INTERNATIONAL SEMINARS ON PLANETARY EMERGENCIES

Executive Summary Plenary Report

56th Session

Chairman: A. Zichichi | Co-Chairman: C. Galbiati

8th – 14th August 2024

ETTORE MAJORANA FOUNDATION AND CENTER FOR SCIENTIFIC CULTURE

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Overview

The 56th session of the International Seminars on Planetary Emergencies at the Foundation Ettore Majorana and Centre for Scientific Culture[1] (FEM) took place between 10-13 August 2024 in Erice, Sicily. The Seminars began in 1981, in midst of the Cold War. Each year, nuclear physicists, and advisors to leaders of the most powerful nations had the opportunity to freely exchange ideas and have discussions, at times very heated, thinking about the possible benefits in finding room for positive collaboration among nations that were on the brink of war. One significant result of those discussions was the historic Seminar in August 1987, where Professor Zhou Guang Zhao (Scientific Advisor to Premier Deng Xiaoping), Professor Edward Teller (Scientific Advisor to President Reagan), Professor Eugenij Velikhov (Scientific Advisor to President Gorbachev) and Professor Antonino Zichichi (Chairman of the International Committee 'Science for Peace', President and Founder of FEM), reached an Agreement for International Scientific Collaboration East-West-North-South without Secrecy and without Frontiers.

The Seminar this year had eight sessions in which 98 scientists, from 22 nations, participated and spoke. The following topics were discussed among a multi-disciplinary assembly of scientists, policy analysts and other experts:

- managing international conflicts and arms control,
- re-emerging infections and neurological diseases,
- the biological and social factors underlying metabolic and neurological diseases,
- children's health,
- pollution and the water crisis,
- combating wild-fires,
- climate geoengineering,
- defense against cosmic objects,
- disruptive impacts of solar storms,
- risks and challenges of artificial intelligence,
- the power sector and the energy transition.

The key messages of each of these eight sessions are summarized in the page.

[1] https://ettoremajoranafoundation.it/

Professor Zhou Guang Zhao (Scientific Advisor to Premier Deng Xiao Ping), Professor Edward Teller (Scientific Advisor to President Reagan), Professor Antonino Zichichi (Chairman of the International Committee 'Science for Peace') and Professor Eugenij Velikhov (Scientific Advisor to President Gorbachev), shaking hands after reaching the Agreement for International Scientific Collaboration East-West-North-South without Secrecy and without Frontiers.

Keynote Address

Cristian Galbiati[1]

Good morning and welcome to the opening of this 56th session of the International Seminars on Planetary Emergencies. We start this session with a very much due and heartfelt tribute to Professor Nino Zichichi, who started not only this Foundation, but also this important seminar that helps with a broader mission of science, to provide a direct link to society, and help enrich everyone's life.

This seminar has few equals in the world, and I think the township of Erice should take pride not only of hosting the Majorana Foundation, but also of hosting this series of seminars. As all of you know, the agenda of this workshop changes from year to year. Each year, we have different Permanent Monitoring Panels that are reporting, triggering debate to shape recommendations and conclusions, the major outcomes of the seminar.

There are urgent topics that will be discussed this year. These start with the management of international conflicts and arms control, something that is on everyone's mind. We are living in a terrible period of crisis with wars raging at our doorstep in Europe and spreading through the Middle East, a major source of concern to us. We will discuss emerging and reemerging infections and neuronal diseases. We will also focus on the power market and the clean energy transition, to see if current policies are working. We will discuss critical problems of pollution and water availability. We will also explore the management of wildfires, a topic of particular interest to Sicily, and many other regions. And we will close with a discussion of the biological and social development factors in the epidemic of metabolic and neurobehavioral diseases.

I look forward to what promises to be a vibrant series of presentations, and active engagement of all participants. We aim to provide a very sharp set of conclusions to be broadly disseminated to help shape policies and directives. Our purpose for the next few days is to promote the scientific advancement of our planet for the benefit of humankind. Scientific advancement has a very strong and undeniable link to free societies, democracies, and the freedom of speech and expression. Science can only and truly flourish in an open society. Free speech, free societies, and democracy are all universal values, which are not available everywhere on our planet. They are the most important, founding values of our scientific method of inquiry. We cherish them deeply, and, following the Erice tradition, strictly adhere to them during our upcoming debates, deliberations, and conclusions.

Alan Turing once said: "Sometimes it is the people no one imagines anything of who do the things no on imagines".

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[1] Professor, Physics Department, Princeton University, USA.

I believe this quotation to be particularly appropriate to remember during our interdisciplinary discussions. Let's move forward, let's open the windows to knowledge, let new ideas into this room as well as bright insights. These will not only advance our scientific understanding of our planet and our society but will also help society guide technological and scientific advancements for the benefit of humankind: To achieve a just, safe. prosperous, and peaceful future.

Session 1 – International Control of Nuclear Weapons
Chairman: William A. Barletta[1] (Chairman Mitigation of Catastrophic Risks PMP)
Speakers: Tariq Rauf[2], William A. Barletta, Richard C. Lanza[3], Karen Hallberg[4]

Reducing the threat of nuclear weapons has been a focus of the International Seminars since their inauguration by Professor Antonino Zichichi in 1981. Thanks to those early informal, confidence building discussions among scientific leaders close the heads of government of the U.S. and USSR, the world saw the START I treaty signed in 1991. With the breakup of the Soviet Union, its nuclear weapons were removed from Ukraine, Belarus, and Kazakhstan.

The following decade (1992–2002) witnessed the reduction of the number of deployed nuclear weapons by the U.S. and Russia. Since 2012 the successes of 1990 have unraveled, and as a result the nuclear danger is greater than at any time since the Cuban missile crisis of 1962. We are left with only a single arms treaty between Russia and the U.S. that will expire in early 2026. North Korea has built and tested thermonuclear weapons and ICBMs. The U.S. and Russia are rebuilding old nuclear weapons, and China is expanding its strategic nuclear weapons and delivery systems.

In the coming decade the U.S. will spend upward of $600B on the modernization of its strategic triad of bombers, ICBMs, and fleet of nuclear submarines. The modernization will swap out presently deployed warheads that are 30 to 40 years old for newly manufactured warheads. The modernized force will have to deter two nuclear armed peers, Russia and China, as China is increasing its deployed strategic weapons by roughly 200 per year. In addition, both Russia and China are introducing new strategic delivery capabilities armed with nuclear warheads, likely of new design. The new Russian systems are noteworthy both in technological breadth and variety as they include a new heavy ICBM capable of attacking over the South Pole and new long endurance hypersonic weapons. The new hypersonic delivery systems may be based on land, sea or air platforms. They can maneuver during flight to avoid detection and interception. Their targets are not predictable, because they don't follow a ballistic trajectory.

The Russian and Chinese nuclear programs are consistent with aggressive, expansionist agendas to reorder international dynamics. They are not driven by mechanistic "action-reaction" to the U.S. modernization efforts. In fact, their arms buildups preceded the U.S. program of nuclear modernization by a decade. Furthermore, any changes in declaratory U.S. deterrence strategies are unlikely to moderate these long-standing programs. This complex of developments should awaken the U.S. to resume its informal dialogues and to begin formal negotiations with Russia and China to limit the actual deployment and possible use of nuclear weapons.

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Current approaches to arms control negotiations – all of which involve risks – are largely intuitive with respect to the management of those risks. Unlike nuclear plants or engineered systems, rigorous, formal, systematic approaches are rarely used. Therefore, quantifying probabilities and risk is very difficult in the context of arms control. It is likely to become much more difficult with rapid introduction of new technologies such as hypersonic boost glide vehicles (HBGV) or artificial intelligence. The operational characteristics of new nuclear delivery systems push the performance envelope of legacy weapons yielding challenges that are complex, and rapidly changing. The lack of a historical database means that negotiators must operate on an instinctive or seat-of-the-pants basis due to the paucity of information concerning capability and performance.

Regardless of analytical methodology, characterizing arms control issues and negotiating proposals to limit deployed weaponry involve some element of risk. During the past year, the Catastrophic Risks PMP has been exploring whether modern risk assessment techniques such as those used in evaluating engineered systems such as nuclear reactors or aerospace vehicles could be applied to enhance arms control negotiations and minimize the associated risks. The group focused on applying fault, event, or decision tree methodologies to non-engineered systems with complex human behaviors. The hope is that a common methodology applied on all sides might enable their respective negotiators to understand the others' position thereby reassessing the incorporation of new technologies and their negotiation strategies.

The PMP considered the case of HBGVs to be a useful example to explore how formal risk assessment methodologies might impact arms control negotiations. The greatest difficulty in this approach is calculating probabilities of human actions. The underlying information challenges connect to deterrence and arms control are 1) timely recognition of latent and emerging threats, 2) evaluation of effective responses to uncertainty and disinformation, 3) identification of and focus on the priorities with greatest leverage, and 4) creation of evidence-based, tailored counters to multiple adversaries who think differently. Their analysis identified ways in which risk assessments can fall short of and lose focus on real objectives. Negotiation teams can focus more on assessment than on risk management. They can develop unjustified confidence in seemingly favorable results, focusing on preventive measures at the risk of ignoring hazards of failed means of risk mitigation. Such behavior can increase the complexity of controls and be perceived as overmanipulating negotiations.

Initial results of the group's work have been published in the Bulletin of the Atomic Scientists, "Formal risk assessments and nuclear arms control: exploring the value of modern methodologies" [Bulletin of the Atomic Scientists, May 2024]. The PMP will examine the use of AI techniques and their applicability to negotiations.

The WFS has not been alone in seeking to control weapons of mass destructions through unofficial confidence building processes. The Pugwash Conferences for Science and World Affairs draw their inspiration from the Russell-Einstein Manifesto of 1955, which urged leaders of the world to "think in a new way": to renounce nuclear weapons, to "remember their humanity" and to find peaceful means to settle all matters of dispute between them. Like the WFS, Pugwash aims to develop and support the use of scientific rationale for policy making and confidence building focusing on problems at the intersection of science and world affairs, such as those discussed in the International Seminars. Both seek to achieve their goals through dialogue, debate, discussion, and collaborative analysis, in an atmosphere of impartiality and mutual respect, in meetings that bring together scientists, experts, and policy makers who participate in their individual capacities and not as representatives of any organization, company or government. Such innovative methods, which have been relevant to achieve past international arms control agreements, later developed into what is now known as Track II and scientific diplomacy.

Session 2 – Emerging/Re-emerging Infections and Neuronal Diseases

Session Chairman: Franco M. Buonaguro[1] (Chairman Medicine and Biotechnology PMP)
Speakers: Franco M. Buonaguro, Ishwar Gilada[2], Sofie Nyström[3], Felice Iasevoli[4], Emanuele Buratti[5], Rino Rappuoli[6]

Introduction

In the wake of the unexpected COVID pandemic, the scientific and healthcare community is looking for new preparedness strategies in terms of diagnostic, preventive and therapeutic tools. The pandemic event has shown the inability of the healthcare system to deal with a rapidly evolving airborne infectious disease that can overcome the quarantine approach with isolation of symptomatic infected patients, as transmission also occurs from subjects without respiratory symptoms (including the absence of cough) and without fever. The pandemic situation has also been aggravated by the difficulty of inducing effective and persistent herd immunity, capable of slowing down the rate of transmission, which can only be achieved for coronavirus infections with multiple vaccination cycles, in addition to masks and social distancing. Furthermore, the need for hospitals that can rapidly adapt to clinical needs has become evident, in particular the difficulty of hospitals to rapidly increase the number of intensive care units with oxygen masks to overcome the two-three weeks of respiratory failure. Finally, the speed of development of adequate diagnostic and therapeutic tools to identify people with viral infections to be quarantined and treated with antivirals and/or monoclonal antibodies.

COVID and Long-COVID issues, Franco M. Buonaguro and Ishwar Gilada focused on the initial global difficulty in managing the pandemic, particularly in low- and middle-income countries, where in addition to limitations in diagnostic reagents, the limited availability of oxygen-supported intensive care units was a critical limitation. Furthermore, the country's economy did not allow for an appropriate population-based vaccination program, in the context of a high burden of infectious diseases, including HIV and multidrug-resistant TB.

During the current low-rate endemic COVID infection, the long-COVID disease is becoming a critical problem. Long COVID or long-haul COVID is a group of health problems that persist or develop after an initial period of COVID-19 infection. Symptoms can last for weeks, months or years and are often debilitating [1]. The World Health Organization defines long COVID as an infection that begins three months after the initial COVID-19 infection, but

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other agencies define it as an infection that begins four weeks after the initial infection. Long COVID is characterized by a large number of symptoms that sometimes disappear and then reappear. Commonly reported symptoms of long COVID are fatigue, memory problems, shortness of breath, and sleep disorders. Several other symptoms may also occur, including headaches, mental health issues, loss of smell or taste, muscle weakness, fever, and cognitive dysfunction. Symptoms often get worse after mental or physical efforts, a process called post-exertional malaise. There is a large overlap in symptoms with myalgic encephalomyelitis/chronic fatigue syndrome (ME/CFS) [2].

The causes of long COVID are not yet fully understood. Hypotheses include lasting damage to organs and blood vessels, problems with blood clotting, neurological dysfunction, persistent virus or a reactivation of latent viruses and autoimmunity. Diagnosis of long COVID is based on (suspected or confirmed) COVID-19 infection or symptom s — and by excluding alternative diagnoses. Estimates of the prevalence of long COVID vary based on definition, population studied, time period studied, and methodology, generally ranging between 5% and 50% [3]. Prevalence is less after vaccination. Risk factors are higher age, female sex, having asthma, and a more severe initial COVID-19 infection. As of August 2024, there are no validated effective treatments [1]. Management of long COVID depends on symptoms. Rest is recommended for fatigue and pacing for post-exertional malaise. People with severe symptoms or those who were in intensive care may require care from a team of specialists. Most people with symptoms at 4 weeks recover by 12 weeks. Recovery is slower (or plateaus) for those still ill at 12 weeks. For a subset of people, for instance those meeting the criteria for ME/CFS, symptoms are expected to be lifelong. Globally, over 400 million people have experienced long COVID. Long COVID may be responsible for a loss of 1% of the world's gross domestic product [3].

Several Funds have been made available for research programs by major health institutions to identify the pathogenic cause of this syndrome and develop the appropriate therapy in particular the NIH Recover project, the European Commission, and the World Health Organization. The data available so far support the importance of inflammation and immune and autoimmune response in the development of Long-COVID and PASC (post-acute consequences of SARS-CoV-2 infection). Neuro-PASC, including chemo-fog state (present in cancer patients treated with chemotherapy and even CAR-T therapy) and cognitive impairment have been associated with auto-immune status [4] and cytokines/chemokines CSF (Cerebrospinal Fluid) imbalance including CCL11 [5].

Connecting the dots between virus amyloids and neurodegenerative diseases. Sofie Nyström reported a further COVID-related neurological issue: specific fragmentation of the spike (S) protein can produce peptides, characterized by the property of precipitating and generating amyloids (amyloidogenic peptides) [6,7]. The full-length folded Spike-protein did not form amyloid fibrils, but amyloid-like fibrils with evident branching were formed during 24-hour co-incubation of the S protein with the protease neutrophil elastase (NE) in vitro. NE effciently cleaved the S-protein, making the exposure of amyloidogenic segments and accumulation of the amyloidogenic peptide 194–203, part of the most amyloidogenic synthetic spike peptide. NE is overexpressed at inflamed sites of viral infection. These data propose a molecular mechanism for potential amyloidogenesis of SARS-CoV-2 S-protein in humans facilitated by endoproteolysis. The prospective of S-protein amyloidogenesis in COVID-19 disease associated pathogenesis is important to understand the disease and long COVID-19. In particular, such results showed that the spike fragments can contribute to anomalous coagulation, not sensible to heparin treatment, and accelerate the neurological process characterized by fibril formation as in Alzheimer and Parkinson disease [8,9].

Circulating biomarkers, genetic signatures and neuroimaging correlates of neuronal damages IN ACQUIRED AND CONGENITAL NEUROLOGICAL AND BEHAVIORAL DISORDERS. Felice Iasevoli reported the link of neurodegeneration and psychiatric disease (i.e. schizophrenia) to SARS-CoV-2 infections [10,11] and current innovative approaches through the analysis of circulating brain vesicles. Genetic and epigenetic alterations involved in DISC-1 based amyloid-like fibrils' generation [12], misassembling of DISC-1 in specific areas of brain [13,14] and the interference with dopamine metabolism [15] have been previously reported. The intersection of COVID-19 and schizophrenia has attracted significant attention due to the pandemic's impact on mental health, particularly in individuals with pre-existing psychiatric conditions. In a group of studies from Felice Iasevoli's staff, the impact of COVID-19 pandemics on mental health of multiple patients' samples has been delineated [16,17], including the first study with original data on the level of COVID-19-associated distress in severe mental disease patients [18]. More recent studies have highlighted the impact on brain functions of putative long COVID, including the occurrence of psychiatric disturbances. Research has identified several circulating biomarkers that are altered in COVID-19 patients, which may contribute to neurological complications, including cognitive dysfunction and potential exacerbation of psychiatric disorders such as schizophrenia [19]. Proteins like Glial Fibrillary Acidic Protein (GFAP), Neurofilament Light Chain (NfL), and inflammatory cytokines (e.g., IL-6, TNF-α) have been significantly altered in COVID-19 patients. These biomarkers are associated with central nervous system (CNS) function and may indicate neuronal damage or inflammation linked to cognitive impairment. Furthermore, specific microRNAs (miRNAs), including miR-146a and miR-155, have shown dysregulation in COVID-19 patients [20]. These miRNAs are implicated in neuroinflammatory responses and may serve as prognostic indicators for cognitive dysfunction following infection [21]. Among patients with severe mental disorders, schizophrenia patients were at the higher risk of detrimental consequences of COVID-19 pandemics and long COVID effects, due to both biological and social factors [22]. Indeed, it has been reported that schizophrenia pathophysiology may involve neuroinflammatory lesions, at least in the early stages of neurodevelopment, including disruption of DISC-1-mediated functions. These putative neuroinflammatory damages may overlap with the inflammatory responses seen in COVID-19. Cytokines such as IL-1β and IL-6 are elevated during psychotic episodes and may also be increased in COVID-19 cases, suggesting a shared inflammatory pathway that could exacerbate symptoms in vulnerable populations [23]. Moreover, it has been hypothesized that the neuroinvasive potential of SARS-CoV-2 might increase the risk of psychosis in individuals with schizophrenia.

This is supported by findings that show elevated levels of inflammatory markers in both conditions, indicating a possible link between viral infection and exacerbation of psychiatric symptoms [24]. Understanding the relationship between circulating biomarkers, COVID-19, and schizophrenia may be crucial for developing targeted interventions. Circulating biomarkers could serve as valuable tools for predicting cognitive outcomes and managing mental health issues post-COVID-19 for multiple reasons: i) monitoring levels of inflammatory cytokines might help assess the risk of cognitive decline or psychotic episodes in affected individuals; ii) identifying specific biomarkers that correlate with disease severity can inform therapeutic strategies aimed at mitigating both neurological and psychiatric complications arising from COVID-19. As a general take-home message, clinicians should consider the combined effects of physical health (COVID-19) and mental health (mostly in schizophrenia cases) when treating patients during and after the pandemic. This includes regular assessments of circulating biomarkers to tailor interventions effectively. The interplay between COVID-19 and schizophrenia through circulating biomarkers underscores the need for integrated healthcare approaches that address both physical and mental health challenges posed by these conditions. These considerations strengthen the idea that more research should be undertaken for expanding our knowledge on the topic.

Identifying fluid biomarkers for neurodegenerative diseases. Emanuele Buratti reported on the TAR-DNA binding protein (TDP-43) an amyloidogenic protein which plays a major pathogenic role in patients affected by amyotrophic lateral sclerosis (ALS), and for such reason with high potentiality for the early diagnosis of such disease still requiring standardized biomarkers [25]. TDP-43 could play some role also in the neurodegenerative disorders associated with S-protein amyloidogenic peptides [26,27], which are mitigated by the TREM2 interaction [28]. From a health and early diagnosis perspective, it therefore becomes imperative to find a way to observe fibril formations or other forms of alterations in patient's biofluids. In fact, although post-translationally modified forms of TDP-43 (pmTDP-43) can be detected in ALS brain and spinal cord postmortem, current bioassays have shown variable performance in quantifying these species in biofluid samples.

To address this gap, our lab together with a USA-base foundation called TargetALS, we have focused on developing novel ALS blood-based biomarker assays that are specific, sensitive, reproducible, affordable and minimally invasive, and are based on analyzing the blood platelet component. Platelets express a large number of neurotransmission-related proteins and contain mitochondria as well as pre-mRNAs, splicing factors and ribosomes to subserve signal-dependent RNA processing and de novo protein synthesis. We have therefore hypothesized that TDP-43 could be involved in these activities in platelets in a manner that parallels its known regulation of RNA processing and translation in situ in neuronal synapses. The detection of disease-related RNA-level changes in platelets and synapses is also likely to reflect nuclear hypofunction of TDP-43 in megakaryocyte and neuronal nuclei, respectively. We have then used transcriptomic analyses to expose possible disease-related differences in TDP-43-associated RNAs. This complementary approach provides the further advantage that RNAs can be differentially detected and quantified with high sensitivity. These results have been recently published [29] and have confirmed that indeed platelets could represent an excellent substrate for novel biomarker analysis which could not just be limited to ALS but also to all the other neurodegenerative diseases that could have connection with Alzheimer and Parkinson disease.

Emerging and re-emerging pandemics preparedness. Rino Rappuoli highlighted the necessity of global preparedness for future pandemics. The health and scientific gaps highlighted by the emergence of the pandemic due to the SARS-CoV-2 infection, has led to the establishment of CEPI, the Coalition for Epidemic Preparedness Innovations [30], a global partnership focused on the 100-day strategy for the characterization of new epidemic pathogens and the development of vaccines, and a greater involvement of policy makers at the national and international levels, including the G7 and G20. Within the context of preparedness for emerging and re-emerging diseases, Rino also highlighted the role of the scientific community in monitoring communicable diseases at high risk of epidemic outbreaks and in supporting new scientific developments to accelerate the production of appropriate preventive (e.g., vaccines) and therapeutic (immune and antiviral tools) strategies, as well as innovative regulatory procedures to safely accelerate and standardize approval procedures. In this regard, he highlighted the role of CNAP, the Italian National Center for Pandemic Preparedness [31], funded in 2022 by the Italian government and IUMS, the International Union of Microbiological Societies [32]. For this reason, the overall final message of the session was that scientific societies, with adequate government support, can significantly contribute to the development of effective pareparedness strategies.

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Session 3 – The Power Market and the Energy Transition

Chairman: Carmine Difiglio (Chairman Energy PMP)

Speakers: Carmine Difiglio[1], Peter Hartley[2], Ashutosh Shastri[3], Teresa A. Gorman[4]

Carmine Difiglio

Introduction

The Energy PMP (Permanent Monitoring Panel. Six PMPs monitor the scientific progress in each of their respective fields, publish research, and organize the plenary program of the Planetary Emergency Seminars) is monitoring the way energy policies affect greenhouse gas emissions, energy costs, and energy security. Last year, in our session on the "Oil Market and the Energy Transition", we examined whether exploration and production (E&P) investments were no longer required as a result of widespread plans to replace the internal combustion vehicle with "zero emission" vehicles. We concluded that "a more sober outlook for U.S. shale growth, likely OPEC+ policies, and the likelihood of increasing world oil demand, despite net-zero policies, all imply that oil E&P investments must increase to avoid world-wide economic disruptions." [Executive Summary, International Seminars on Planetary Emergencies, 55th Session, p. 12]. This year we focused on net-zero power market policies. Despite the low cost of wind and solar capacity (as measured by its LCOE that stands for the Levelized Cost of Electricity.) increasing shares of renewable power appears to be correlated with rising electricity costs. Complicating the picture is the widespread practice of balancing supply and demand with competitive power grids. Due to the low, sometimes negative, price that renewable producers are able to bid into these grids, baseload power is discouraged compared to the importance of baseload power in State owned or regulated private monopoly utilities. In these older regimes, the economic value of different power generators is considered as a system. Under prevailing current frameworks, independent renewable providers enjoy low costs but impose a cost on the system as they are typically not responsible for the back-up power their supplies require [Renewable power producers also do not typically incur the full costs of a transmission network that integrates widely dispersed intermittent power sources to power customers]. Part of the problem is that energy storage is relatively expensive and of limited scalability, especially for longer-term storage. Fossil fuel peaking plants that would normally provide back-up power [Hydro-electric power plants and pumped storage were typically used to provide backup power, but these sources cannot be easily scaled up] are also being phased out by net-zero climate plans. Net-zero plans also anticipate converting steam coal plants with carbon capture, a technology that has not yet demonstrated commercial viability. Nuclear power can provide reliable, low emission, baseload power, but is typically not featured among the various government subsidies, regulations or investments to achieve a net-zero power sector.

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These concerns about the efficacy of current climate and energy policies do not diminish the need to reduce greenhouse gas emissions or reflect any "climate skepticism" by the Energy PMP. As has been noted by the Executive Director of the International Energy Agency, Fatih Birol, "despite progress renewables still have a long way to go. We need much more action to make sure that everyone has access to energy and that we slow climate change, reduce pollution and make the world sustainable" [https://www.eib.org/en/publications/eib-big-ideas-a-bright-future]. However, regardless of how meritorious the objectives of government policies may be, they still need to be evaluated to see whether they work and whether they are sustainable. In addition, OECD climate policies will have little impact on atmospheric greenhouse gas concentrations unless they are emulated by less-developed countries. They are the major emitters of greenhouse gases, and their energy consumption will grow in order to improve national welfare. If OECD policies are not shown to reduce emissions, while providing energy services at affordable prices, it is not likely that developing countries would emulate them.

The following summaries provide important messages that should be considered in any reassessment of current climate and energy policies in order to make them more effective and less costly.

Peter Hartley
A costly transition

Recent experience with electricity generation in many countries has highlighted a paradox. The first observation is that the average costs of wind and solar generation have been falling. Reasons have included technological improvements and the increasing market dominance by lower-cost Chinese producers. The cost reductions are mostly measured by calculating the Levelized Cost of Electricity (LCOE). This converts the capital and annual fixed costs to an annual annuity and then divides by annual generation to arrive at a per unit fixed cost that is added to variable costs (if any) to arrive at LCOE. The claim is that this enables a "fair" comparison of the costs of technologies with very different ratios of fixed to variable costs. In recent years, many of these calculations have revealed that wind and solar generation have among the lowest LCOEs.

The second observation is that in practice there is strong evidence that the higher the proportion of wind or solar capacity in the generation mix, other things equal, the higher the retail price of electricity. This is reflected in panel data from Western European countries or states within the large OECD countries and the last 15-20 years.

Why doesn't a low LCOE translate into "cheap electricity"? Transmission lines are needed to deliver generated power to customers. To obtain higher capacity factors wind and solar generators need to be placed where wind and solar resources are favorable. The relatively low energy density of wind and solar power also means that land requirements are high, and land costs are also relatively low in locations remote from major loads. New, long transmission lines are usually needed, which are then used at relatively low load factors. Finally, retiring fossil fuel generators tend to be closer to loads, and existing transmission lines are then under-utilized.

Furthermore, voltage, frequency, and reactive power also must be maintained within tight limits, which in turn requires *controllable* generation sufficient to ensure continuous supply approximately equal to load. Additional *controllable* reserve generation capacity on stand-by is also needed to meet unforeseen emergencies. *Controllable* generation is also needed at the right locations to respect constraints on transmission flows maintained to protect against thermal overload, transient instability, dynamic instability, or voltage collapse. When sufficient large-scale hydroelectricity based on stored water is unavailable, thermal generators provide the backup. Such plants then are *not* used to supply power when the wind is blowing, and the sun is shining, which lowers their average capacity factor. That, in turn, increases capital and other fixed costs per unit of electricity supplied. For plants with a steam cycle, maintaining a head of steam while not producing electricity wastes energy. Cycling thermal plants increases wear and tear requiring more scheduled maintenance and increasing the chance of unplanned outages.

To compare the costs of generating technologies, one needs to calculate the Levelized Full System Cost of Electricity (LFSCOE). In the case of the ERCOT system in Texas, this showed that a system with nuclear and storage (to smooth load) had lower LFSCOE than one with wind and solar plus storage (to smooth generation output as well as load) because the latter requires far greater amounts of high-cost storage. Allowing for natural gas as backup lowers the LFSCOE of wind and solar generation because of the low cost of natural gas in Texas. Even moderate increases of the price of natural gas, however, can make the inclusion of nuclear capacity economic.

The rapid growth of wind and solar generation in ERCOT has increased reliability problems and transmission constraints. These are reflected in locational marginal prices. They show that although most stress occurs in peak periods, there is considerable evidence that the system is more stressed in base than intermediate load periods – especially when wind output is high.

Finally, there are serious technical and economic problems associated with transitioning to a system based solely on wind, solar, and storage. The inertia of large hydroelectric or thermal generators helps stabilize frequency. It is unclear how these services can be effectively supplied in an all-inverter-based system and, if so, at what cost. It is also unclear whether a system with all generation having zero marginal cost (but high fixed cost) is compatible with competitive wholesale electricity markets. If prices are frequently bid to zero, how can the fixed costs be recovered?

Another issue with wind, solar, and battery technology that is troublesome from the energy security perspective is the dominance of China in the production of the harvesting equipment and the supply chains that underlie its manufacture, including the processing of mineral inputs.

Ashutosh Shastri
Emerging Lessons from the UK/European Clean Energy Transition

The salient points of the presentation are:
1. The UK has led from the front demonstrating impressive performance; but it's "quixotic".
2. Electricity pricing and security related reforms matter more than decarbonization; sequencing this right is important.
3. Low Energy Economic Growth is a myth - both UK and Europe now expriencing "De-Industrialization"
4. Low carbon energy transition implies greater electrification and greater demands on the electricity systems - we are all unprepared for this level of electrification.
5. Net Zero is an unrealistic goal and policy course correction is inevitable - the issue is how and where do we make these trade-offs?

Impressive but quixotic electricity market reforms in UK, but only selectively followed in EU: The UK has by far the world's most mature electricity market reform program and has gone about systematically to isolate the natural monopoly elements of the electricity value chain and subjecting them to fair performance-based incentive driven regulation whilst subjecting the non-monopolistic elements, e.g., supply, marketing, trading and generation to market competition. In so doing, the UK has benefitted from competitively priced electricity for over 30 years since the program started in the late 80s and hence was better prepared to meet the new challenges- when they arose, of decarbonization.

In contrast, the approach in the EU electricity markets could be characterized as weakly regulated- to accommodate the various interests of the EU member states- resulting in poor progress in uniform unbundling - e.g., Germany still has four different transmission systems in operations; and competition has not resulted in competitively priced electricity across the EU. The transmission constraints and player conduct result in significant cross-border pricing discontinuities. Nevertheless, the EU also has an ambitious de-carbonization program on achieving net zero by 2050 that no longer appears credible.
Security and competitive pricing trumps decarbonization: The recent experiences following the Russian invasion of Ukraine proved to be the proverbial straw that broke the electricity and gas markets in Europe; prices multiplied more than 5 fold across the board and

a significant amount of fossil fuel fired capacity that was earmarked for decommissioning, due to net zero goals, came to the rescue, ironically because the EU was slow and insincere in its regulatory reform! In contrast, the UK gas and electricity markets did not have this fallback option and the debate in the industry now has reverted to ensuring life extensions and new licenses for new gas fired power plants, indeed we are also likely to see an emergence of re-commissioning of existing mothballed nuclear capacity in markets such as Italy. The German nuclear power policy has proved to be disastrous., not only for Germany but also for the integrated NW European Markets.

Teresa A. Gorman
Can the U.S. EPA require the power sector to achieve net zero?

In response to the challenge of passing legislation in a politically divided Congress, recent U.S. Presidents have encouraged regulatory agencies to use their existing authorities to achieve broader policy objectives. As a result, U.S. regulatory agencies are increasingly interpreting existing statutory authorities in new ways, recognizing that courts often defer to agency interpretations. Agencies have also learned that a combination of multiple regulations, government subsidies and enforcement actions can be powerful tools in affecting change within an industry avoiding the need for new legislation or compromise.

This general trend provides an important context for the U.S. Environmental Protection Agency's (EPA's) recent regulatory efforts to reduce greenhouse gas (GHG) emissions from the power sector. After two failed legislative attempts in 2003 and 2009, EPA has developed innovative approaches to interpreting the "best system of emission reduction" (BSER) that is "adequately demonstrated" and "available" for the power sector as required under Section 111 of the Clean Air Act. The first attempt in 2015, defined BSER in a way that would require states to shift generation away from higher emitting coal and natural gas power plants to non-emitting generation sources. This rule was stayed by the Supreme Court in 2016 and eventually overturned by the same Court in 2022 that found that EPA did not have the authority under Section 111 to require generation shifting. Specifically, citing the Major Questions Doctrine, the Supreme Court noted Agencies cannot enact regulations with such significant economic or political consequences without explicit authorization from Congress.

In April 2024, the EPA issued a revised Section 111 rule that defined BSER for existing coal units and new gas plants as a performance standard equivalent to adopting carbon capture and sequestration (CCS) technologies with a 90 percent capture rate. Under the final rule, existing coal generation plants have no new requirements if they commit to retire by 2032.

However, if existing coal plants plan to operate after 2039, the plants must meet an emission standard equivalent to CCS with a 90 percent capture rate. (Plants operating after 2032 but closing before 2039 are required to meet a lesser standard based on 40 percent co-firing with natural gas.) Similarly, new natural gas fired combustion turbines that plan to operate at 40 percent or higher capacity factors will also have to achieve an emission rate equivalent to using CCS with 90 percent capture by 2032. It is important to note that these standards are not based on life-cycle emissions and do not address the CO_2 emissions produced from the significant energy needed to run the CO_2 capture technology or the potential for stored CO_2 to leak back into the atmosphere.

Industry and at least 26 states are now challenging the 2024 U.S. EPA rule over the decision to base BSER on the performance of CCS, which they claim is neither "adequately demonstrated" nor "achievable" as required under Section 111. They cite the U.S. federal government's legacy of investing close to $700 million in several failed U.S. powerplant CCS projects. While 14 US industrial sources operate with CCS today using the sequestered CO_2 for enhanced oil and gas recovery, only one U.S. coal-fired power plant, the Texas Petra-Nova power plant, operates today with CCS. Despite close to $200 million in federal subsidies, Petro Nova closed in 2020 citing poor economics, only to reopen in 2023 when NRG sold its 50 percent stake in the plant for $3.6 million (a small fraction of the shared $1 billion in construction costs). During its first three years of operation (2017 through 2019) the plant captured only 84 percent of the 4.2 million metric tons of CO_2 expected at a 90 percent capture rate. Critics question whether Petra Nova has ever achieved a 90 percent capture rate over its brief lifetime, reinforcing concerns that CCS for power plants is not "adequately demonstrated" or "achievable." In response, the U.S. EPA claims that BSER and the meaning of what is "available" under Section 111 can be based on projections of the technology's performance and use. In addition to industry opposition, several environmental and local environmental justice groups oppose the use of CCS on powerplants, claiming the technology is not economically feasible, safe for local communities, or proven.

If the April 2024 rule is not stayed or overturned, it will depress new investment in U.S. baseload natural gas generation and encourage the retirement of existing U.S. coal-fired plants. EPA's own regulatory impact assessment (RIA) of the rule, based on partial and full equilibrium models, suggest that less than 1 percent of power plant generation in 2045 will be using CCS. EPA has also announced plans to propose new standards for existing gas-fired combustion turbines later this year. The new regulations may have a significant impact on the power sector as it seeks to increase generation to meet rising electricity demands and address reliability concerns.

Session 4 – Managing International Conflicts: Middle East and Ukraine Session Chairman: William A. Barletta (Chairman Mitigation of Catastrophic Risks PMP)

Speakers: Nichole Argo[1], Lydia Wilson[2], Bilal M. Ayyub[3], William A. Barletta, Tariq Rauf[4]

The "psychological underpinnings of the Israeli-Palestinian conflict" refer to inter-group dynamics that lead to the dehumanization of the "other" or "out group", with greater significance given to one's own or "in group". These dynamics can lead to violence against the "out group". In contrast, the "in group" holds itself sacred based on its religious and social identity. Field research data from the second intifada, carried out between 2001-2007, involved interviews with 15 would-be Palestinian "bombers" and the families of 30 Palestinian "militants". Sixty percent of the sample had no attachment to "militant" organizations. Missions were carried out within one month of being recruited by family or friends.

Their motivations were driven by shock or trauma, and by role models–Palestinian "bombers" who had executed their assigned missions. Motivations also included expressive emotions of making the enemy feel pain rather than necessarily to defeat the enemy. Sacrificial motivations also were observed from the data, including those with religious connotations such as "God's wishes", social distancing from the "out group", and dehumanization of the "out group".

When large groups feel targeted for their identity, they form tighter bonds with the group directly under threat, with psychological and real-world ramifications. This tendency is exacerbated when the group feels under extreme threat, to the point of possible extinction, because of its identity. Such a retreat into hard psychological boundaries increases when the violence and traumatic experiences are ongoing and inter-generational and increase when the psychological wounds of trauma go unrecognized and untreated.

Both Palestinians and Israelis inherit intergenerational trauma. For Israelis, as for other Jews around the world, the memory of the Holocaust is embodied in their determination of "never again". The Holocaust itself was only one expression of European anti-Semitism. For Palestinians, the major trauma was the "Nakba" (or catastrophe), when Israel was founded in 1948, and hundreds of thousand Palestinians lost their homes in the ensuing violence. Many of the descendants of those who were driven from their homes in 1948 are still living in refugee camps. Although the displacements during the Nakba are irreversible, the slogan of Palestinians is "never surrender".

However, the two situations are not equivalent. The Holocaust was perpetrated in Europe by Europeans while Israelis, since the Nakba, have controlled many Palestinian lives. Nonetheless, both groups have major traumas in their recent past, and feelings of rage, humiliation, and the injustice has been passed on down the generations.

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[4] Former Head of Verification and Security Policy, International Atomic Energy Agency, Austria.

Actual existential threats create a psychological imperative to keep to one's group and not cross group boundaries. Merely trying to understand the other side is often seen and felt to be betrayal. A stark illustration is the Oslo accord negotiated between Yitzhak Rabin and Anwar Sadat. Although the international community hailed their agreement as a breakthrough, both peacemakers were murdered – by people from their own side.

Modeling complexity of conflicts including economic, structural and psychological perspectives: These inter-related systems require complexity analysis to understand the roots of interminable conflicts. The 20th century transformed societies by introducing new energy sources, creative manufacturing processes, and an information revolution, all of which led to prosperity, wealth accumulation, connectedness, and information access. Nonetheless, the outcomes have often resulted in: (1) disparity in wealth distribution across countries, as well as within population centers, (2) decentralized information distribution and broad access to information, empowered by social media, and (3) emergence of disenfranchised masses as a byproduct of the prior two items. We are witnessing increased tensions, as new actors (both state and non-state) are emerging demanding (sometimes violently) a seat at the table. Stressors to the present world order are leading to regional wars, tense international relations, arm races, etc.

The rational/irrational duality in decision-making emerges when the same actor (or player) in a conflict demonstrates a mindset spanning a spectrum from sacred values to be defended at any cost to those things that are amenable by tradeoffs. To mitigate the structural roots of conflict, complexity needs to be simplified. In this context, the situation on the ground should be understood from the perspectives of the actors or players involved with the aim of instituting an honorable, just value system and seeking achievable favorable outcomes.

The talk, "Application to NATO, Russia and Ukraine," described political and structural perspectives as viewed from Kyiv and Moscow as well as from a clash of their respective "sacred values." The Zelenskyy government insists on sovereign political and economic independence from the Russian sphere of influence in the form of applying for membership in both the European Union and NATO. In contrast, President Putin views the large Russian speaking population in the Luhansk and Donetsk Oblast as making those regions (if not all of the Ukraine) part of Greater Russia and supporting a common Russian view that the Ukraine is, in reality, just a part of Russia. According to that view, Ukraine was called a separate country after World War II, so that the Soviet Union would have three votes in the UN General Assembly. The present Ukrainian pursuit of NATO membership conflicts with Russian interpretations of promises made in the Lisbon agreement (1992), namely, Ukrainian neutrality.

As seen from Moscow, the steady growth of NATO now up to the Russian frontier, is a betrayal of promises made by the U.S. in the early 1990s as part of the repatriation of Soviet nuclear weapons to Russia and the including the Ukraine in the Non-Proliferation Treaty. Hence, President Putin considers his war with the Zelenskyy government as a war against the West embodied by NATO and the U.S.

This session concluded with the moderator's report of the extended discussion of the war in Gaza that was held during the meeting of the MCR PMP on the day preceding opening of the Seminars. That discussion was introduced three short presentations by speakers at this session. Participants offered both comments on the conflict, and possible actions that the WFS could take: 1) to devise creative solutions for the way forward, 2) to formulate strategies to engage with respective political and decision-making authorities, and 3) to seek and promote trust- and confidence-building peace narratives.

Session 5 – Perspectives, risks and challenges of cyber security and AI
Chairman: Axel Lehmann[1] (Chairman The Future of Cybersecurity and AI PMP)
Speakers: Hamadoun Toure[2], Arthur I. Miller[3], Alexander Ntoko[4], Sun Kun Oh[5], Anna Pouliou[6], Pier Paolo Menchetti[7]

Axel Lehmann
Introduction

Since its foundation in 2001, the Future of Cyber Security and AI PMP was monitoring significant challenges in the rapidly expanding cyber world. Special attention was focused on increasing cybersecurity risks and countermeasures from economical, technological and legal points of view. In recent years, the panel focused especially on new challenges with respect to vulnerabilities and security risks for public and private life arising from:

- widespread applications of AI and respective tools,
- exponentially increasing amounts and importance of data as a key resource for the use of AI technologies, and
- hyperconnectivity of digital components, systems and networks forming extremely complex "Systems-of-Systems" ["The World is becoming an Intelligent, Digitally Enabled Mesh of People, Things, and Services", Gartner Group Inc, 2017].

It was emphasized that the wave of AI tools and applications, especially those of generative AI tools, offers completely new opportunities for businesses as well as for individuals, but also significant deficiencies and even risks regarding unexamined application of AI tools, applied data, and of generated results. Therefore, the panel recognizes as important requirements:
- intensive research and the need for insight into "black box" AI tools widely used nowadays; technological evolutions, especially those of generative AI tools, urgently require the possibility for verification, validation and better understanding of AI generated results;
- more attention has to be given to ensure origin, authenticity and quality of the applied data – a major security and risk factor which requires global public awareness and education.

Finally, in consideration of potential future developments of AI, a significant statement of key experts of AI developments was mentioned and must be seriously considered ["Risk of extinction on par with pandemics and nuclear warfare" (Sam Altman, Demis Hassabis, Geoffrey

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[3] Professor Emeritus of History and Philosophy of Science, University College London, UK.
[4] Chief, Operations and Planning Department, International Telecommunication Union ITU, Switzerland.
[5] Professor Emeritus, Department of Physics, Konkuk University, South Korea.
[6] Chief Privacy Officer, Mars Inc., and University of Maastricht, Faculty of Law, The Netherlands.
[7] Professor for Ortopedia e Traumatologia, University of Palermo, UPMC Salvator Mundi International Hospital, Italy.

Hinton, et. al., Fortune, May 30, 2023)]. In this session, five speakers addressed deficiencies as well as opportunities arising from these rapid developments, especially of generative AI, from interdisciplinary perspectives - from technological, educational, management, normative and legal points of view.

Hamadoun Toure
Current Status and Associated Challenges of AI

Nowadays almost everybody in public and private life is talking about AI or is even using it, consciously or unconsciously. But according to a poll in 2018, among 1,500 senior business leaders in the USA, only 17 percent were familiar with AI. Especially with the first release of ChatGPT in November 2022, a wider audience and a rapidly increasing user community became aware of the potential of generative AI tools and their capabilities.

This presentation summarized important development steps and keystones of AI, including basic methods, algorithms and their applications. In the 80s, machine learning algorithms were developed; artificial neural networks were established in the 90s, and deep learning algorithms with multilayer neural nets were achieved in the 2000s. These ground-breaking developments were facilitated by tremendous advancements in microelectronics and nanotechnology, offering increasing computing performance and storage capacities. Advanced sensor, storage, and communication network technologies enabled the effective use of huge amounts of data ("Big Data"). Besides rapid advantages for businesses and industries, these innovations also push and increase the use of social networks, "Smart Systems of Systems", and innovative AI tools and applications. Especially, recent developments of generative AI tools offered completely new opportunities such as text generation (e.g., ChatGPT), image generation (e.g., DAL-E 2), natural language processing (e.g., Transformer) or platforms for creation of multi-lingual chatbots (like BotStar).

However, rapidly advancing digital technologies also create new vulnerabilities, including security risks through ignorance and criminal activities. Therefore, these evolutionary developments require rapid action for phrasing and accepting codes-of-conduct, ethical rules and legal frameworks, preferably on a global scale. The establishment of responsible social behavior of individual users, system developers, companies, and state actors urgently require such frameworks. They need to cover many elements, including information distribution, social networking, and smart system developments, i.e., smart energy systems or AI-based decision support systems. Inadequate governance of generative AI tools makes information and knowledge fraud more likely with severe consequences for public and private life.

In summary, besides major beneficial achievements of current AI technologies, new security and safety risks require the development of basic rules for use of AI technologies, codes-of-conduct, and global legal frameworks. Also required are actions to generate public awareness of these risks, as well as political awareness of missing national and international norms, and a legal basis for AI tool developments and applications.

Arthur I. Miller

The Brave New World of Machines that can Make Art, create Prose and Think

That machines can be creative has been abundantly clear since at least 2016, when the algorithm AlphaGo, running on an artificial neural network, trounced a highly regarded Go master. That was a WOW moment for AI. The horse was out of the stable. AI was here to stay. Naysayers as to whether machines can be creative hesitate when AlphaGo and its successors are brought up.

The ante was raised with the appearance of the new generative AIs, the hottest topic in AI today. Indeed, the world has never been the same since November 2022 when ChatGPT was released. With the proper prompt, ChatGPT can create sometimes stunning prose, write code and translate between languages, among other things. The presentation focused on art created by generative AI art bots that respond to prompts.

Generative AI algorithms such as Dalle-2, Stable Diffusion and Midjourney create art that is often difficult to distinguish from art created by humans. Can art created by these bots be patented? No, says the U.S. Patent Office which declares flatly that only humans can be creative. This opens up the byzantine area of AI copyright which is hotly debated today.
We may ask, why have we not seen a masterpiece of AI art (an AI Mona Lisa)? Perhaps we will be able to appreciate AI art accounting for the fact that it has been created by a machine. In the future, machines may need to explain their art to humans (whatever humans will be like by then). Machines will create art that, at present, we cannot imagine. So, what do art bots tell us about creativity? That creativity can be a property not only of carbon-based systems such as us, but also of silicon-based systems, seemingly dumb artificial neural networks.

Generative AI art bots, responding to a prompt like ‘infinite joy’, can create art of deep emotional content, leading to speculation that there is something going on in the machine that goes beyond probabilities and numbers. Musing about the brave new world of AI is complex not only because advances occur so quickly, but also because we are merging with machines. Consequently, it is almost impossible to imagine what our world will be like in the ‘deep’ future.

Alexander Ntoko

Advanced Information Management System (AIMS) and the Interconnectedness of AI and Data Security

In the rapidly evolving landscape of AI, particularly in the realm of generative AI including Large Language Models (LLMs), data has emerged as the most critical asset. The way in which this data, ranging from traditional transactional data to text, images, files, etc., is securely managed is of paramount importance, with far-reaching implications for individuals, organizations, and even nations. When the data is not managed with utmost care, it carries the risk of misuse and loss of ownership, potentially resulting in unauthorized usage and other negative consequences instead of driving progress. As the new age AI relies heavily on diverse forms of data to function effectively, the need for robust data management and data security becomes ever more essential.

An Advanced Information Management & Security (AIMS) framework can address these challenges by treating data as a first-class citizen, ensuring that it is managed with the highest levels of integrity. AIMS does not replace, but complements, existing information management systems and frameworks, focusing more on the unique needs raised by AI technologies, and is based on the related ITU-T standards for security. AIMS provides a comprehensive and specialized framework for data management in the era of generative AI, that emphasizes user control and security. AIMS relies on four foundational pillars, collectively known as SITO-Security, Interoperability, Trust, and Ownership. Each pillar plays a crucial role in addressing the challenges posed by new age AI like LLM and data security:

1. Security: Data security is not just a feature but the core of the AIMS platform. By implementing the latest security practices and guidelines, AIMS ensures that only the rightful owner can own, access and use their data.
2. Interoperability: In a constantly evolving technological landscape, AIMS provides a unified approach to information exchange. It enables seamless integration with exi sting systems, irrespective of the vendor, thereby reducing total cost of ownership and eliminating vendor lock-in.
3. Trust: Trust is the cornerstone of data management. AIMS applies zero-trust principles throughout the data lifecycle, ensuring that data usage is always signed, verified, and authorized. By doing so, it removes any assumptions about prior permission, protecting the integrity of the data.
4. Ownership: AIMS empowers users with full control over their data and privacy. This pillar ensures that the creator of the data retains ultimate control over its use, with the

> freedom to move or modify data across vendors as needed. This level of ownership is essential in a world where data is often mishandled or used without consent, including AI model developments.

As AI technologies continue to advance, they bring with them many opportunities to address needs today and new challenges, particularly in the areas of data security, ownership and integrity. AI systems are only as robust as the data they are trained on, making the proper management of this data essential for the development of trustworthy and effective AI solutions. AIMS will safeguard not only the data but also ensures that AI systems, built upon it, are more reliable, secure, and ethical. It represents a crucial step forward in the responsible management and usage of data, laying a solid foundation for the future of AI and technology.

Sun Kun OH
Northeast Asian perspectives on AI challenges

To South Koreans, China and Japan are nearest neighbors, with overwhelming influences historically and geopolitically. China has been a dominance over Korean peninsula for more than a millennium. China is now one of the two poles of the world. Japan has also been one of the economic superpowers since the second half of the 20th century. In between the two giants, the South Korean people have struggled not only to survive but also to thrive. The competitive spirit has been the driving force, and international recognition has been the most important agenda for South Koreans. The outcomes are visible in various fields. Either in the success of its economic growth or in sports, South Korea is now a fast chaser of its giant neighbors. A Singaporean newspaper noticed that, at the 2024 Paris Olympics, the remarkable performance of Chinese, Japanese, and South Korean athletes have propelled all three nations into the top 10 of the medal table, showcasing the sporting prowess of Northeast Asia to the world. The symbiotic relationship between Japan, South Korea, China and the Olympics have revealed the vitality and prospects of Northeast Asia's development.

Indeed, the three countries are well aware of the importance of their neighbors for mutual development. On 27 May, 2024, South Korea hosted the 9th Trilateral Summit among them, where leaders from China, Japan, and South Korea reaffirmed a shared commitment to "peace, stability and prosperity" in Northeast Asia. In a joint statement, the three countries vowed to increase trilateral cooperation in a number of key areas, with a heavy emphasis on repairing trade relations, increasing technology cooperation and promoting cultural exchanges.
In the field of artificial intelligence (AI), too, the competition and cooperation among these three countries are remarkable. In an era where digital innovation is reshaping our world, AI emerged as a pivotal force, revolutionizing industries and societal structures. In order to cope

with the risks and hazards, the three countries recognized and participated as active partners in the global trends towards legal clarity in AI regulatory approaches, by UNESCO, OECD, EU, and UN, in which the EU's AI Act is the strongest legislation so far.

Note that South Korea is proactively evolving its legislative and regulatory environment to enhance the AI sector's global competitiveness and manage emergent risks. South Korea's proposed comprehensive AI regulations will capitalize on its integrated ecosystem for AI development and will allow South Korea to focus its policy on fostering innovation.

The following list summarizes significant milestones in AI policy and regulatory frameworks in the three Northeast Asian countries:

China: The National Data Bureau was established in October 2023 with members from government. Background was the AI-Initiative, declared at the 14th NPC in March 2023. The Bureau has lost focus on the development of "Digital China" and reports to the National Development and Reform Committee.

Japan: An AI Strategy Council was established in May 2023 with a balanced composition with the Prime Minister and several ministers among a total of 17 members. The foundation of the Council was motivated by the "Hiroshima AI Process", proposed and accepted at the G7 / Hiroshima Summit in May 2023. The aim of the Council is "to maximize the AI potentials, while addressing the risks of AI". The Council was well aware of the EU's AI Act, but it focused on the formulation of guidelines rather than national laws.

South Korea: A National AI Committee was established in July 2024 as a public / private platform, supervised by the government.

Anna Pouliou

Challenges in the Digital Era ahead: AI Risks and Legislative Approaches

With AI on the rise, there is a lot of debate on its potential, the risks it represents and the ethical parameters to implement. The evolution of technology represents both a risk and an opportunity. AI has a huge potential to improve human lives providing comfort, safety, better management of resources, and better healthcare. There are AI-powered robotic surgery devices that can perform incredible precision surgery, and AI-powered diagnostic tools that can detect malignant formations, pixel by pixel, that the human eye cannot.

While there are undeniable benefits, AI has already brought a new set of risks. All around us we see virtual creations that are difficult to discern even for experts, let alone by the wider public. A person's identity, dignity and reputation can be compromised while the evolution of natural language processing (NLP) may amplify risks from scams and back-engineering calling

for measures especially in the financial sector. We also see deepfakes and organized disinformation campaigns that can affect elections and threaten democracy. Additionally, the use of AI for military purposes, with pilotless AI airplanes, drones, and robotics can create new risks, as AI controls may have no "personal ethics" or "fears" stemming from self-preservation instincts and thus, being capable of massive disasters.
In this digital reality for mankind, there are several approaches to control the risk at the national level. The EU has adopted various acts with the latest addition, the EU AI Act, being the world's first comprehensive AI law with the goal of ensuring AI systems in the EU are safe, transparent, traceable, environmentally friendly, and non-discriminatory. An EU AI Liability Directive is also in the works. Other countries like Brazil, Canada and China are also working on AI bills. However, countries like the U.S., UK, Switzerland, and Japan are adopting a different approach with no specific AI laws, rather favoring self-regulation with the issue of guidance or reliance on other existing laws. Reaching convergence on an international level may prove a major challenge. However, the UN, the OECD and other IGOs are also very active on the topic of AI. The development of an ethical AI framework is timely and of major importance.

Pier Paolo Menchetti
AI in Health

The growth of the Health Information Exchange (HIE) market is expected to reach $2.0 billion, with a CAGR of 12.2%. It is obvious that data is increasingly important in modern medicine for improving chronic care, performing medical research, avoiding medical errors. and increasing efficiency in the delivery of medical services.

The Global Forecast [Binarics: Artificial Intelligence in Healthcare: Market Size, Growth and Trends] indicates that by 2029 the AI Healthcare Market will increase almost by 50%. Companies with advanced diagnostics and efficient data management will have an advantage to capture a share of this growing market.

As of today, major benefits of AI in healthcare concern:
- Ability to analyze data and improve diagnosis;
- AI-equipped technology can analyze data much faster than any human, including clinical studies, medical records and genetic information;
- Reduce diagnostic and therapeutic errors;
- Increase patient safety and huge cost savings associated with use of AI;
- Carry out administrative and routine tasks, as AI can automate many routine tasks.

With less time being spent on administration, medical professionals can place more focus on patient care.

For the use of AI-based products in healthcare significant rules have to be considered and followed:
- Adequate risk assessment;
- High-quality datasets;
- Activity logging to ensure result traceability;
- Detailed documentation providing all necessary information about the system;
- Appropriate human oversight measures to minimize risks; and
- High level of robustness, security, and accuracy.

Major challenges for AI in Healthcare include:
- Training set: Difficulty accessing necessary data (+bias);
- Legal responsibility & transparent AI;
- Development costs;
- Privacy & cybersecurity; and
- Integration and interoperability issues.

Session 6 – Engineering the Mitigation of the Global Wildfire Emergency and other Threats to Civil Infrastructures
Chairman: William A. Barletta (Chairman Mitigation of Catastrophic Risks PMP)
Speakers: James H. Lambert[1], Bilal M. Ayyub, R. Ranger Dorn[2], John Organek[3], Robert Rosner[4], Anatoly V. Zaitsev[5], Sergei Pulinets[6]

Systems analysis of the wildfire emergency: The MCR Wildfire Group presented data showing that extensive wildfires have become a global multi-scale planetary emergency. They offered a systems analysis of technological countermeasures, with special attention paid to Sicily, California, and several other regions to describe a framework for the integration of firefighting systems, satellites, fixed imaging, and aerial vehicles, with mathematical simulation and machine learning, to support both mitigation policies and societal responses to incidents. The responses include (a) characterization of the planetary wildfire emergency, (b) early detection and characterization of dangerous wildfires and identification of means for their control, and (c) reduction of the danger to population centers in both rural and urban areas through better understanding of the threat.

Societal metrics of success include human health and safety, environmental and ecological health, integrity of critical food and industrial supply chains, geopolitical security, and others. Several technology and policy countermeasures of particular interest are regional fuel management, distributed sensors, computational intelligence, advanced firefighting materials, protocols, automatic and semi-autonomous responses, benefiting from the latest advancements of information technologies, including artificial intelligence, machine learning and others.

The presentation featured a simulation exercise involving all plenary participants of the 56th Session and observers who were invited from regional agencies. Designed to raise awareness and understanding, the exercise described a sequence of circumstances and evaluations of potential positive impacts of different detection technologies and mitigation actions for a scenario of a wildfire encroaching on the town of Erice. This "tabletop" approach has relevance to wildfire countermeasures globally, as well as to the variety of planetary emergencies addressed in the 56th Session.

Postscript: Based on the extensive work of the MCR's Wildfire Emergency group, the City of Erice has confirmed its agreement to support the Foundation Ettore Majorana's establishment of a Wildfire Emergencies study center. This will include the assignment of a forest, Bosco di San Matteo, with the required agreement of the Sicilian Region, to study all

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[4] Professor, Harris Public Policy, University of Chicago, USA.

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available technologies and subsequently launch a Pilot Project in the region for the early detection and mitigation of wildfires.

Solar geo-engineering: The recent IPCC 6th Assessment (AR6) argues that the Paris Agreement's "nationally determined contributions" for decarbonization are not on track to meet commitments for 2030. As their nominal 1.5°C and 2°C targets for global mean temperature rise above preindustrial levels are unlikely to be met, some form of engineering of the geosphere may be necessary to avoid some severe consequences of the failure to meet the decarbonization targets. Geo-engineering proposals include direct removal of CO_2 (CDR) from the atmosphere and solar radiation management. While CDR was discussed at last year's Erice Seminars, solar radiation management was not.

Solar radiation management (SRM) aims either to reduce the net influx of solar energy deposited on Earth or to increase the effective cooling rate of the Earth projected into space, or possibly both. Any decisions regarding the deployment of SRM must rest on an informed balancing of risks associated with 1) not intervening in climate evolution versus 2) with intervening in climate evolution. Evaluating these risks requires rigorous scientific assessments of the two alternatives. The speaker described both significant advantages and disadvantages of SRM and focused on the question: Should we move towards a serious scientific assessment of SRM? He argued that the answer is "yes." Although it is presently premature to deploy SRM, there is also an overwhelming reason to evaluate the potential downsides of SRM: By 2100, the relatively poor non-OECD nations, not the wealthy OECD nations, will dominate future CO_2 emissions. These nations do not have the financial resources to decarbonize, and the OECD nations are unlikely to be politically able to provide the necessary financial assistance. Consequently, as contended by IPCC AR6, climate conditions, that seriously impact human life, will become prevalent, especially in the tropics. Thus, it is increasingly likely that SRM will be needed to "shave" the peak damaging effects of coming climate change, thereby providing a longer window of time for decarbonizing human activities on Earth. Moving in that direction, without having established the science to support such a decision, would be foolhardy. We must move forward with scientific assessments of SRM.

Defense against cosmic threats: About 300 asteroids fly through the Earth's gravisphere every year, and present observation systems cannot detect objects arriving from the direction of the Sun (such as the Chelyabinsk meteorite). A catastrophe resulting from a collision of an asteroid or comet with the Earth could occur at any time. Yet an international Planetary Defense System (PDS) has not yet been created, even though the basic principles are known, and the possibility of its creation was justified about 30 years ago. For that purpose, an International Treaty is necessary, the principles for the formation of which have been developed.

SOLAR STORM DISRUPTIONS OF POWER: Coronal mass ejections (CME) from the Sun of massive quantities of energetic charged particles (solar storms) can produce large distortions of the Earth's magnetosphere. Such geomagnetic disturbances (GMDs) and the accompanying intense electromagnetic radiation threaten critical electrical energy distribution networks, communications and navigation infrastructures, and gas and oil pipelines. They can also affect human health both on the ground surface and during air and space flights.

GDMs are known to cause spatially distributed voltage differences in electrical power grids thereby generating excess high current oscillations throughout the network of connected transmission lines. These high-current oscillations can damage or destroy transformers. Excess currents induced by ionizing radiation can also damage electronic circuits that collect and channel the energy from the particles. Utilities collect a wide range of data before, during, and after GMD events so that risk models and operational standards can be improved. Unfortunately, the communications sector is not as mature in its preparations, execution, and data collection as is the electric power sector.

Thanks to the early detection of the G5 level GMD event of May 10-12, 2024, plus the reliable projection of potential effects, national space weather command centers issued immediate warnings to utilities. Mitigating actions taken by potentially affected utilities resulted in no reports of significant damage. Clearly, an international system is necessary for effectively monitoring and forecasting space weather and to coordinate the efforts of various countries to mitigate the global consequences of extreme space weather.

Session 7 – Pollution and Water Crisis
Chairman: Lorne G. Everett[1] (Chairman Pollution and Water Crisis PMP)
Speakers: Daniel B. Stephens[2], Vijay P. Singh[3], Shammy Puri[4], Hugo A. Loaiciga[5]

Lorne G. Everett
Introduction

The Pollution and Water Crisis Permanent Monitoring Panel/PMP met in the John von Neumann Lecture Hall in the San Domenico Monastery. In addition to the 4 summary papers presented below, an in-depth presentation on PFAS (per and poly fluorinated alkyl substances) was presented by Gina Calderone[6], PFAS is often referred to as "Forever chemicals" since the fluorine/carbon bond is one of the strongest bonds in nature and may require 1,000 years to degrade. Recent maximum permitted levels for PFAS in water in the U.S. may result in the most expensive environmental regulation in history. Sicily is experiencing the highest water drought crisis in the past 20 years threatening human health, agriculture, and tourism is. Our PMP session focused on drought.

Daniel B. Stephens
Groundwater contamination and unintended consequences

Advances in chemical engineering have produced so many benefits to our society. But, with many of the benefits have come unintended and undesired consequences. For example, DDT, an insecticide for mosquitos, especially important in malaria prone areas, was found to kill birds which ate the insects, as pointed out by Rachel Carson, in her book Silent Spring more than 50 years ago. She wrote, "If we are to live so intimately with these chemicals…we had better know something about their nature and their power."

The field of groundwater hydrology blossomed in the US during the 1980s as new federal environmental regulations were promulgated to protect human health and the environment, including RCRA and CERCLA. These regulations were driven in part by extensive contamination in our aquifers, largely by leaks and spills, mostly accidental. For example, transportation fuels for jets, trucks, and cars often have been stored underground in steel tanks. Over time some tanks failed due to corrosion. Although the fuel is less dense than water and tends to form a localized 'pancake' on the water table, chemical additives like MTBE tend to dissolve in the groundwater and form a plume far from the source of the leak. Organic solvents,

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[5] Director of the Hydrology Laboratory, University of California, Santa Barbara, USA.

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developed with good intention for dry cleaning clothing and degreasing metals in manufacturing, have found their way into soil, impacting groundwater. Organic solvents are denser than water and some liquid becomes trapped in groundwater, again forming large dissolved chemical plumes, including PCE, TCE and TCA. These dense organic liquids, when intentionally discharged to sumps and floor drains in dry cleaners or manufacturing facilities, unknown to personnel at the time, tend to leak through broken or poorly connected underground sewer pipes.

Groundwater contamination isn't just related to unexpected impacts from fuels and solvents. Even in dry desert environments like the Southwest U.S., uranium mill tailings have leached radioactive elements to groundwater. Abandoned surface and underground mines may contain heavy metals and acid water that infiltrate to groundwater. Cooling tower water treated with a chromium algicide when discharged to ponds, lagoons, and drainages, has impacted groundwater with hexavalent chromium that is very mobile in groundwater. No one would argue the benefits of using a foam to smother a fire. But the foam may contain PFOA/PFOS chemicals which are carried into the soil and groundwater by the water used in the firefight.

Cleanup of these chemical plumes can range from several hundred thousand to several hundred million dollars or more. And each year, it seems that improved analytical chemical methods and environmental research reveals new, potentially dangerous, chemicals. These 'emerging' contaminants may be a threat to human health and the environment but are currently unregulated. Beneficial products such as prescription drugs, home cleaning chemicals, and personal care products are routinely discharged to our toilets, where they, unexpectedly, may find their way to groundwater through septic tanks and leaky sewers. And, more recently, we find microplastics in our surface water and groundwater.

Microplastics are particles 1 micron to 5 mm in size made from plastics such as polycarbonate, polyester (clothing), polyamide (nylon), polyethylene, polypropylene, and others. These microplastic particles may be in scrubbers for skin cleaning, abrasives, and feedstocks for manufacturing. They may break down from large plastics like discarded bottles, packaging, fishing lines, agricultural mulches, plastic bags and cups etc. Plastic trash runs off urban hardscapes to our water ways and beaches eventually producing microplastic particles which find their way into the food chain of benthic organisms which get consumed by larger aquatic organisms, including fish, which are consumed by humans. Plastics in uncovered landfills and agricultural fields may produce windblown microplastic particles which have been found worldwide, from the Marianas trench to Mt. Everest and even in our groundwater. Recent research has found microplastics in human blood and lung tissue. Some U.S. States and other countries have begun to initiate controls on some types and uses of plastic. Unfortunately, no health risk levels have been established anywhere in the world. In the case of microplastics, this emerging contaminant is not localized to a plume from a spill or leak, but rather is found throughout our planet, entrained in the hydrologic cycle. The unintended consequences to human health and the environment have yet to be determined.

Like anthropogenically produced chemicals which may introduce undesirable substances to the environment, contaminants rendering water unfit to drink or for other uses for example, rising seawater may also have this effect. It is commonly thought that the impacts of sea level rise will lead to a slow progressive surface flooding as the coastline gradually recedes, along with periodic but more frequent and disastrous storm surges from typhoons and hurricanes. Rising sea levels will also lead to rising coastal groundwater tables, a factor not so often taken into consideration by decision-makers, although the impacts could be more far reaching.

Over about the next 75 years, sea level is predicted to rise on average 0.43 to 0.84 m [IPPC, Summary for Policy Makers, Chapter 4, p. 324. https://www.ipcc.ch/srocc/]. Data show the rate of rise has accelerated in many areas. It has been estimated that about 1.4 billion people live along a coast where the land surface is less than 1.5 m above sea level. And in these areas, the water table would be even shallower. The oceans and coastal water table aquifers are in hydraulic connection to some degree. There is a 'wedge' of salt water which naturally penetrates inland, creating a brackish water interface with the fresh groundwater. When the sea level rises, the coastal water table rises. When the sea level rises, the saltwater wedge moves inland.

Let's consider briefly some of the potential consequences of rising groundwater in coastal communities. First, wells which tap the fresh water, may start to produce brackish water. Coastal forest soils may become water-logged by the rising freshwater table, causing the trees to die off, creating 'ghost forests. Ocean storm surges may push saltwater miles inland via rivers, canals and drains. This salty water may then infiltrate beneath agricultural fields, rending the soil unfit to grow crops. In urban areas, building foundations may become prone to settlement and structural damage. Sewers may fill with groundwater, so that domestic sewage and storm water backs up into homes, buildings and streets. Chemicals held in soils, including from hazardous waste sites and home septic systems, may become mobilized and start to move with and contaminate the groundwater.

No doubt many of the groundwater problems associated with rising sea levels can be solved with engineering. Some low-lying countries have been dealing with this for centuries. However, rising sea levels will have much wider impacts, especially affecting poor populations which cannot afford extensive engineering solutions. Water resource planners urgently need to expand their areas of concern to include the unexpected consequences of sea level rise on groundwater.

VIJAY P. SINGH
WATER: HOW SECURE ARE WE?

The state of our planet depends on seven pillars comprising freshwater, air, soil, oceans, forests, climate, and the ecosystem. Central to these pillars, however, is water, for without water, other pillars will not exist. Thus, it is vital that our planet is water secure. The question arises: Are we water secure?

Water security is defined as access at all times to sufficient and quality water to satisfy varied needs and is built on three pillars: (1) availability and supply of sufficient quantities of quality water on a consistent basis; (2) demand for and appropriate use of water based on the knowledge of quality water and treatment; and (3) access determined by having sufficient resources to obtain appropriate quantities of quality water for satisfying needs. Each of these pillars is discussed in what follows.

How much water is available globally? Of the total global water, only 2.5% is freshwater, about 1% is saline water, and 96.5% is oceanic water. Freshwater comprises 1.2% in rivers, large lakes, reservoirs, wetlands, and sources; 30.1% as groundwater; and 68.7% in glaciers and permanent ice caps. The total volume of water in rivers, large lakes, reservoirs, wetlands, and other bodies is 124,200 km^3 of which 24.8% is found in Asia, 25.6% in Africa, 25.8% in South America, 21.7% in North America, and 0.002% in Australia.

On a global basis, 68% of freshwater is used for agriculture, 20% for industry, and 12% for domestic purposes. The 20% industrial use is made up of 10% for power generation, 8% for other industries, and 2% for primary energy generation. Thus, agriculture consumes the largest share of freshwater.

A person needs 4 to 5 gallons of water per day to survive. An average American uses 100 to 176 gallons of water per day at home. An average African family uses 5 gallons per day. Kuwait has the highest per capita water consumption. It grew from 200 liters per person per day in the 1980s to 500 liters per person per day.

Crop water use depends on crop types, soil types, climate, and irrigation systems. 1,000 liters of water are needed to produce one kg of grain, 15,500 liters of water to produce one kg of beef, 17,196 liters of water to produce 1 kg of chocolate, 5,988 gallons of water to produce 1 kg of pork, 4,325 gallons of water to produce 1 kg of chicken, 3,400 gallons of water to produce 1 kg of rice, and 1,220 gallons of water to produce 1 kg of maize.

Electricity production is one of the largest users of water. For example, to produce 1 million BTU, natural gas needs 3 gallons of water, a hydroelectric power plant needs 20 gallons of water, a coal power plant needs 41 to 461 gallons of water, a nuclear power plant needs 2,400 to 5,600 gallons, ethanol production needs 2,500 to 29,100 gallons of water, and biodiesel production needs 14,000 to 75,000 gallons. Biofuels are an irony when it comes to water. Currently 2% irrigated water is used for energy crops. If all plans were implemented, 180 km^3 of water will be needed.

The next question is: What is the current water situation in the globe? Local water shortages are multiplying. Current patterns of water being withdrawn are dangerously close to the limit and even beyond. Only 37% of the longest rivers (>1,000 km) in the globe remain free flowing. An alarming number of rivers – the Indus, the Rio Grande, the Colorado, the Murray-Darling, the Yellow River – the arteries of main grain growing areas – no longer reach the sea. 50% of the world's wetlands have been drained, damaged or destroyed in the twentieth century. 40% of groundwater has already been extracted from 68 of the largest aquifers of the world, and one third of the aquifers have been depleted beyond recovery.

According to the UN, the freshwater availability of 500 m^3 per person per year corresponds to absolute water scarcity, water availability between 500 and 1,000 m^3 corresponds to scarcity, water availability between 1,000 and 1,700 m^3 corresponds to stress, and water availability between 1,700 and 2,500 m^3 corresponds to vulnerability. China, parts of Africa, and Europe are in vulnerable situations, whereas India and South Africa are under water stress. Parts of East Africa are in water scarce conditions, and North Africa and Gulf countries are in absolute water scarcity conditions. Defining water stress index (WSI) as the ratio of annual mean total water withdrawal to available discharge, about 2.28 billion people live under high water stress and by the end of century, 4.15 billion people will live under high water stress. Middle Eastern and Northern African (MENA) countries are in absolute water scarcity situation (< 500 m^3/person); Kuwait has the least per capita water availability: 27 m^3 in 1970, 9 m^3 in 2001 and it is projected to decrease to 5 m^3 in 2025.

There is a water crisis in the world. One billion people do not have access to safe drinking water. According to the UN, by 2025 1.8 billion people (almost 2/3^{rds} of the world population), will be living in water scarce or water stress areas. The water crisis is particularly severe in more populated areas of Africa and Asia. The reasons for a water crisis are an alarming rise in population, exploitation of groundwater, and wastage of water.

India with a population of 1.45 billion people but only 4% of global water is heading for a disaster. 54% of India faces high to extremely high-water stress. It is the world's largest extractor of groundwater, 92% of which is used for agriculture. Two-thirds of its population depend on agriculture for their living. Tens of millions of farmers do not have enough water. Its capital Delhi faces a severe water crisis. In 2023, only 0.34 billion cubic meters of groundwater was accessible, with 99.1% already extracted. Groundwater extraction rose from 98.16% in 2022 to 99.13% in 2023.

Water scarcity is attributable to population rise, higher food and energy requirements, and economic development. In the last 50 years (1970–2019), population rose from 3.7 billion to 7.7 billion and water use rose from 2,360 km^3 to 4,600 km^3. By 2050, population is projected to increase by another 1.7-2.5 billion (22-34%), and water use by 20 to 30% above the current level. More than 50% of the population will be water stressed or scarce (nearly 6 billion).

Water is limited and should not be wasted. Sustainable water supply and use requires an integrated approach entailing water conservation, efficient use, treatment, recycle, reuse, and development of additional water resources. Every drop conserved is a drop that can be used for other purposes. Irrigation methods should be improved so that every drop counts and is not wasted.

Climate change has implications for food security, energy production, extreme hazards, ecosystems, ecosphere, biosphere, water resource, and human society. Hydrological impacts of climate change are illustrated using droughts and floods. For example. During a 20-year period 1996–2015, there were 10 drought occurrences. Climate change is expected to increase the frequency and magnitude of extreme weather events. Annually drought affected 1.1 billion people, killed 22,000 more, and caused US$100 billion in damage. 16.5 million people were affected in the People's Republic of China, 17.5 million people in India, and 2.5 million people in Ethiopia. During the same period (1996–2015), 100 flood events occurred. 36 million people were affected annually. 67 million people were affected in China, 19 million in India, 5 million in Bangladesh. People at risk from floods were 1.2 billion in 2010 and are projected to increase to 1.6 billion in 2050 (~20% of the world population).

In order to have a water secure future, it is time to reexamine and reflect on the integrated water, food and energy security systems, including partnerships among academia, governments, NGOs, and the private sector, especially farmers, and public education.

Shammy Puri
Water Security and Global Water Pollution

Water scarcity on its own is a significant challenge to humans, as well as to nature. While the latter can withstand significant short-term extremes, the same cannot be said of humans. There is widespread and universally accepted understanding of the problem. In other words, lack of water has a direct and often devastating impact on humans, and especially babies. Even under less severe conditions of water scarcity, water quality also has a direct impact of human health. Human organisms can only tolerate a minor and, in some cases, zero concentrations of compounds that are broadly termed 'contaminants'. The most ubiquitous contaminant in water is untreated anthropological waste. 1 m^3 of untreated wastewater requires approximately 8 m^3 of fresh water for it to be diluted to a scale where it could be consumed. While wastewater treatment is a norm in most countries of the developed north, this is not the case in much of the developing south. Even in some parts of the former, current trends are showing that water treatment is insufficient. Consequently, the purpose of this presentation was to outline the extent and the severity of this issue. Two examples were included to illustrate the issue and its scope – the Colorado river basin (USA) and the Ebro River basin (Spain).

WATER AVAILABILITY: Water availability is usually measured as the amount of freshwater per capita in a country. This gives a 'country' level measure – thus classifying countries on a consistent scale. The scales that are used are: $< 1,000$ m^3 per capita = extremely low water availability (e.g., Malta, <100 m^3 per); and $>10,000$ m^3 per capita, or above median water availability. The global classification of water availability by country is routinely done by the UN agencies associated with water resources, i.e., UN Water. Under the UN's Sustainable Development Goals (SDG) activities, recent surveys on the water stress indicator have been conducted. The selected indicators measure the proportion of total water resources used, taking account of the requirements for the aquatic environment, for each country. The findings from the SDG assessment indicate that at a global scale the averaged water stress is ~18%; however, at regional scales it is much higher, e.g., in central & southern Asia it reaches over 70%. The degree to which the stress becomes more critical is a function of the aridity in the country, associated with the density of population.
As noted above, when scarcity is coupled to water pollution (untreated or semi treated wastewater), the 'scarcity' problem is increasingly magnified causing human health as well as aquatic environmental and, often irreversible, health concerns. Most rivers and river basins of the world are reaching high level of development. Consequently, there are very few 'pristine' rivers basins left in the world and, in the majority of them, human waste will eventually end up in them as well.

EMERGING POLLUTANTS: There are three sources of pollution into rivers and aquifers; from agricultural activities, from industrial discharges and from households. Waste that enters the river systems arises from 'point sources' (such as wastewater discharge points) and 'diffuse sources' (such as agricultural application of agricultural chemicals and pesticide / insecticides), which eventual flow across the land to water courses. Despite there being wastewater treatment, there is still a general increase of pollution in rivers and aquifers, since frequently the degree of treatment is insufficient. In general, pollutants are classified as follows: phosphorous, organic matter, pesticides, acidification; pharmaceuticals and antibiotics. The combination of reduced quantity of water in rivers with increasing pollutant loads = "scarcity" measured as a function of water availability and pollution. According to this approach – 40 M km^2 of additional basin areas, and 3 billion more people may face water scarcity by 2050. Studies have shown that new emerging pollutants and antibiotics are, in some places, accumulating in rivers at an alarming rate.

The issues discussed above were illustrated through examples from the Colorado basin (USA), and the Ebro River basin (Spain) and scaled up to indicate some global assessments. In the Colorado Basin, the utilisation of river water is so intense that the river "no longer reaches the sea". Overall water consumption includes both direct human uses in the municipal, commercial, industrial, and agricultural sectors, as well as indirect water losses to reservoir evaporation and water consumed through riparian/wetland evapotranspiration.
Irrigated agriculture is responsible for 74% of direct human uses and 52% of overall water consumption. Water consumed for agriculture amounts to three times all other direct uses combined. Cattle feed crops including alfalfa and other grass hays account for 46% of all direct water consumption [Brian D. Richter, Gamhir Lamsal, Landon Marston, Sameer Dhakal, Laljeet Singh Sangha, Richard R. Rushforth, Dongyang Wei, Benjamin L. Ruddell Kyle Frankel Davis, Astrid Hernandez-Cruz, Samuel Sandoval-Solis & John C. Schmidt, "New water accounting reveals why the Colorado River no longer reaches the sea". Communications Warth & Environment 5:134. 2024 https://doi.org/10.1038/s43247-024-01291-0].

As for the Ebro River, there is an accumulation of antibiotics in the river waters. Despite the European and national measures taken to restrict the use of antibiotics and exposure to these substances (as analysed and presented in Moles, et al. 2022) [Samuel Moles, Sebastiano Gozzo, María P. Ormad, Rosa Mosteo, Jairo Gómez, Francisco Laborda and Joanna Szpunar, "LongTerm Study of Antibiotic Presence in Ebro River Basin (Spain): Identification of the Emission Sources", Water,14,1033. 2022 https://doi.org/10.3390/w14071033], the collected data demonstrated that: enrofloxacin and sulfadiazine were present in almost all surface-water control points, which denotes high, direct exposure to these substances, especially in areas that are close to intensive farming. In fact, this fluoroquinolone antibiotic appears at very high concentrations in rivers of the Ebro basin near intensive farming, such as the Segre, Gallego or Cinca Rivers. Significant differences were found between the areas exposed to high livestock pressure and the concentration of enrofloxacin. Azithromycin was detected at very high concentrations in WWTPs. Complementarily, trimethoprim and enrofloxacin were detected in wastewaters of the Ebro River basin, especially in areas near large urban cores (>100,000 equivalent inhabitants).

The discussion, and the two examples, are used above to illustrate the continuing issues that dog global water security for both the human populations, as well as the natural aquatic environment. Too many people in underprivileged regions, with limited access to information, consume water that is polluted, with insufficient access to medical support. With time, water scarcity will increase in most regions of the world, as water is diverted for irrigation for food security, thus leaving rivers in the conditions "where they no longer reach the sea". The corollary to this situation is, that aquatic ecology also suffers, with the aquatic bio resources degrading. This is truly a "ticking time bomb" and is an evolving planetary emergency, needing urgent attention with provision of adequate finance and increased awareness.

Hugo A. Loaiciga
Groundwater

The intensity of global groundwater use rose from 124 m^3 per capita in 1950 to 152 m^3 in 2021, for a 22.6% rise in the annual per capita use. The intensity of total primary energy consumption rose from 13.0 GWh in 1965 to 20.9 in 2021, for a 61% rise in the annual per capita energy consumption. This rise in global per capita water and energy use reflects rising consumption patterns and an expanding population. The global use of groundwater, which provides between 21% and 30% of the total freshwater annual consumption, will continue to expand due to the sustained population growth projected through most of the 21st century and to the important role that groundwater plays in the water-food-energy nexus. The rise in groundwater use, on the other hand, has inflicted adverse impacts in many aquifers, such as land subsidence, seawater intrusion, stream depletion and deterioration of groundwater-dependent ecosystems, groundwater-quality degradation, and aridification. The projected global annual groundwater withdrawal in 2050 is 1,535 km^3 (or 810,713 acre feet). The projected global groundwater depletion, i.e., the excess of withdrawal over recharge, in 2050 equals 887 km^3, which is about 61% larger than in 2021. This projection signals probable exacerbation of adverse groundwater-withdrawal impacts, which are worsened by climatic trends and the environmental requirement of groundwater flow unless concerted national and international efforts achieve groundwater sustainability.

Session 8 – Biological and Social Developmental Factors in the Epidemic of Metabolic and Neuro-Behavioral Diseases

Chairmen: Stefano Parmigiani[1] and Frederick vom Saal[2]
(Chairmen Environment and Health PMP)
Speakers: Christopher D. Kassotis[3], Mary E. Gilbert[4], Steven A. Haas[5]

Introduction

Prenatal and early postnatal exposures to environmental pollutants (e.g., man-made endocrine disrupting chemicals – EDCs) and psychosocial stressors have been associated with increased diseases and neurobehavioral disorders later in life. Therefore, regarding the so-called Developmental Origins of Health and Disease (DOHaD) children face the highest risks because small exposures to toxic chemicals and psychosocial stress in utero and in early childhood can have a lifelong impact, causing neurometabolic diseases, disability, and early death.

There is now extensive evidence that war has profound effects on fetuses, infants and children, making developing in a war zone a planetary emergency. War results in disruption of developing neural, behavioral and metabolic systems due to exposure to chronic stress, endocrine disrupting chemical pollutants and famine. The endocrine system coordinates development, and early life disruption of the hormonal control systems essential for normal development of the brain and all other organs and bodily functions leads to permanent, irreversible damage. For those who survive, war results in a predictable suite of neuro-behavioral and metabolic diseases, and a shortened lifespan.

In this session two experts of the developmental disrupting effects of environmental contaminants and one expert of the impact of war on childhood presented a synopsis of their research on the epigenetic effects on health resulting from early (pre- and postnatal) exposure to environmental pollutants and psychosocial stress due to war.

Christopher D. Kassotis
Environmental contaminants, developmental disruption and neurometabolic health effects

The speaker discussed environmental contaminants as a contributory factor in the worsening rates of neurodevelopmental and metabolic health dysfunction. There are both well-described mechanisms through which environmental chemicals can influence these adverse health

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[2] Distinguished Professor Emeritus, Division of Biological Sciences, University of Missouri-Columbia, USA.

[3] Professor, Institute of Environmental Health Sciences and Department of Pharmacology, School of Medicine, Wayne State University, USA.

[4] Mary E. Gilbert, Office of Research and Development Center for Public Health and Environmental Assessment U.S. Environmental Protection Agency, USA.

[5] Professor, Department of Sociology and Criminology, Pennsylvania State University, USA.

outcomes as well as documented human epidemiological and controlled exposure evidence that chemicals and pharmaceuticals can elicit these effects in people. There is now burgeoning cell and animal model-based evidence for hundreds or thousands of chemicals as able to disrupt these developmental processes. In addition to single chemicals, there is the complex issue of chemical mixtures. There are now>350,000 chemicals registered on the global market. Humans are exposed to between hundreds and tens of thousands of chemicals starting during gestation and chronically through early development and maturation. Moreover, there is strong evidence that chemicals can interact to produce greater than anticipated effects in combination than would be predicted based on understanding of the individual component chemical toxicity. This has completely left the chemical regulatory environment behind, which is entirely centered on regulating chemicals based on individual chemical toxicity. Substantial research is needed in this space to better understand chemical mixture effects, the mechanisms through which these effects operate, and to better predict when these effects might occur.

As one example of common chemical mixtures and neurometabolic health effects, an assessment of polyethoxylated surfactants was presented. These compounds are widely used in hard surface cleaners, detergents, personal care products, pesticide formulations, and other commercial products. As a result, they are ubiquitously present in the environment, being measured in surface, ground, and drinking water; household dust; soil and sediments; and even in human serum and urine. These compounds promote a hyperactivity phenotype in developmentally exposed zebrafish at environmentally relevant concentrations, increase body weights, and increased adipose tissue development with a skew towards visceral adipose tissue, which has a worse metabolic health profile relative to subcutaneous adipose. There is some evidence that these compounds may be acting through disruption of thyroid hormone receptor signaling, which may contribute to both the neurodevelopmental outcomes as well as the metabolic health effects. These are just one group of environmental chemicals present in the complex chemical milieu to which humans are exposed on a daily basis. There are, without any doubt, hundreds to thousands of chemicals we interact with daily that are likely to contribute to chronic adverse health conditions. These are major public health issues and yet we remain largely reactionary, focused on lurching from new therapeutic to new therapeutic without addressing the underlying concerns and causes.
[Kassotis CD, Vom Saal FS, Babin PJ, Lagadic-Gossmann D, Le Mentec H, Blumberg B, et al. 2022. Obesity iii: Obesogen assays: Limitations, strengths, and new directions. Biochemical Pharmacology: 115014. 35393121, 10.1016/j.bcp. 2022.11501437].

MARY E. GILBERT

THYROID HORMONE INSUFFICIENCY MEDIATES IMPORTANT ADVERSE EFFECTS OF CHEMICAL POLLUTION AND NUTRITIONAL DEPRIVATION ON BRAIN DEVELOPMENT

The speaker discussed how thyroid disruption chemical pollution and nutritional deficiencies are worsened in times of global crises. Thyroid hormones control many aspects of physiology including growth, development, metabolism and thermogenesis. Perturbations of the thyroid axis can lead to goiters, body weight gains, and alter mood and cognition. In the adult, these are largely reversible. In contrast, in the fetus, newborn and young child, thyroid hormone insufficiencies can have devastating effects on the developing brain, inducing irreversible effects on brain development and IQ function.

Iodine is an essential element for the synthesis of thyroid hormone. In areas of the world with low iodine in the soil, iodine deficiency is common and in extreme cases leads to a condition of endemic cretinism, a syndrome characterized by stunted growth and severe mental retardation. With severe iodine deficient conditions, IQ deficits are evident. These may be small (4-5 IQ points) on an individual level, but on a population level, this leftward shift in the normal IQ distribution of 5 points leads to a significant loss in the number of gifted individuals, with a corresponding increase in the number of individuals with learning disabilities and severe intellectual disability. This shift in population not only deprives individuals the right and opportunity to reach their full potential in life but has a significant impact on society with the added economic burden associated with the care and wellbeing of this group of affected individuals.

Perchlorate is an environmental contaminant that inhibits the transport of iodine into the thyroid gland and reduces the production of hormone. Perchlorate is a primary component of solid rocket fuels, missiles, munitions and other military ordnances. It is a contaminant that is highly soluble in water and persistent in the environment. It has found its way into the drinking water and food supply in many regions of the U.S. Alarmingly, it has been detected in breast milk of nursing mothers and amniotic fluid of pregnant women. It can cross the placenta to reach the fetal developing fetal thyroid gland. As such perchlorate exposure poses a risk to the immature brain of the fetus indirectly by depriving the fetus of a maternal source of thyroid hormone and directly by impacting the production of hormone in the developing fetal thyroid gland. In rodent pregnancy models, perchlorate induces structural brain defects in the rat fetus and neonate and these brain defects persist throughout the lifetime of the animal. These are associated with alterations in behavior and learning ability in offspring who were exposed in utero and postnatally via maternal consumption of perchlorate-contaminated water. Importantly, these effects on the developing brain are exacerbated when perchlorate is delivered under conditions of dietary iodine deficiency.

The importance of these observations in the context of Global Planetary Emergencies is that there are currently in excess of 40 armed conflicts happening in our world, some large, some smaller, all detrimental to the health of the environment and the health and welfare of the people who are forced to endure them. Active military operations cause chemical pollution: materials in weapon systems, explosives, propellants contaminate air, water and soil. The dumping and decomposition of war equipment release and leach explosive residues to contaminate the ecosystem. Estimates of perchlorate in contaminated military training grounds in the U.S. indicate levels of perchlorate in the sediment and groundwater that far exceed estimated safe levels.

In war-torn regions today, notably in Israel, Gaza, and Ukraine, prior to military invasions, iodine deficiency was rampant. Scarcity of clean water resources in these regions has led to programs of seawater desalination. Taking water from the sea for drinking and irrigation removes all iodine to create iodine deficient populations and further exacerbating the impact of perchlorate contamination on the population, a population that includes scores of pregnant women and young children. During times of war, government mandated iodine supplementation programs are not maintained, air and water pollution rises, and the increase in storms and flooding that grow more prevalent, during changing climate conditions, strip iodine from the soil reduce crop yields, adding to increasing food and water scarcity. It is a perfect storm with children being the most vulnerable and creating societal burdens that can last generations.
[Gilbert ME, O'Shaughnessy KL, Axelstad M. 2020. Regulation of thyroid-disrupting chemicals to protect the developing brain. Endocrinology 161. 32615585, PMC8650774, 10.1210/ENDOCR/BQAA106].

Steven A. Haas
The long-term impacts of childhood exposure to war

The speaker discussed the long-term impacts of childhood exposure to war. According to the Upsala Conflict Data program there are 43 active conflicts around the world. Recent decades have witnessed an increase in both the frequency and the severity of armed conflicts. The UN estimates that currently, over 400 million children around the world are either living in or fleeing from war zones. Estimates vary, but currently approximately 20% of all children live in countries hosting armed conflict of one sort or another. Armed conflict is a broad contextual phenomenon extending well beyond direct exposure to physical violence.

War is similar to natural disasters. It frequently results in institutional breakdowns in which core institutions like schools, markets, utilities, sanitation, and health and other basic services cease to function. War disrupts systems of production, distribution, and consumption and creates conditions of poverty and stress. War creates physical displacement and destruction of housing and property and undermines family, household, and kinship structures. Children in contexts of war are also especially vulnerable to sexual violence and other forms of exploitation. Of particular interest to this Planetary Emergencies seminar, conflict is often accompanied by extreme resource and nutritional scarcity.

By dramatically limiting the quantity and content of nutritional resources, war can permanently alter metabolic function through the development of the so-called thrifty phenotype. Nutritional deprivation experienced in utero and very early childhood can create a Predictive Adaptative Response that alters glucose and lipid metabolism, induce insulin resistance, can permanently alter heart rate, blood pressure, and program abdominal adipocytes to store any excess calories as fat as the developing fetus is biologically programmed to face life in an environment of resource scarcity. While these adaptations increase the likelihood of fetal survival in the short-term, they are maladaptive in the long-term increasing risk of cardiometabolic conditions such as heart disease, diabetes, obesity, and stroke.

Similarly, stress can be experienced either by the child directly or indirectly from mother as elevated maternal cortisol is passed to child via the placenta in the case of intrauterine exposure and breast milk among infants. War-induced stress can permanently alter the function of the Hypothalamic-Pituitary-Adrenal axis and make individuals more reactive to stressors across their life. Elevated levels of stress hormones further delay central nervous system maturation, reducing gray matter volume, and impairing brain development. Prenatal exposure to acute exogenous stressors (e.g., natural disasters) has been shown to adversely impact children's cognitive outcomes. Various epigenetic changes are also implicated such as methylation of the BNDF and the NR3-C1. Early life is also a critical period for musculoskeletal development. Muscle and bone mass increase during childhood and adolescence, peak in the early adult years, and then begin to decline around age 40. There is substantial evidence that early-life material/social conditions affect adult muscle and bone mass, and body composition. In turn, these influence sarcope¬nia, osteoporosis, and bone fractures in later life.

Two empirical examples were presented to describe the long-term impacts of childhood war exposure on later life health and social outcomes. The Dutch famine provides a natural experiment in which segments of the population were exposed to nutritional deprivation in a quasi-random fashion. Those exposed to the famine in utero had substantially elevated risk of cardiovascular disease, diabetes, and obesity across their adult lives. They also experienced significantly reduced educational and labor market outcomes. The second empirical example utilized data from the Survey of Health, Aging, and Retirement in Europe to examine the later life health impacts of childhood exposure to hostilities during WW2. Those exposed as children had elevated lifetime risk of cardiovascular disease, hypertension, hypercholesterolemia, diabetes, and obesity. Risk varied dramatically by age at exposure with the greatest risks concentrated among those exposed either in utero or during the first 2 years of life.

War exerts profound effects on the lives of children. These do not end when the fighting stops. Rather, children carry these wounds with them for the rest of their lives. War permanently alters developmental trajectories and many of the most pernicious effects will not even begin to manifest until decades later as they reach middle and later adulthood. As we calculate the ongoing human costs of war in places like Ukraine and the Mid-East and the kinds of interventions necessary to mitigate their impacts on children, it will behoove scientists and policy makers to consider not just their immediate short-term outcomes but also to recognize the hidden wounds they will carry with them in the coming years and decades. The true costs of these conflicts on population health are much higher and wide ranging than have been previously acknowledged. Are we prepared to deal with these long-term consequences? Will we have the political will and commitment to address the effects of wounds that will not even begin to appear for 40 or 50 years?
[Ramirez D, Haas SA. 2022. Windows of vulnerability: Consequences of exposure timing during the Dutch hunger winter. Population and Development Review 48:959-989. 37063488, PMC10087479, 10.1111/padr.12513].

INTERNATIONAL SEMINAR ON PLANETARY EMERGENCIES
56th Session
Erice, 8-14 August 2024
Paul A.M. Dirac Lecture Hall – Patrick M.S. Blackett Institute

Thursday 8 August 2024

Arrivals
20:00 Dinner

Friday 9 August 2024

09:30 PMP Meetings
20:00 Dinner

Saturday 10 August 2024

09:30 Welcome and Introductory Remarks:
- S. Fabrizio Zichichi (introducing Antonino Zichichi)
- Antonino Zichichi (via video)
- Mrs. Daniela Toscano Pecorella, Mayor of the Municipality of Erice, Italy
- H.E. Rev. Msgr. Pietro Maria Fragnelli, Bishop of Trapani, Italy
- Hon. Roberto Di Mauro, Deputy for Energy and Public Utilities of the Sicilian Region, Palermo, Italy
- Dr. Fabio Ciciliano, Head of the National Department of Italian Civil Protection, Presidency of the Council of Ministers, Rome, Italy

10:30 Keynote Address: Cristian Galbiati

11:00 Coffee Break

11:30 Session 1: Managing international conflicts and arms control
Session Chairman: William A. Barletta, *Chairman Mitigation of Catastrophic Risks PMP*
11:30 Tariq Rauf: *The growing threat of nuclear weapons*
11:45 William A. Barletta: *New Nuclear Delivery Systems*
12:00 Richard C. Lanza: *Risk Assessments and Nuclear Arms Control*
12:15 Karen Hallberg: *Conflict management and the Pugwash process*
12:30 Discussion

13:30 Lunch

15:30 Session 2: Emerging/Re-emerging infections and neuronal diseases
Session Chairman: Franco M. Buonaguro, Chairman Medicine and Biotechnology PMP
15:30 Franco M. Buonaguro: *Long COVID disaster and update of current outbreaks/epidemics*
15:40 Ishwar Gilada: *Avian Influenza and COVID pandemic update in India*
16:00 Sofie Nyström: *Connecting the dots between virus amyloids and neuro degenerative diseases*
16:15 Felice Iasevoli: *Circulating biomarkers, genetic signatures and neuroimaging correlates of neuronal damages in acquired and congenital neurologicaland behavioral disorders*
16:30 Emanuele Buratti: *Identifying fluid biomarkers for neurodegenerative diseases*
16:45 Rino Rappuoli: *Emerging and re-emerging pandemics preparedness*
17:00 Discussion
18:00 Adjourn
20:00 Conference Dinner

Sunday 11 August 2024

09:30 Session 3: The power market and the energy transition

Session Chairman: Carmine Difiglio, *Chairman Energy PMP*
09:30 Carmine Difiglio: *Introduction, Energy security and the power sector*
09:40 Peter Hartley: *A costly transition*
10:00 Alessandro Clerici: *The electrical power system within the global energy trends*
10:20 Ashutosh Shastri: *Walking the tightrope of regulation and markets for a low carbon energy transition – emerging lessons learn from the UK/European Experience*
10:40 Teresa A. Gorman: *Can the US EPA mandate net zero?*
11:00 Discussion

11:45 Coffee Break

12:15 Session 4: Managing International Conflicts

Session Chairman: William A. Barletta, Chairman Mitigation of Catastrophic Risks PMP
12:15 Nichole Argo and Lydia Wilson: Psychological pathways to international conflict
12:35 Bilal M. Ayyub: Modeling Complexity of Conflicts including Economic, Structural and Psychological Perspectives
12:50 Francesca Giovannini: Application to NATO, Russia and Ukraine
13:05 Tariq Rauf: *Rapporteur's Report – Paths Forward in the Conflict in the Middle East*
13:15 Discussion

14:00 Lunch

16:00 Session 5: Perspectives, Risks and Challenges of Cyber Security and AI

Session Chairman: Axel Lehmann, *Chairman Future of Cyber Security and AI PMP*
16:00 Axel Lehmann: *Introduction*
16:05 Hamadoun Toure: *Current Status and Associated Challenges of AI*
16:17 Sun Kun Oh: *Challenges to AI and its Global Position from an Asian Perspective*
16:29 Arthur I. Miller: *The Brave New World of Machines that Make Art, Create\Prose and also Think*
16:41 Pavan Duggal: *Emerging Legal and Policy Trends Impacting AI and Generative AI*
16:53 Anna Pouliou: *Immediate Privacy and Cyber Risks from AI and Countering Legislation*
17:05 Alex Ntoko: *Advanced Information Management System and Artificial Intelligence*
17:17 Pier Paolo Menchetti: *AI in Health*
17:30 Discussion

18:00 Adjourn
20:00 Conference Dinner

Monday 12 August 2024

09:30 Session 6: Global wildfire emergency and other threats to civil infrastructures

Session Chairman: William A. Barletta, Chairman Mitigation of Catastrophic Risks PMP
09:30 James H. Lambert & Bilal M. Ayyub: *Systems analysis of wildfire emergency*
09:45 R. Ranger Dorn: *Erice wildfire scenarios*
10:30 Wildfire discussion
10:45 Robert Rosner: *Solar Geoengineering*
11:05 Anatoly V. Zaitsev: *Update on defense against cosmic threats*

11:20 John Organek: *Solar Storm Disruptions of Power & Communications*
11:30 Coffee Break

12:00 Session 7: Pollution and Water Crisis
Session Chairman: Lorne G. Everett, *Chairman Pollution and Water Crisis PMP*
12:00 Daniel B. Stephens: *Groundwater Contamination: A History of Unintended Consequences*
12:20 Shammy Puri: *Scarcity Plus Global Water Pollution-A Ticking Time Bomb?*
12:40 Vijay P. Singh: *Water Security in the World's Most Populated Country, India*
13:00 Hugo A. Loaiciga: *Water and Energy Provision in a Changing World: Prospects for the 21st Century*
13:20 Discussion

14:00 Lunch

16:00 Session 8: Biological and social developmental factors in the epidemic of metabolic and neuro-behavioural diseases
Session Chairmen: Stefano Parmigiani & Fred vom Saal, *Chairmen Environment and Health PMP*
16:00 Christopher D. Kassotis: *Environmental contaminants (and mixtures), developmental disruption and neurometabolic health effects*
16:20 Mary E. Gilbert: *Thyroid hormone insufficiency mediates important adverse effects of chemical pollution and nutritional deprivation on brain development*
16:40 Jose T. Hernandez: *Prematurity and low birth weight as risk factors for obesity in early childhood and adulthood*
16:55 Steven A. Haas: *The Wounds they Carry: The Long-Term Impacts of Childhood Exposure to War*
17:20 Discussion

18:00 Adjourn
20:00 Gala Dinner with Sicilian Folk Music

Tuesday 13 August 2024

10:00 Wrap-Up Session (press will be present)
10:00 S. Fabrizio Zichichi, Session Moderator
10:10 PMP Chairs' Reports
11:00 S. Fabrizio Zichichi, *Plenary Discussion of PMP Priorities with PMP Chairs' Panel*
12:00 Cristian Galbiati, *Closing Remarks*
12:30 S. Fabrizio Zichichi, *Plenary Discussion – Synopsis: 2024 Seminars and Plans for 2025*

13:30 Adjourn Plenary Sessions/Lunch
19:00 Dinner

Wednesday 14 August 2024

Departures

OMAGGIO

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