

WG21 Report to IUPAP General Assembly, October 2026

Nithaya Chetty, Chair, Igle Gledhill, Secretary

1. Background

There is mounting evidence of the impact of the changing climate throughout the world^{1,2,3}. The challenges of climate change are intimately connected with the need for energy security, food security, water security, and sustainability of the environment, and are already impacting severely on poverty, inequality, mass migration, and human health⁴. These are global problems that require a global effort, including a transdisciplinary endeavour across all sciences, engineering, human and social sciences, law, health sciences, and basic sciences. IUPAP has key roles in encouraging physicists to engage, both through the discoveries and new paradigms of pure physics, and through applied, and necessarily transdisciplinary, physics in teams.

The task of WG21 is to promote and grow the unique role that physics is, and should be, playing in climate science and sustainability science.

2. Members

Capitals indicate family name, underlining preferred first name.

Members	Country or territory	
Prof. <u>Nithaya</u> CHETTY Chair	South Africa	Chair WG21 University of the Witwatersrand, Johannesburg
Prof. Irvy (<u>Igle</u>) GLEDHILL Secretary	South Africa	Secretary WG21 University of the Witwatersrand, Johannesburg
Prof. <u>Marcelo</u> BARREIRO	Uruguay	Instituto de Física, Universidad de la República, Uruguay
Dr. <u>Hyunjung</u> LEE	Korea	Korea Institute of Fusion Energy
Prof. <u>Morgan</u> O'NEILL	Canada	Canada, University of Toronto
Prof. Dr. <u>Ram</u> Prasad REGMI	Nepal	Chief Scientist, National Atmospheric Resource and Environmental Research Laboratory (NARERL) and Professor at the Central Department of Physics, Tribhuvan University
Prof. <u>Jon</u> SAMSETH	Norway	Oslo Metropolitan University; chair SCOPE - Scientific Committee of Problems of the Environment; member, IUPAP WG6 on Energy; chair, IUPAP WG12 on Energy
Prof. <u>Jean-Louis</u> SCARTEZZINI	Switzerland	Former Director, Director of EPFL Solar Energy and Building Physics Laboratory, EPFL, École Polytechnique Fédérale de Lausanne
Prof. <u>Awnesh</u> SINGH	Fiji	Interim Director of the Centre for Sustainable Futures (CSF) at USP, IPCC lead author WG1 Seventh Assessment Report
Dr. <u>Tomás</u> M. SINTES	Spain	University of the Balearic Islands, Palma de Mallorca
Dr. <u>Gry</u> Merete TVETEN	Norway	Expert Analytics AS, Oslo

Prof Singh was appointed in 2026.

¹ IPCC Sixth Assessment Reports, 2022, [Online]. Available: <https://www.ipcc.ch/assessment-report/ar6/>

² World Meteorological Organisation, State of the Global Climate 2025, <https://wmo.int/publication-series/state-of-global-climate/state-of-global-climate-2025>

³ Berkeley Earth July 2026 Temperature Update, <https://berkeleyearth.org/july-2026-temperature-update/>

⁴ Romanello M, Walawender M, Hsu S et al., The 2025 report of the Lancet Countdown on health and climate change: climate change action offers a lifeline, The Lancet, 2025; 406, 2804-2857, [https://doi.org/10.1016/S0140-6736\(25\)01919-1](https://doi.org/10.1016/S0140-6736(25)01919-1)

3. Meetings

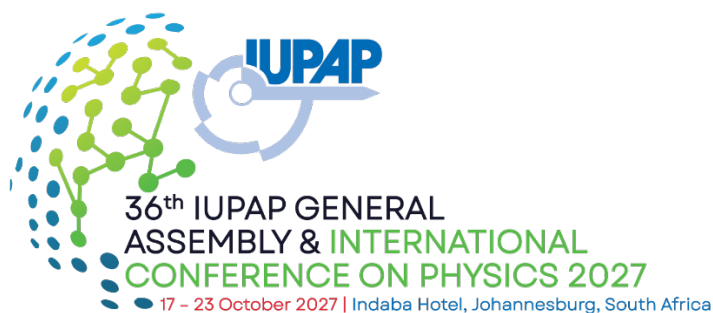
Most work takes place between meetings, offline. WG21 members are members of the International Organising Committee of the International Conference on Physics, as below. WG21 and IOC meetings have been combined and the first of these took place on 2026/08/07 and at least one further meeting will take place in 2026.

4. 2025 to 2026 activities: Joint initiatives of WG21 from WG21 task 6

4.1. International Conference on Physics, with IUPAP Executive

The WG21 Task 6 is the holding of at least one major conference by 2027. When the Executive Council made the decision to call for bids to host both the International Conference in Physics, ICP, and the General Assembly and associated events in 2027, the call for hosting of the WG21 conference was included in the call documents, and the bid was won by SAPHysNet, the Southern Africa Physics Network, and SAIP, the South Africa Institute of Physics.

The conference is titled: The IUPAP International Conference on Physics: “Physics for sustainable development: equitable wellbeing on a healthy, lively planet”.



A Professional Conference Organiser, Scatterlings, has been contracted. The LOC, which includes international members from SAPHysNet, the Southern Africa Physics Network, is in place and its subsidiary committees have been formed. The LOC includes Rudzani Nemutidi and Igle Gledhill from the IUPAP Executive. The IOC includes all members of WG21, Physics for climate change action and sustainable development, together with Sunil Gupta, IUPAP President-Designate, Kuijuan Jin, Vice-President at Large for Projects and Sponsorship, Michel Spiro, Past President, and Joe Niemela, C13 chair.

Local Organising Committee (LOC)
Secretariat
International Organising Committee (IOC)
Scientific Committee
Sponsorship Committee

Chair Rudolph Erasmus
Executive Director Brian Masara, also C13
Chair Igle Gledhill
Chair Michel Spiro
Chair Sunil Gupta

The Draft conference themes were worked out with reference to task 1 of WG21, based on work by Tomás Sintés and Morgan O'Neill, but also using presentations made by all members to the WG. The themes are:

Physics in Climate Science	
Physics in Sustainable Development for Equitable Wellbeing	Physics in Mitigation (general)
	Physics in Adaptation:
	Energy
	Green Economy
	Human and Environmental Health
	Disaster Risk Reduction
Physics in Science Diplomacy and Communication	
Physics Education and Skills Development in Climate Physics and Sustainability	

Announcements are imminent (Sept 2026).

4.2. Pacific Island Nations Physics Summit, with Standing Committee on Membership and Development

This double event is also covered in the report of the Standing Committee on Membership and Development from the point of view of intended IUPAP membership for the Pacific Island Nations, while the theme arose from the work of WG21. The IUPAP-UNESCO Physics Summit and the UNESCO-IUPAP Entrepreneurship in Physics to Green Pacific Economies ran in parallel with an interchange of speakers and representatives. The event was planned for Apia, Samoa, and the venue was kindly offered by the National University of Samoa via Tupuivao Vaiao and Fa'afetai Kolose. A most unfortunate dengue outbreak resulted in changes to the university timetable, and the events were moved to the Nalagi Hotel, Nadi, Fiji, with the help of the LOC chaired by Gabriel Bioletti and listed below, with the leadership and generosity of Professor Ramendra Prasad, University of Fiji and Dr Ravita Prasad, Fiji National University. Prof Manjula Sharma, chair C13, has become an integral part of the initiative. Sponsors contributed generously both in funds and in kind. ICTP became a valued partner, sending Riccardo Farnetii and three Pacific alumni.

Local Organising Committee	International Organising Committee	Sponsors in kind and in funds
<ul style="list-style-type: none"> - Dr Gabriel Bioletti (National University of Samoa NUS, Victoria University, OpenStar Technologies) (chair) - Tupuivao Vaiao (NUS, Samoa's Ministry of Finance) - Prof David Hutchinson (Otago University, Ministry of Business, Innovation, and Employment - NZ) - Dr Ravita Prasad (Fiji National University) - Dr Ramendra Prasad (University of Fiji) - Fa'afetai Kolose (Scientific Research Organisation of Samoa) 	<ul style="list-style-type: none"> - Prof Irvy (Igle) Gledhill (chair, Physics Summit) (IUPAP VP Membership and Development 2025-2027) - Prof Nithaya Chetty (IUPAP Working Group21 chair)(IUPAP VP Membership and Development 2021-2024) - Prof Joe Niemela (chair, IUPAP C13, Physics for Development) - Prof Surya Raghu (Advanced Fluidics, LLC, ET Cube International, Inc.)(- Dr Gabriel Bioletti (LOC chair) (National University of Samoa, Victoria University, OpenStar Technologies) - Prof Cather Simpson (University of Auckland, Engender Technologies, Orbis Diagnostics) - Prof. Halina Rubinsztein-Dunlop (AO, U. Queensland, Australian Academy of Science) - Susan Schneegans (UNESCO Pacific) - Walter Faamatuainu (UNESCO Pacific) - Artika Devi (UNESCO Pacific) 	<ul style="list-style-type: none"> IUPAP UNESCO APS USA DPG Germany AIP Australia MacDiarmid Institute Te Whai Ao Dodd Walls Centre Photon Factory Laser Laboratory Australian Academy of Science University of Otago SAIP South African Institute of Physics ICTP The Abdus Salam International Institute for Theoretical Physics IAPS Int Assoc Physics Students ETCube National University of Samoa University of Fiji Fiji National University

The LOC and IOC, both representing the Pacific Island Nations, IUPAP and UNESCO Pacific, decided on the theme of climate change and sustainability. The theme was spontaneously stressed by VIP speakers at the meeting: Professor Shaista Shammem: VC of the University of Fiji; the Honourable Aseri Radrodoro, Minister for Education in Fiji; and Mr Navin Raj, Fiji's Permanent Secretary for Education, a physicist.

Excellent talks resulted from invitations to Dr Shilpa Lal, University of New Caledonia and an ICTP alumna, a specialist in marine heatwaves in the southwest Pacific; Dr Awnesh Singh, of the University

of the South Pacific, a physicist in ocean science; and Mr Vinal Prakash, from the Fiji Meteorological Service, on Disaster Risk and Reduction. From the workshops held, it is clear that climate change, energy, disasters, education, the brain drain to Australia and New Zealand, and low fractions of women in the field are at the top of the list for physicists in the Pacific Island Nations. The VIPs present concurred.

The UNESCO-IUPAP Entrepreneurship and Innovation event also adopted sustainability and physics as themes. UNESCO supported about 30 postgrad students and early-career scientists for a 5-day intensive bootcamp on all aspects of innovation. The participants were formed into teams, with presentations and group exercises formulated by entrepreneur-physicist Surya Raghu, ETCube⁵ and delivered with the help of Joe Niemela.

Day 1	How tech entrepreneurs can help drive Pacific Islands' sustainable future, identifying top challenges in Pacific Islands that need technological solutions, tools for opportunity assessment and feasibility analysis, an introduction to the entrepreneurial ecosystem in Fiji and rest of the Pacific Islands
Day 2	Creating a value proposition, customer survey and revising your innovation and value proposition, introduction to business models, working on a lean business canvas, introduction to start-up finance, estimating finances for a start-up business, :where and how to look for venture capital, experience of start-ups in seeking financing
Day 3	Conducting "market surveys", Marketing and sales, determining the market size, taking an idea and invention to market
Day 4	Introduction to intellectual property, soft skills in business: Communication, Networking, Pitching
Day 5	Four Venture Capitalists from the region formed a panel of judges, who heard the pitches of the teams and awarded a First Prize (which was, in part, sponsored by IAPS, the International Association of Physics Students).



IUPAP-UNESCO Physics Summit



UNESCO-IUPAP Entrepreneurship

⁵ <https://etcube.org/>

4.3. IUPAP-UNESCO International Colloquia on Physics for Society, with the colloquium organisers

WG21 proposed the theme of IDSSD⁶ for 2026 for the colloquia, and has suggested names of possible speakers. The first two were Prof Steven Chu, Nobel Prize in Physics 1997, “The challenges and opportunities of getting to net-zero GHG emissions”, and Prof Paulo Artaxo, co-recipient of the 2007 Nobel Peace Prize awarded to the IPCC, on “Climate change, tropical forests and global sustainability”⁷.

5. Tasks of WG21

A number of tasks arise from the Resolution forming the Working Group as follows.

1. Identify, promote, engage and discuss the unique role that physics is and should be playing in this area.

A defining paper, or briefing document, is in the process of construction, describing the mission and intention of the group. The process is being led by Morgan O'Neill and Tomás Sintés. This will be a critical output of WG21. Once completed, and after EC approval. It will be the basis for our engagements with IUPAC and other Unions. This work has already contributed very significantly to the formulation of the International Conference on Physics.

2. Entrench an evidence-based approach to responses to climate change studies and the energy transition process in close collaboration with experts from other disciplines, **and**
3. Establish a strong bridge with the broad international public on these topics.

Dr. Hyunjung Lee and Prof. Jean-Louis Scartezzini have produced a Communication Strategy for WG21, available on request. This now forms a basis for ICP communications. WG21 is developing a system of “Climate contacts” across the world, requesting nominations from member liaisons.

4. Suggest and encourage ways of incorporating green economy and sustainability thinking in university curricula and research training.

This task was deferred, due to events outside the control of the group.

5. Advise Executive Council on actions to be taken, work to be done, statements to be issued.

Discussion with the EC on IYBSSD has taken place.

6. Organize at least one major conference over the next three years.

The 2025 Pacific Island Physics Week and 2027 ICP are covered above.

7. Engage with the activities that are expected to take place in connection with the IDSSD.

Speakers are recommended for the IUPAP-UNESCO lectures in 2026. It is hoped that the programme can be continued in 2027.

8. Liaise with Regional, national Physics Societies, with other Unions in other fields in the spirit of IYBSSD.

WG21 is developing a system of “Climate contacts” across the world. Part of their function is specifically to be the main contact in an IUPAP member territory, or a country, for the 2027 conference. Most member liaisons have been slow to respond to the call.

⁶ International Decade of Science for Sustainable Development

⁷ <https://iupap.org/strategic-plan/outreach/iupap-unesco-international-colloquia/>

6. IUPAP Internal liaison

In 2023/2024 Commissions, Working Groups and Affiliated Commissions were invited to identify liaisons. The process of confirming and appointing liaisons after the election GA of October 2024 is under way. AC1 has proposed Prof. Thomas Roser, who will also represent Sustainable HEP (High Energy Physics), strengthening the initiative to encourage sustainability in all physics laboratory and design endeavours. A number of Commission Chairs have provided accounts of the role of physics in Commission scope in climate change action in sustainability: excellent examples are below.

Commission C2, Symbols, Units, Nomenclature, Atomic Masses and Fundamental Constants: provides the scientific bedrock upon which climate action and sustainability rest. Its work in standardizing units, symbols and nomenclature, ensures that climate science is precise, interoperable, and globally accessible.

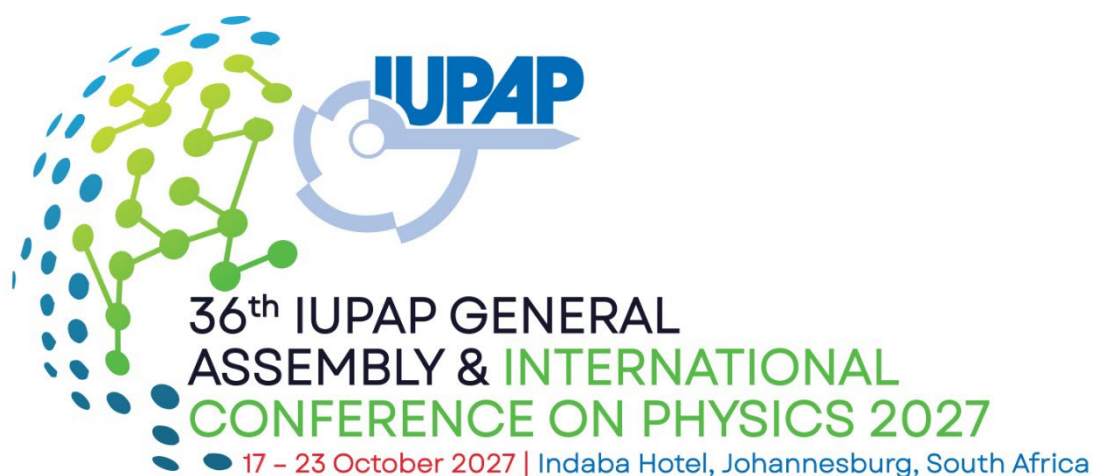
Commission C3, Statistical Physics: The view of chaos theory proves to be useful in understanding the dynamics of climate change. Broadly speaking, climate dynamics can thus be considered as a special appearance of nonequilibrium statistical physics.

Commission C9, Commission on Magnetism: can contribute to Climate Change Action and Sustainable Development by promoting research and development on (i) spintronics for energy-efficient computing and (ii) permanent magnet for energy-efficient motors and generators.

Commission C15, Atomic, Molecular, and Optical Physics: By mastering the interactions between light and matter, AMO physicists have laid the foundation for quantum sensing, communication, and computing, which can transform humanity's capacity to monitor, model, and mitigate environmental change. At the same time, the digital revolution, powered by artificial intelligence (AI), carries an unsustainable energy consumption. To balance technological progress with sustainability, computation must become more energy-efficient, and quantum computing offers a viable path forward.

Commission Chairs are encouraged to submit descriptions of roles of physics within their scope that contribute to climate change action, sustainable development, and regenerative development (via the Secretary, lgledhill@wits.ac.za).

Appendix: Draft themes for The IUPAP International Conference on Physics: “Physics for sustainable development: equitable wellbeing on a healthy, lively planet”.



IUPAP International Conference on Physics

“Physics for Sustainable Development: Equitable wellbeing on a healthy, lively planet”

Physics Focus: *The roles that physics is playing, and should be playing, in the present climate crisis of our planet.*

Physics in Climate Science	
Physics in Sustainable Development for Equitable Wellbeing	Physics in Mitigation (general) Physics in Adaptation: Energy Green Economy Human and Environmental Health Disaster Risk Reduction
Physics in Science Diplomacy and Communication	
Physics Education and Skills Development in Climate Physics and Sustainability	

1. Physics in Climate Science

including physics-powered solutions in climate science and observation; Earth Systems Models, fundamental physics needed in models; validation; the science of attribution, data integrity; evidence in terms of Earth Observation, oceanography, atmospheric physics and meteorology, geophysics, polar science and ice mechanics; the nature of evidence and of uncertainty; sensors, satellites, platforms and system integration (buoys, gliders, autonomous underwater vehicles, shipboard observations, ground stations, mobile land platforms); satellites and systems, space science and planetary science; the fundamental natures of stochastic forcing in complex systems, fundamental physics shedding light on climate; chaos theory, non-linear dynamics, turbulence; novel modelling, monitoring, observations; machine

learning & AI, data science

2. Physics in Sustainable Development for Equitable Wellbeing:

2.1 Mitigation & Adaptation

including emissions reduction, carbon sequestration

2.2 Energy

including physics in energy systems for a low-C future; energy efficiency, energy saving in favour of lean buildings and lean transportation systems; renewable energy generation and storage, solar, wind, tidal, hydroelectric, geothermal and generation systems, sustainable practice, local adaptation, low cost systems and physics for development; fusion energy, major facilities and start-ups; superconductivity; nuclear energy, microreactors, new physics, sustainability considerations; transmission networks, stability and dynamics

2.3 Physics in the green economy

materials for the future, condensed matter physics and materials science; sustainable manufacturing, lasers in industry; natural lighting and daylighting, sustainable ventilation and cooling, building systems and materials, low-cost materials, urban hotspots, rural protection, coastal protection, novel recycling; nanotechnologies for energy conversion;

Sustainable High Energy Physics, sustainable physics labs, computing, and data management

2.4 Physics in human and environmental health

including medical physics, radiology, novel image processing; physics for health, solutions for heat-health impacts; lasers, optical physics and photonics; diagnostics: quantum sensors, microfluidics, accessible low-cost medical care and diagnostics in the field; vaccines and treatments, vector control – biophysics, bioinformatics, electronic structure methods, synchrotrons, nanoscience; physics applied to the Food-Water-Energy nexus: clean water (water purification), energy provision, applications to pests and diseases in agriculture and pastoralism, metagenomics, soil science, resilient crops; fish stock monitoring, physics in the economy of the ocean; toxin sensors in foods, innovative support of subsistence farmers and fisheries, onsite refrigeration; adaptation to harsh environments, shade and cooling hubs, dust protection, precision farming; the biosphere, observation and modelling, regenerative science

2.5 Physics in Disaster Risk Reduction

the nature of severe events: storms, flooding, drought, heat stress; effective Early Warning Systems and community inclusion, very low-cost weather and climate station support, fire sensors, soil sensors, rescue support, novel personal protective equipment; disaster recovery and systems; resilient infrastructure for the future; rescue systems, wearable beacons; hospital and clinic support and systems

3 Physics in Science Diplomacy and Communication

Science diplomacy, policy, climate justice; law and ethics in climate change, inequality, vulnerability and preparedness across the globe, physics for development; cross-border warning systems and data sharing, climate data governance and interoperability; physics applied in quantitative finance, financial sector stability, equitable access to finance, insurance, climate finance, fiscal stress due to climate change; predictive analysis; science communication, misinformation, methods of communication; government-private-sector-academia-community-environment systems for action; citizen science

4 Physics Education and Skills Development in Climate Physics and Sustainability

Physics education methods, curriculum development; critical thinking and reasoning methods, scientific method, understanding uncertainty; career advice, availability of jobs; courses for established physicists; entrepreneurship and innovation; reducing the disproportionate impact of climate change on women