Statement on behalf of the global engineering community

to the High-Level Political Forum on Sustainable Development

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Innovative Action Requires Non-Traditional Collaboration

- Presenter: K. N. Gunalan, Ph.D., P.E., NAC
  - Co-Chair, United Nations Science and Technology Community Major Group
  - Chair, World Federation of Engineering Organizations UN Relations Committee
  - President, Atlas Initiative for Critical Infrastructure
  - Vice Chair, International Committee for Sustainable Infrastructure
  - Stimson Center Ambassador for Climate Resilience
  - President Emeritus, American Society of Engineers

- Author: Jerry Buckwalter
  - International Director of Innovation, Atlas Initiative for Critical Infrastructure
  - Chief Innovation Officer, American Society of Civil Engineers
  - President, Strategy Essentials
  - Board Member, Center for Public Policy Innovation
  - Board Member, ARES Institute

This statement is delivered on behalf of the UN Scientific and Technological Community Major Group and the Atlas Initiative for Critical Infrastructure (Atlas). The world is equipped with levels of knowledge, technologies, and resources that are unprecedented in history. Yet the potential for science, technology, innovation, and data to be applied to the Sustainable Development Goals (SDGs) is vastly underutilized.

The SDGs require a higher level of knowledge sharing, education, and action, requiring a more targeted use, and integration, of science, technology, innovation, and engineering (STIE) to accelerate progress towards these goals. Unfortunately, efforts thus far often involve those elements of STIE in each of their separate domains, but not as an integrated whole.

An Integrated Approach

Quality of human life and our ability to handle an uncertain, disruptive, and evolving environment are dependent to a significant extent on civil infrastructure systems. Civil infrastructure systems play a critical role in all aspects of life. Several SDGs address infrastructure systems directly and infrastructure systems are indirectly an enabler of success in all other SDGs. Therefore, it becomes obvious that policy and action in infrastructure can affect all SDGs.

As an example, climate resilient infrastructure is a complex problem, and as with all complex problems, can only be solved by embracing an integrated approach to the problem. Without that,

efforts simply stall in each silo of activity. Or progress in one silo causes a spillover unintended consequence in another silo via direct or indirect infrastructure connections.

Transdisciplinary scientific research, transdisciplinary engineering teamwork, and a system- based approach are the only way to make real progress because it allows us to better understand the multiple underlying drivers and interdependencies of global challenges**.** This new way of thinking means viewing the problem through multiple lenses, engaging all stakeholders from the outset.

Climate resilient infrastructure is also a global and systemic crisis. Unfortunately, governments' responses have focussed predominantly on national solutions, which are insufficient to remedy the broad societal impact. A longer-term perspective is needed at national, regional, and global levels that is aligned with the global framework for achieving sustainable development.

Collaboration with Engineers

The entire ecosystem must collaborate at a level not yet experienced. The engineering community has been an afterthought. Hence, the potential of harnessing STIE is never reached. The engineering profession plays a leading role in planning, designing, constructing, operating, and maintaining many infrastructure sectors directly, and that in turn supports the interdependent functions and performance of interconnected food, energy, and water sectors.

Engineers are the ones who apply the science, who use the technology. We must align the science (both basic research and applied research) with the practical applications engineers (who deliver solutions at the grass roots level), government leaders, policy makers, business and economic leaders, educators, all financial and societal actors, and the public. And we must align these vested party interests and the funding streams in real time.

Collaboration with Industry

If we desire systemic change to happen, we must also find a way to enable the transformative power of the free market. We must align the economic incentives that drive industry, and their technology and scientific breakthroughs, with the climate resilient infrastructure outcomes all parties' desire. Start by asking, "How do we fund the scientific research in a way that will create the economic construct for industry to invest in the right solutions?"

Break the siloes between academia and practitioners, between the laboratories and the companies. And break the linear path currently used. This shouldn't be a hand-off from science to engineering. This should be parallel activity with flexibility and fluidity as required by each problem. If capitalistic behavior is corrupt, root it out. But corruption can be found in every sector, every organization, and every country. Let's tackle it without abandoning a natural capital market source of funding.

Collaborative Financing

An improved funding approach is to support research in the laboratories and universities with a proactive and fully managed partnership with industry who will in turn get some aid in preparing those solutions for the market. Industry investments would then be guided by the goals, plans and funding streams of the government decision makers – in a very natural manner.

If we don't do this, our problems will "break the global bank." There is momentum building for the global finance community (e.g., World Bank, International Monetary Fund, Multi-National Development Banks) to orient their money to sustainable and resilient infrastructure. That's good progress.

However, both public and private sector money must be applied. An aligned plan of investments tied to the natural free market investment mechanisms get all vested parties moving in the right direction.

Game-Changing Innovations

There are several emerging areas of innovation that hold the potential for changing the dynamics of infrastructure – the very fabric of food, water, shelter, travel, and communications. These are the areas ripe for full knowledge sharing and education among all vested parties:

- **Transformative Energy**: This includes all alternatives to fossil fuel applied in a sensible mix. Emphasis on alternative energy sources (e.g., wind, solar) will emerge under an "electrify everything" paradigm. But battery storage, and it's drain on natural resources, will need ethical guidance. Fuel cell technology will continue to mature and our ability to produce green hydrogen will catch up to the demand generated by fuel cells. And micro nuclear fission and nuclear fusion solutions will gain traction as the public begins to understand the safety dynamics.

- **Next-Generation Computing**: Current research in fundamentally different computing methods will progress and likely emerge from research to feasibility and affordability analysis in the coming years. The well-known research is in quantum computing, but other possible approaches (e.g., cryogenic computing) are also underway around the globe. These compute methods will require new computer code. But our next generation of computer programmers will tackle that with enthusiasm.

- **Synthetic Biology**: Organic construction materials are on the rise. They will be able to sequester carbon as they are produced and naturally improve air quality and climate control. They will be attractive, so will generate a need to scale. Biomimicry using a variety of materials will fill some of the need. And the synthetic production of biological materials will expand dramatically where it will be used for many purposes (e.g., synthetic photosynthesis to generate power, creating food supply that can be synthesized and printed locally) to meet global needs.

- **New Materials:** Research is on-ging as the world attempts to find new materials with improved properties (e.g., self-healing, regenerative, breathable, permeable, adaptable) for many uses. For infrastructure, it is inevitable that we will eventually supplement our structures made from concrete, glass and steel with old solutions reimagined (e.g., timber) and new materials such as polymers, metal foam, graphene, aerogel, and even organic/inorganic combinations.

- **Artificial Intelligence**: Complex problems require smarter systems. Advanced technologies (e.g., machine learning, neural networks) present an opportunity to design a new generation of smart infrastructure where the structures detect information from the environment and the people in it. That means we will need sensors or some way of capturing that

information, but smart structures will go a step further by adapting, aggregating and sorting that information, and improving our ability to make decisions.

Taking Action

The gap between available knowledge and action is widening. Much existing scientific knowledge is not being used. This will worsen as new innovations emerge from the laboratories into practical applications. Failure to create action from innovation threatens progress on the SDG agenda.

Our attention has been on advocating for the world's political and scientific communities to establish stronger and more agile science-policy interfaces that can inform anticipatory action and prevention on emerging issues and translate existing scientific evidence into solutions. However, engineers turn science into action. They are the ones who steward the right technology, apply it to the problem, and generate the outcome we desire.

But engineers can't do it alone. It is essential that our approach is rigorously informed by evidence from the science community. Problem-solving engineers must be working hand in hand with the scientists to create impactful action. Positive change is underpinned by both science and engineering solutions and by both academics and practitioners. The responsible practice of science, engineering, policy, innovation, and shared information is fundamental to improved quality of life.

It's time to harness science and engineering as the workhorse of action. Let us enable it to achieve its full potential and generate new solutions on which transformations can be put into practice, and can be inclusive, accessible, reliable, open, and affordable. Let it become the global public good for which we have all hoped. If we don't, our Sustainable Development Goals won't be achieved.