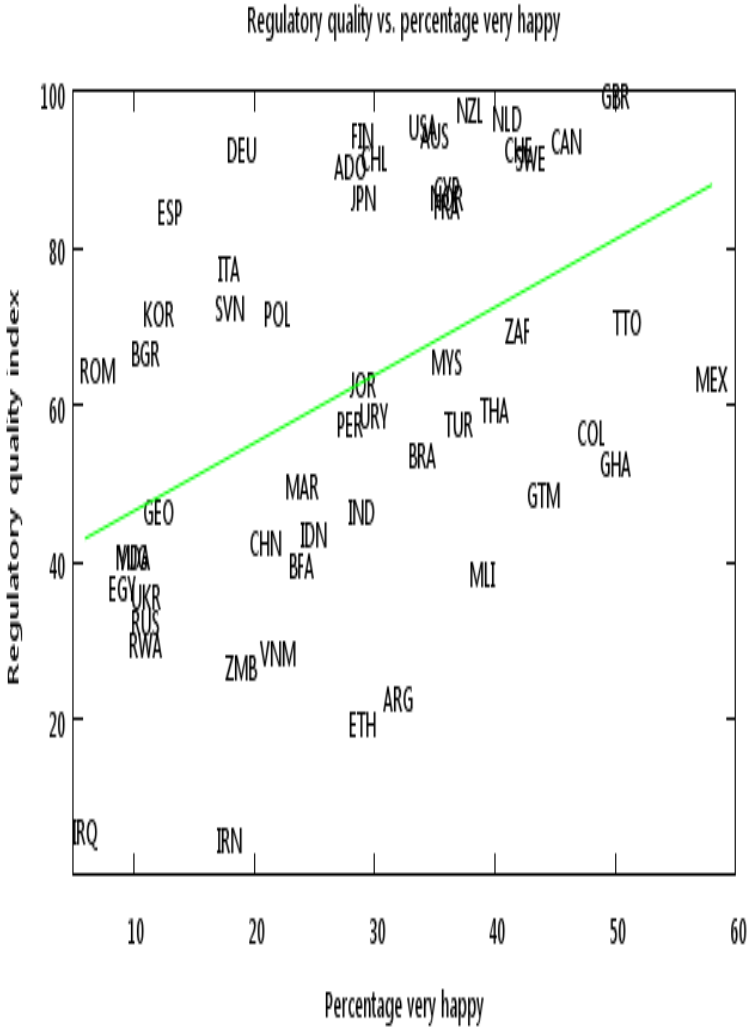


Figure 4. Regulatory quality index [7] as a function of the percentage of very happy people [9]

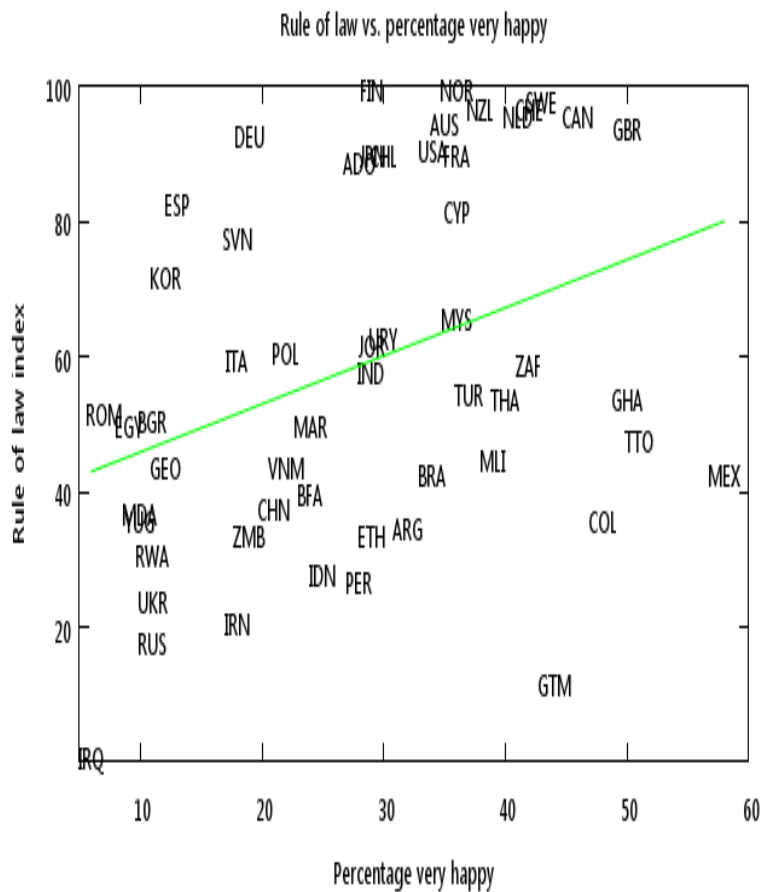


Figure 5. Rule of law index [7] as a function of the percentage of very happy people [9]

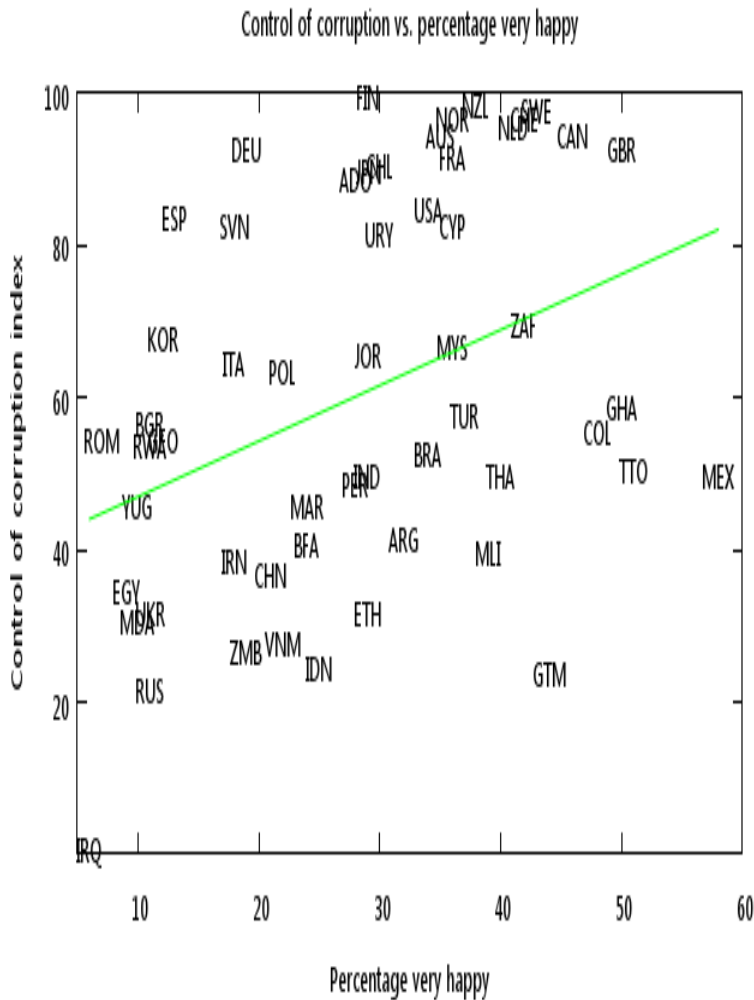


Figure 6. Control of corruption index [7] as a function of the percentage of very happy people [9]

Discussion

The trendlines in Figures 1 – 6 demonstrate that the results for the percentage of very happy people are similar to the results for average happiness by Helliwell and Huang [8]. Although the data are strongly scattered, there is a positive correlation between the percentage of very happy people and each World Bank indicator of good governance. There are some very happy countries with not so good governance and there are also some not very happy country with good governance. The trendlines are very similar for each World Bank indicator except for the political stability index where the correlation is still positive but somewhat weaker.

As Helliwell and Huang [8] found different behaviour between the developed countries and developing countries, we also noticed a trend related to cultural differences. In our previous work on sustainability indicators [13] we found culturally similar countries form distinct patterns. Four most expressed groups are [13]: 1) Western predominantly Germanic countries; 2) Predominantly Romanic countries; 3) Former communist countries; 4) Developing countries. For illustration we show the results for the correlation of extreme happiness with the government effectiveness index in Figures 7 - 10. Some countries can belong to more than one group. Since the names of the countries are given in Figures, it is easy to see if some country behaves differently from the trend for similar countries.

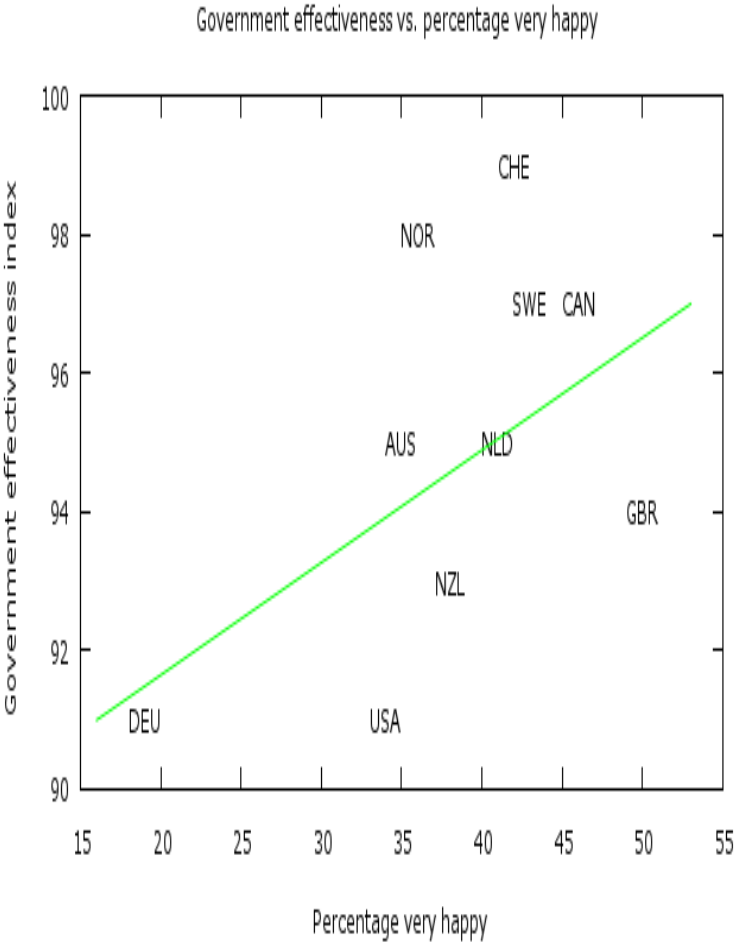


Figure 7. Government effectiveness index [7] as a function of the percentage of very happy people [9] for Western predominantly Germanic countries

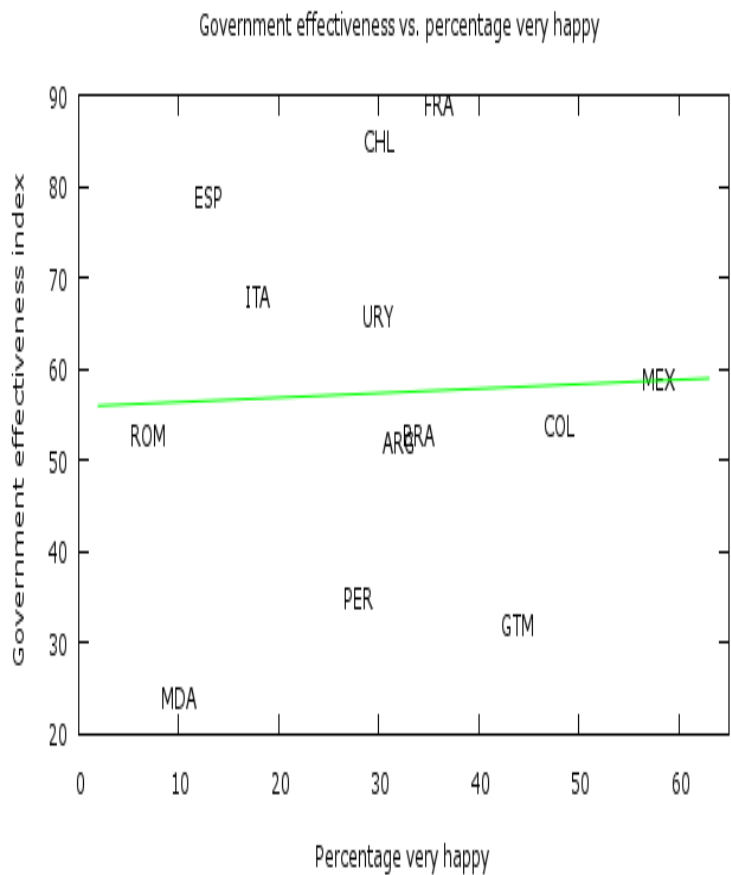


Figure 8. Government effectiveness index [7] as a function of the percentage of very happy people [9] for predominantly Romanic countries

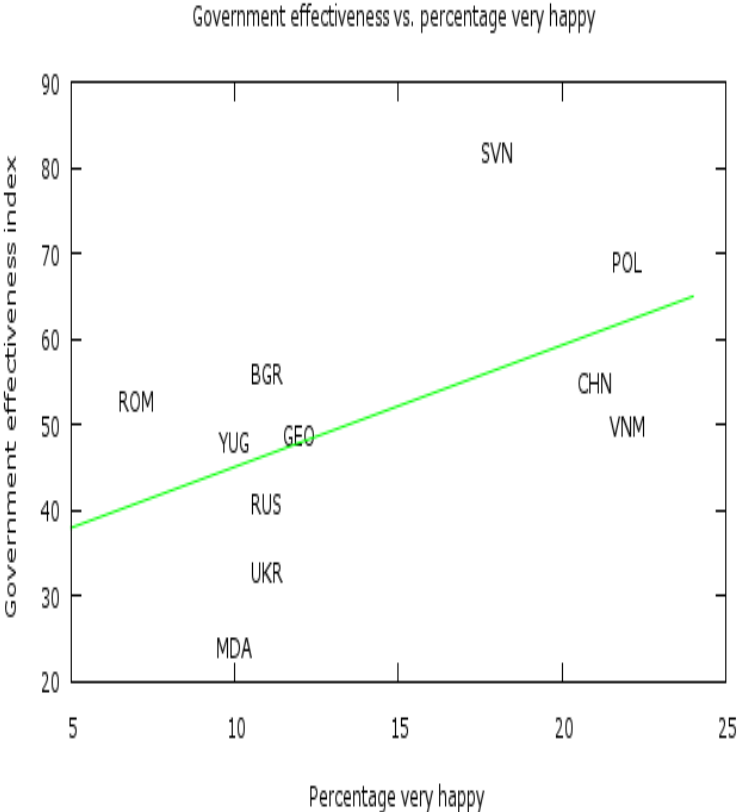


Figure 9. Government effectiveness index [7] as a function of the percentage of very happy people [9] for former communist countries

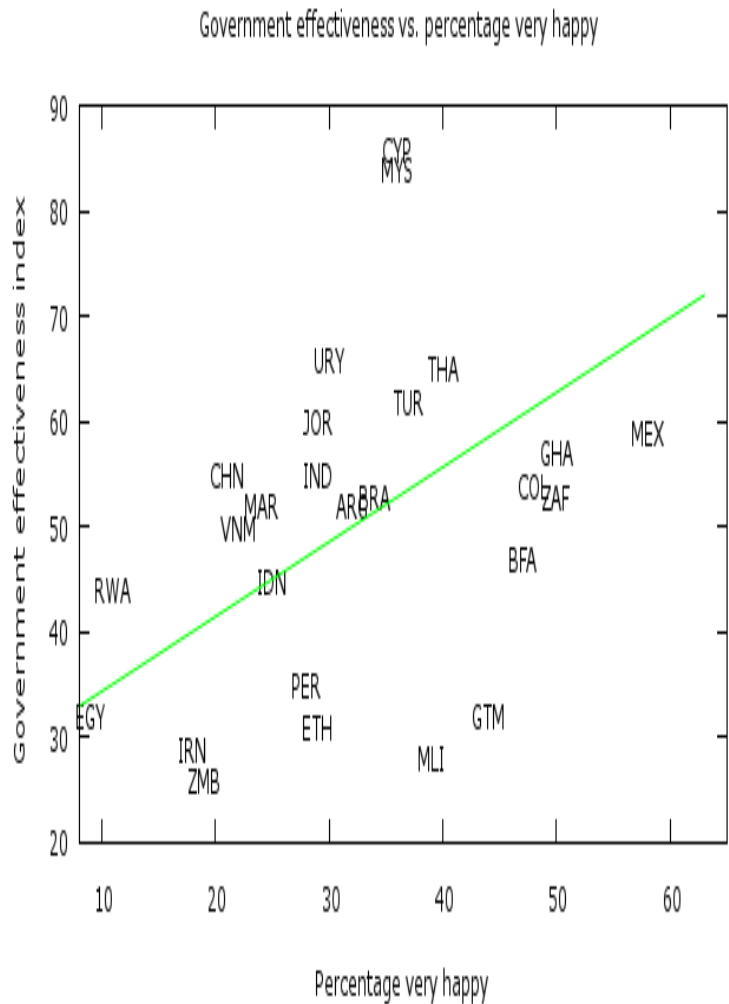


Figure 10. Government effectiveness index [7] as a function of the percentage of very happy people [9] for the developing countries

If we investigate correlations between happiness and good governance for these groups of countries, we get for three of these groups (groups 1, 3 and 4) a clearly positive correlation. There are however some important differences between these similarly behaved groups. The group number 1 is characterized by excellent governance and the group number 4 with rather poor governance. The fit in group number 1 shows that two countries deviate significantly, namely Germany has much less extreme happiness than estimated from its governance indicators, and Great Britain has a much larger number of very happy people than indicated by its governance indicators. The group number 3 is in addition to rather poor governance also characterized by extreme lack of happiness. Here there is also a distinct group of former Soviet Union countries little above 10% of very happy people where happiness seems to be rather independent of the quality of governance. The group number 2 of predominantly Romanic countries is however significantly different from all other groups. In the Romanic group there is very little correlation and there is a large standard deviation. Spain as the Romanic countries with third best governance is for example among the least happy countries, and Mexico as the happiest among the observed countries has only an average quality of governance. It is however interesting that the 3 developed countries in this group behave differently than the rest of Romanic countries. Namely, all 3 developed countries are among the 5 countries above the trendline. In addition, the 2 former communist countries are on the left-hand side of the graph below the trendline with very little extreme happiness. Without these two groups of countries the unusual behaviour of the Romanic countries is limited to Latin American countries to the south of equator, namely Chile, Uruguay, Brasil, Argentina and Peru. All these countries have about 30% of very happy people; however, their governance indicators are very different. While Chile has excellent governance at the level of developed countries, Peru has very weak governance at the level of the third world. For these countries happiness appears to be independent of the quality of governance. It is interesting that this is a similar phenomenon as for the former Soviet Union countries. Similar to the Soviet Union, also all 5 observed Latin American countries experienced periods of dictatorship in the late 20th century and we governed by a military junta. It might be possible that the brutality of dictatorship has a long-term effect on happiness, which can't be eliminated even with exemplary governance as observed in the case of Chile.

It is also important to take into account cultural, religious and other differences between the countries, which have a strong effect on happiness. It is difficult to estimate the size of all these effects. It is however clear that the behaviour of both developed and developing countries is similar, although the baseline is very different. From this analysis it is clear that culturally different countries have distinct patterns, however with the exception of the developing Romanic countries all indicators of good governance are strongly correlated with the observed indicator of extreme happiness.

While many different approaches link happiness to good governance, this is not only a theoretical exercise. As countries explore possibilities to introduce measures of happiness to compete with GDP, there are several possibilities. Here the happiness research is important, because on one hand it provides theoretical foundations for the political decision on new national indicators of well-being, and on the other hand it also helps to popularize the concept. Among the indicators directly related to happiness, the average happiness and nations as well as the percentage of very happy people seem as reasonable indicators. They are both positively correlated with good governance indicators and with many other measures of well-being. The percentage of very happy people indicator has at the moment an advantage that it is much more sensitive to changes, because its value in most countries is rather low, and does not exceed even 60% in any observed country. It therefore has a lot of potential for growth.

GDP however has another important advantage. It is measured all over the world with a high frequency. It is available every month almost immediately, while the happiness indicators require large scale questionnaires and are only measured every few years. This is a serious disadvantage of all happiness indicators. It could either be solved with expensive frequent questionnaires on a large sample of population or with algorithms for facial recognition of emotions. The questionnaires improved quite a lot in the recent decades. It is for example possible to determine voters' preferences to less than 1% error, as shown in the example of US presidential elections 2008. Many public opinion agencies measured the support for the candidates every day, and Rasmussen for example was verified by elections to get the correct result within less than 1% error [14]. In order to achieve the error below 1% the cost of such measurements would not exceed the costs of collecting the economic data for measurement of GDP.

It is also important to stress that raising incomes are more important for countries with low per capita income. Easterline [12] found that for incomes below about 10.000 USD per capita raising income contributes significantly to happiness, and for incomes above 10.000 USD per capita this contribution becomes weak. Based on this finding it could be argued that for the developed countries GDP is not a good measure for quality of life. Our analysis in the previous chapter demonstrates that there is a positive – although weak – correlation between extreme happiness and indicators of good governance. Helliwell and Huang [8] also found that average happiness is positively correlated with indicators of good governance. We also found that the correlation is stronger for the developing countries than for the developed countries, which is somehow consistent with the results of Easterline [12].

The question of measuring the quality of life is however somewhat philosophical. Namely, the quality of life is a rather subjective category, which depends on individual preferences. It is also understandable that these preferences change over time. The World Values Survey [15] for example demonstrated that postmaterialistic values have become dominant in the developed countries. As individual preferences evolve with time, this also means that the measures quality of life should evolve. Following the ideas from late 18th century, happiness is a good candidate for a universal indicator of the quality of life. Namely, the Declaration of Independence announced in 1776 “that all men are created equal, that they are endowed by their Creator with certain unalienable Rights, that among these are Life, Liberty and the pursuit of Happiness” [16], and philosopher Jeremy Bentham developed a principle of greatest happiness, which states that “the greatest happiness of the greatest number is the foundation of morals and legislation” [17].

We can therefore state that the selection of the quality-of-life indicator is somewhat arbitrary; however, there is no reason why happiness in nations couldn't be the dominant indicator for the quality of life at least for the developed countries with high per capita income above 10.000 USD, where the rising income is less significant to happiness of individuals. It is also clear that national statistical offices could measure any happiness indicators with either an objective or subjective method at reasonable cost comparable or lower to those for collecting the data on GDP.

Conclusion

We showed on the example of percentage of very happy people from the last wave of the World Values Survey between 2005 and 2008 that good governance indicators are positively correlated with the percentage of very happy people. There are however two exceptions where happiness seems to be limited to about 30% for the Latin American countries to the south of equator and to about 10-12% for the former Soviet Union countries independent of the quality of governance. These exceptions demonstrate that dictatorships are detrimental to happiness and that good governance alone is not enough to overcome their long-term effects.

We have also shown that the percentage of very happy people appears to be an excellent candidate for a happiness indicator, which could either compete with the GDP or serve as an additional indicator that would measure different aspects of the quality of life.

Nomenclature list

EPI – Environmental Performance Index

GDP – Gross Domestic Product

GNH – Gross National Happiness

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IV) Towards Fusion Power

Past, Present and Future of Fusion Power

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In the 19th century, many people worked on better oil lamps. Little did they know that most progress in lightning would originate from apparently unrelated research and development of electricity and its pioneers like Nikola Tesla.

Today, a similar development is happening in the way people produce energy. Although more than three-quarters of our contemporary energy originates from burning fossil fuels, new technologies are being developed. Among these, solar power and nuclear fusion power seem the most promising.

As the number of people on Earth has been growing fast for the past two centuries, it is important to consider the environmental consequences of each newly developed technology.

Among the currently possible technologies, nuclear fusion has by far the best energy-to-mass ratio. It is, therefore, clear that any reasonable implementation of nuclear fusion can significantly reduce the environmental impact of the production of energy. However, the technology might not arrive in time to help climate [1].

Past

Soon after nuclear fission power was developed with the first nuclear reactor, Pile-1, by Enrico Fermi and his group in Chicago in 1942, ideas for nuclear fusion appeared to model nuclear reactions inside the stars. In the United Kingdom, a patent related to nuclear fusion reactors was registered already in 1946 by Sir George Paget Thomson and Moses Blackman [2].

Developing nuclear fusion has proven to be a difficult task with the 20th-century technology. A broad international collaboration was therefore required. An important initiative started with a meeting of US President Reagan and USSR General Secretary Gorbachev at the Geneva Superpower Summit in 1985. One year later, an agreement was reached also with the European Union and Japan to jointly design a large international fusion facility called ITER. Its final design was approved in 2001 and in 2006 the ITER Agreement was officially signed by its seven members. ITER is under construction in southern France in Cadarache (Fig. 1) and will get the first plasma injected in 2025 [3].

The design of ITER expects its first fusion reactor to deliver 500 MW of thermal power in pulses lasting several hundred seconds out of 50 MW of input thermal power, not to produce electricity but to test technologies and demonstrate that nuclear fusion is possible. The ratio between the output and input thermal energies, so called Q factor, would thus be 10.

In principle, a Q factor larger than 1 should be enough for commercial applications. However, this listed Q factor of 10 is only the scientific Q factor. For real world applications, the produced electrical power should be larger than the complete input power used for the nuclear fusion reactor.



Figure 1. ITER site 2018 aerial view by Oak Ridge National Laboratory is licensed under CC BY 2.0.

Present

In addition to ITER, there are several other international initiatives and startups in nuclear fusion, also attracting billions of USD in investment.

Currently, the only ITER alternative that achieved Q factor larger than 1 is the laser fusion experiment at the National Ignition Facility of the Lawrence Livermore National Laboratory (LLNL). After they achieved ignition with $Q = 1.5$ in 2022, they repeated the experiment several times in 2023. Their best result was 3.88 MJ produced of 2.05 MJ input on 30 July 2023 thus giving $Q = 1.9$. Although this is also a scientific Q factor and additional orders of magnitude should be achieved for commercial applications, they are on a steep performance curve and expect higher energy yields in the near future [4].

Best startup

Both financially and with sound scientific backing, Commonwealth Fusion Systems could be considered the best fusion startup [5]. It is developing the MIT idea of a SPARC, smallest possible affordable, robust, compact fusion reactor. They collected over 2 billion USD and demonstrated the physical soundness of its concept. The concept is based on a tokamak using high- T_c superconducting magnets (Fig. 2), which allows for higher magnetic fields and smaller tokamak radius.

Although the resulting power will be smaller, about 100-200 MW, the system will be much simpler to build than ITER DEMO. The Commonwealth Fusion Systems refrains from predictions on timing for commercial fusion power, the first SPARC is already under construction under construction in Devens, Massachusetts and is expected to be completed by 2026. If this first SPARC is successful, commercial application could start already in the next decade.

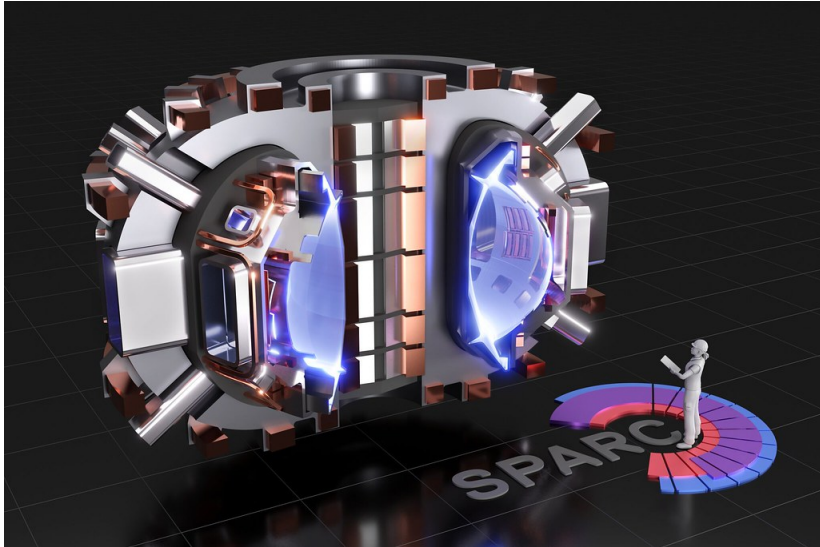


Figure 2. A SPARC of Fusion Energy by jurvetson is licensed under CC BY 2.0.

Wildest predictions

Helion is known for a wild prediction of achieving commercial fusion already in this decade [6]. They claim to be building the world's first fusion power plant. Their most important original idea is a different geometry of the reaction region in the shape of a dumbbell, which is coupled by direct conversion of the produced fusion power into electric energy, due to the fusion of the ^2H and ^3He nuclei into a proton and an alpha particle.

Their current prototype is called Polaris and is expected to be completed in 2024. Their further plan is to create net energy gain by 2025 operating in pulses of at least 50 MJ at 0.1 Hz for about 5 MW of power (Fig. 3).

In the most optimistic scenario, commercial fusion reactor could be built by 2028. There are still many technological challenges to be solved in order to assure such an optimistic outcome. Nevertheless, even many setback and a longer delay would still allow Helion to realise their dream and build the world's first fusion power plant.

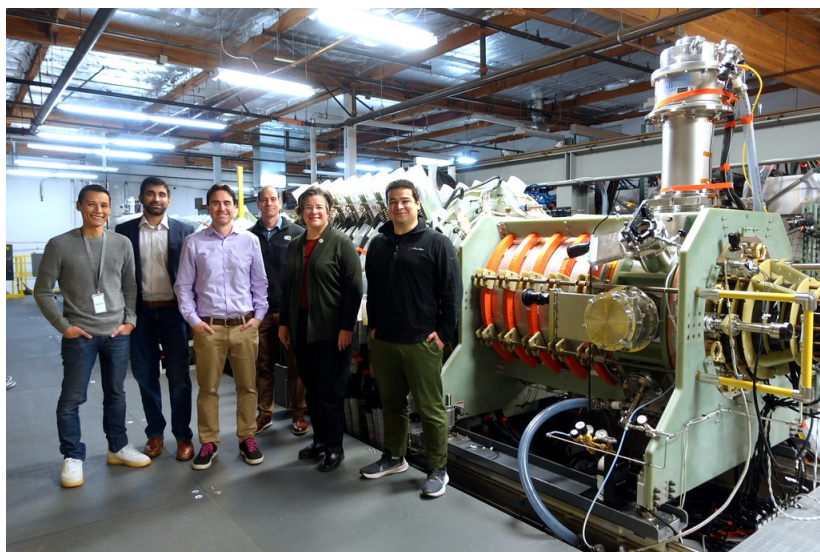


Figure 3. Commissioner Annie Caputo Visits Pacific Northwest Facilities by NRCgov is licensed under CC BY 2.0.

Smallest possible fusion reactor

Avalanche Energy is developing the most original fusion device in the size of a manual fire extinguisher that would fit on a desk at an expected 5 kW of power [7]. Their concept is called Orbitron and could be used for a variety of applications due to its low weight.

Their most important innovation is the magnetic cusp system that confines high-temperature plasma without a large central solenoid so that the system size can be very small. The other innovation is very efficient and robust radiofrequency heating. Together with other innovations, such a system can be very small.

Even if all these technologies function perfectly, their price would still be very high, which makes space applications in orbit or for interplanetary missions quite suitable. The planned timeline for the completion and operation of the prototype reactor is in the middle of the next decade. Although this is slower than other competing concepts, the Orbitron's small size and relative simplicity would allow for the commercial use short after the prototype reactor is successfully demonstrated.

Other initiatives

The most original among other initiatives is taking advantage of a different nuclear reaction, with protons hitting ^{11}B nuclei, creating three alpha particles. This reaction is used both by American TAE Technologies [8] and by Australian HB11 [9].

There are countless other initiatives, with the best 19 startups attracting 20 million USD or more investments and the best eight even more than 100 million USD [10]. While none of them is certain to make a breakthrough strong enough for commercial fusion, competition between them is promising to deliver commercial fusion reactors soon.

Last but not least, both ITER and LANL continue their development. While ITER has a clear timeline of building a DEMO power plant by the middle of century, LANL still needs significant breakthroughs before considering commercial applications of laser powered nuclear fusion power.

Future

While future is always unpredictable, the baseline is defined by the planes of ITER. They plan to start the deuterium–tritium operation in 2035. Their next reactor DEMO is planned to have Q factor of about 25 and deliver electricity by about the middle of the century, after which commercial nuclear fusion reactors could be built.

Among the other described concepts, the MIT idea of SPARC, as developed by the Commonwealth Fusion Systems, is the most promising. As a similar tokamak concept, it benefits from the scientific and technological development at ITER and aims to build a smaller, simpler reactor using high- T_c superconducting magnets. The investors are also optimistic, have invested over 2 billion USD in this startup. Further insight into global fusion initiatives can be obtained from a comprehensive IAEA review, the IAEA World Fusion Outlook 2023 [11].

Although it is impossible to predict when SPARC and other concepts will lead to commercial fusion, it seems reasonable to expect it in the first half of this century. Additionally, the development of these concepts can be significantly accelerated by using more human and financial power, attracting the best and the brightest of the future generation fusion scientists.

Realising the dangers of the expected climate change and the enormous costs of the necessary energy transformation away from fossil fuels, there is a strong moral imperative to inform people about these developments and attract the best and the brightest in this process, so we get nuclear fusion power sooner rather than later. In addition to solving the climate change problems, abundant cheap and reliable energy will also assist in significantly improving the quality of lives and eliminating poverty worldwide.

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V) Conclusions

The Path Ahead – In Search for Opportunities

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Following the plethora of innovative ideas for a path to a sustainable future for humanity, we conclude with some recommendations on how to use them for the best possible outcome.

The first among the solutions is provided by the Club of Rome Honorary Member and WAAS Honorary President Ivo Šlaus, who focuses on global peace. This is the most fundamental precondition for a successful future for humanity, as any war can escalate toward nuclear war. Therefore, building peace is more difficult today than ever, in the age of smart machines, which can cause wars even more dangerous than the nuclear war alone. However, this emerging world of smart machines also offers smart opportunities to overcome wars and build lasting peace if we are strong enough to change ourselves and remember our humanity.

Every big societal change starts with a personal decision. The President of the Croatian Association Goran Bandov presents a view on how to support the transformation of society into a sustainable society on a personal level. This thoughtful analysis can help anybody who wants to make a more profound, unique contribution to a sustainable society.

Seven years have passed since a powerful initiative to create the South-East European International Institute for Sustainable Technologies was first presented at an international meeting in Trieste. It originated from CERN and was devoted to building a powerful international centre that would connect scientists and other smart people from South-East Europe and other countries. Although the realisation of this plan has hit financial obstacles, the overall idea is so important that it must be kept until it is realized. The President of the Serbian Association, Nebojša Nešković, presented this idea in more detail, thus allowing people of good will to carry the torch and convince decision-makers for the continuation and realisation of this valuable idea.

Some people are convinced that sustainable transformation requires sacrificing economic development of human happiness or both. Therefore, a paper by the President of the Slovenian association, Aleksander Zidanšek and WAAS Honorary President Ivo Šlaus presented ideas on how to develop happiness and sustainability using good governance simultaneously.

Since people can't live with happiness alone, a sustainable transformation of energy systems is necessary. For these systems to be cheap, clean and reliable, nuclear fusion is the best possible technology to achieve this transformation in an economically viable way. A recent development, presented by the President of the Slovenian Association, Aleksander Zidanšek and Vice President Robert Repnik, can serve as a starting point for education and dissemination of the plethora of ideas and initiatives to reach nuclear fusion, not in 50 years but in the next decade and thus be in time for a massive contribution to climate solutions. The Slovenian Association called for the development of clean, cheap nuclear fusion energy before the end of the decade already in 2019. This call was reiterated in 2023 and is given at the end of this volume. It is aimed at motivating both decision-makers and the best, brightest young minds to do their part, join worldwide efforts and make this planet more sustainable.

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**At the crossroad toward sustainable
civilisation
Earth for All Statement of the Slovenian
Association for the Club of Rome
*25 October 2023***

Slovenian Association for the Club of Rome

Following the optimistic message from Earth for All, which identified five extraordinary turnarounds, for poverty, inequality, empowerment, food and energy, to set our societies on a safe pathway to wellbeing for all, there is a clear path toward strong sustainable solutions.

At the onset of these exciting transformations, huge cost of about 2-4% GDP (at least 2 trillion current USD annually every year until 2050) poses a gigantic obstacle.

The emerging artificial general intelligence and nuclear fusion energy are clear examples of technologies that could significantly reduce these costs. Recent advances in artificial intelligence demonstrate only a glimpse of possibilities to help people resolve pressing issues, including severe societal, economic, environmental, and other emergencies like the threat of weapons of mass destruction and nuclear war.

In addition to reducing the cost, cleaner nuclear energy like fusion or thorium power would function even in the case of nuclear or climate disaster that would prevent the use of other energy sources. While many difficult or almost impossible challenges hinder this development, artificial intelligence promises to assist in faster progress in laser-driven inertial confinement fusion and small tokamak fusion reactors. While the former has already in 2022 achieved positive energy gain in the laboratory conditions at the National Ignition Facility located at Lawrence Livermore National Laboratory, the latter exhibits many promising, innovative ideas. Thorium power could be developed even faster as it is already tested in a reactor in the Gobi Desert since 2021.

The current planetary emergencies require a significant acceleration of the nuclear fusion and thorium energy development efforts, which can proceed faster if more strongly supported by countries and international organisations. A small reorganisation of transformation costs allocating only about 10% of these funds toward nuclear fusion and thorium technologies, could lead to breakthroughs saving trillions every year and thus greatly improving the course of the necessary transformations.

Therefore, the Slovenian Association for the Club of Rome calls all countries and international organisations to focus their efforts on this new Apollo project, this time not to put the human on the Moon and back safely, but to develop a safe, reliable, continuous, cheap, and clean nuclear fusion and thorium energy technology, not in the distant future, but within a decade. We reiterate our call from 2019 and demand to

Develop a clean, cheap, continuous, carbonless energy source within a decade!

Such a unifying grand vision shall also inspire the urgent action necessary for the survival of human civilisation, attracting the best and the brightest to tackle contemporary crises with the development of reliable, continuous, cheap, and clean energy technologies, at a small fraction of the total transformations costs.

Therefore, the Slovenian Association proposes to the Club of Rome to strengthen the efforts to move international decision-makers toward this bold vision for a sustainable civilisation powered with reliable, clean and cheap energy.

Pathways to a Sustainable Future for Humanity

Basic Science for Sustainable Development:

Solutions from National Associations

**Develop a clean, cheap, continuous,
carbonless energy source within a decade!**
-- Slovenian Association for the Club of Rome, 2023

Slovenian, Croatian and Serbian Associations for
the Club of Rome, 2023

