CLIMATE ACTION BY & WITHIN IEEE

White paper

Prof. Amara Amara, Dr. Victor Grimblatt, Dr. Balwant Godara

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I - The complex interplay between climate change and digital technologies

The **impacts of climate change are everywhere**, from health to migration, food security to, more broadly, poverty. Climate change does not affect everyone equally – persons and communities who are already vulnerable suffer more due to the impact of climate change; impacts of climate change deepen the inequalities, since the vulnerable are least equipped to rebuild and reconstruct after the immediate catastrophes. The realities and impacts of climate change are receiving increasing attention the world over; and the issues of climate action are closely related to the Sustainable Development Goals (SDGs).

Much recent research has turned its focus on the link between **digital technologies and climate change**. Digital technologies are a part of the climate problem, with "concerns surrounding ICT waste management, energy management and emission management", while also being part of the solution, [enabling] "the integration of technology within the environmental management processes to improve performance."

II - IEEE's actions relating to climate change and action

The **IEEE is increasingly important as a voice on the links - both virtuous and vicious - between climate change and digital technologies**, with the recent formation of an ad-hoc committee on climate by the Board of Directors, the Technical Activities Board's programme on climate change to support this committee.. There have already been fora dedicated to specific technologies and climate change – in 2021, the IEEE Future Tech Forum and in 2022, the Quantum Conference. In 2020, IEEE made an international call for standards to combat climate change. Finally, there is a dedicated portal for IEEE members on all things related to sustainability, "Sustainable ICT and sustainability through ICT". The IEEE Spectrum has been increasingly publishing articles describing technologies to address specific issues of climate change.

The IEEE's future position on climate action would be well advised to take this nuanced view of the interplay between digital technologies and climate change/action. The most directly - and immediately - applicable recommendations are:

- Include the environment as a key stakeholder in design, testing and implementation of digital solutions.
- Focus on impacts of digital technologies on climate change, as well as benefits, adopting a "responsible" perspective.
- Research ICT in improving systems and processes in transportation, agriculture, and manufacturing industries to improve energy efficiency, reduce waste and deliver accurate data
- Strengthen the role of ICT in the provision of key data that can inform decision makers on the progress of global warming initiatives (e.g. using sensor based IoT technologies to alert authorities on emission levels)
- Creating models and simulations within an overall sustainability framework that can encapsulate multi-level perspectives on the provision of data and technology interaction.

III – EmC2 Workshop

IEEE's first EmC2 workshop took place in Singapore over 2 days, November 29th and 30th, 2022. The participants hailed from 10 countries – Italy, France, Spain, USA, Singapore, Japan,

South Korea, Kenya, South Africa and Chile. They were a mix of people working in research laboratories and industry.

It opened with scene-setting by the chairs, followed by 4 keynotes. Participants then broke off into two groups, one on 'health' and the other on 'food' - poverty/economy and migration were interwoven into the two. Each group consisted of 10 members. The group work lasted two half-day sessions. At the end of the group work, representatives of each group reported back in plenary.

Participants identified takeaways from the keynotes, which constitute **the ten guiding principles for the digital technology community as relates to climate action.**

1. Clearly understand the complexity of climate change and its impacts. Increase our capacity to articulate the three dimensions of climate action – adaptation, mitigation and resilience.
2. Promote a nuanced view of the link between digital and climate – digital technologies are real contributors to climate change and potential contributors to climate action. The pros and cons must be weighed against each other – while digital technologies can help understand and attenuate the impacts of climate change, they also contribute to climate change through irrational resource exploitation, improper waste management and energy consumption.
3. The digital technology community needs to "think global and act local" when it comes to contributing to climate action. This implies that the design of local and specific solutions must also be informed by the global trends and realities of climate change.
4. Consider the climate cost of producing electronics and electronic waste, and keep in mind the growing evidence base for the impacts of digital technologies on climate change. From this principle flows the promotion of technologies and processes that leave a smaller carbon footprint.
5. Take a 'systems' approach to solution design, which implies interdisciplinarity and members working with other disciplines, and looking at multiple disciplines and factors simultaneously and how they influence and impact on each other.
6. Ensure a closer interface with the key climate actors – policy, political and financial decision-makers – so that the technical solutions proposed by the IEEE communities are considered for climate action.
7. Account for the resource constraints in the settings for which the digital solutions are being designed, so that the solutions are realistic and efficient.
8. Promote the use of digital technologies in understanding the realities of climate change and in informing climate action. This includes collection, analysis and timely communication of data to relevant stakeholders. Related to this is the potential of digital technologies and data-driven Artificial Intelligence to help model climate change and develop Early Alert Systems.
9. Design solutions which are sustainable in the sense of 'sustainable development' – take an approach that promotes resource-effectiveness over resource-intensiveness of the digital technologies (in both fabrication and operation).
10. Communicate more effectively – democratise the understanding of the interface between climate action and digital technologies, and sensitise the population of the real potential of digital technologies to climate action.

IV - Digital technologies for climate action in terms of health

The 'health' group's deliberations emphasised the intrinsic interrelatedness of human health with other aspects – water, food, energy, health and medical technology, education and knowledge, and the environment at large. For instance, climate change impacts on health in

that it may exacerbate existing health issues (e.g. more rainfall may lead to increases in vector-borne diseases such as malaria) and/or create conflict in the allocation of resources in future (e.g., funding and consumption of energy towards ageing and medical care for elderly). ICT solutions like biosensors, wearable medical devices and patient information systems need thus to be designed in concert with other disciplines.
Participants spoke of how digital technologies can help solve specific climate- and environment-related problems. One example touched upon air pollution, which has a certain effect on human health, but for which the collation and integration data to predict health issues or concentrations of pollutants is not well done. Thus, if data could be mapped into an aerial view of contamination, this could aid in more accurate diagnostics, correlation/causation of medical conditions, prediction of public health concerns, and improved land use planning and effectiveness of interventions e.g. tree planting and wind tunnels. This however requires influence on policy makers to lead integration.

Another example concerns vulnerability of – and access to **- patient information systems.** There is a gap in how health information systems are stored and integrated; medical providers do not have consistent systems and some are locally stored. This means that in a disaster situation (flooding, storm, fire, conflict etc), patient information may be inaccessible or lost, or effort and time wasted re-collecting information, potentially increasing death and injury. In terms of **wearable medical devices, notably for** elderly people, sensors already exist and are able to collect personal biometric data. But the gaps gaps are a) access is limited to those who can afford and are interested in adopting such devices and b) lack of integration into institutions and medical service providers.

So, while digital technologies do exist for health in contexts of the impacts of climate change, there are several barriers to adoption: mistrust in technology by physicians, medical administrators and patients; legal liability; low awareness and ability to use technology options by users and medical professionals. So, one core pre-requisite is for health experts to guide the development and deployment of digital health technologies.

V - Digital technologies for climate action in terms of food security

The group adapted the session to have a more in-depth discussion on the factors and issues involved in one of the member's ongoing work involving precision agriculture in the Piedmont region of Italy. Climate change impacts on food production (and thus, food security) through pathways of water availability and soil quality.
This group too agreed on the fact that extra-technological factors determine whether and how digital technologies can contribute meaningfully to food security. These factors include – optimal design of the entire food supply chain and not only food production; scalability and adaptability of technologies to various agriculture contexts; and funding available for research, designing and deploying digital technologies.

Important technological considerations like dimensioning of sensors and their networks depending on the land use and bio-compatibility and bio-degradability of digital technology, have a clear impact on how electronics exacerbate climate change problems and need to be weighed against the real benefits of digitising food production and distribution.

Overall, there is a well-founded scepticism in the food and nutrition industry on using digital technologies and this can be overcome by educating these stakeholders about the good practices as well as involving them in the very design and deployment of digital solutions.

ICTs for food security can be envisioned at two interconnected, complementary levels – the higher/macro level ("above the soil"); and at the lower/micro level ("in the soil"). ICTs can be used to collect information from the lower level and use this information to make decisions that will ensure food security. Moreover, different parts of the world have different dimensions of food insecurity – in the developed world, the problem is more about quality and wastage, for which ICTs like tracking can be useful; in the developing world, the main problem is one of food quantity – ICTs like soil monitoring and satellite imagery can be used to improve yields. An additional dimension is that of distribution of food, from the areas of production/surplus to those of consumption/shortage.

VI - Avenues of work for IEEE on climate action

IEEE's contributions to climate action could be on three fronts, in view of its position as a technical exchange body, a lobby, a standard-setter, a platform for collaborations and a capacity-building organisation:

- Build a holistic view of digital technologies and climate change.
- Help promote technology and processes that leave lower carbon footprint.
- Enable new generations of engineers to act for climate action.

10 approaches and actions to Operationalise IEEE's contribution to climate action:

1. Ensure that IEEE's future conferences and workshops expand participation to climate scientists, policy advisors, health professionals and agronomists.
2. Create spaces – within IEEE journals and conferences – to promote bio-compatible, bio-degradable, low-cost, low-power, high-usability solutions. This can be done via special editions of journals and special sessions in conferences.
3. Create a CASS sub-group to influence the IEEE's policy advocacy, in such a way that new climate policies take into account climate change, and vice versa. This will make CASS more involved in different IEEE bodies that work on policies
4. Create a CAS-specific or joint special interest group on climate change. This is important to illustrate across the IEEE the need and chance to work together on climate change.
5. Organise a cross-society joint workshop or conference on climate change in 2023, across different IEEE societies (tentative date - Sep 13-15 2023).
6. Establish a student design competition to encourage students to develop solutions to present in IEEE conferences. Such a competition is being considered for ISCAS 2023; if it does not happen, there is an embedded workshop on climate change at ISCAS 2024.
7. Start IEEE CAS students chapter (with SSIT) as a platform to increase awareness of impact of climate change on younger generations.
8. Look for collaboration with industry/govt to fund for technical skills to students to enable them to solve problems and design solutions and innovate matters in climate change
9. As conferences come back to being in-person events, there is an increased carbon footprint. So, study how to rationalise the number of conferences sponsored by CAS. Another approach is to encourage regional conferences so participants have to cover shorter distances.
10. That there needs to be leadership renewal within IEEE, with intergenerational collaboration and transmission, and a better use of social media and collaboration.