

CONCEPT NOTE

A global research initiative in support of a successful implementation of the UN 2030 Agenda

One of the most pressing challenges currently facing the global community is how to realize the benefits of future global social and economic development within a safe and just operating space of a stable planet. There is still significant inequality between and within societies and overwhelming evidence of rising global risks due to ever increasing human pressures on the planet. Ensuring future sustainable development will require socio-economic development within sustainability limits and budgets for improving human well-being and preserving natural resources and environmental processes that regulate ecosystem and planetary resilience (often referred to as planetary boundaries). A sustainable development pathway must also take account of the critical drivers of human capacity, demographic changes, opportunities for technological innovation and diffusion, sound institutions and transformative governance capabilities, sustainable diets, and other critical socio-economic developments.

The Sustainable Development Goals (SDGs), unanimously adopted by the United Nations in September 2015, provide an aspirational narrative for the desired future for human development with an actionable agenda. The aspiration is for a world free from hunger, injustice and absolute poverty, of universal education, health and employment with inclusive economic growth, based on transparency, dignity and equity, all achieved within the boundaries of the planet. The urgent question now is how to act on this aspirational agenda and to have a clear understanding of the full consequences and cost of inaction and the benefits of achieving the SDGs in every major region of the world. The World in 2050 initiative aims, not only to contribute to this understanding, but also develop science-based transformational and equitable pathways to sustainable development that can provide much needed information and guidance for policy makers responsible for the implementation of the SDGs.

Pathways towards a sustainable future

TWI2050 is a global research initiative launched by the International Institute for Applied Systems Analysis (IIASA), the Sustainable Development Solutions Network (SDSN), and the Stockholm Resilience Center (SRC). The initiative brings together a network of leading policymakers, analysts, modeling and analytical teams, and organisations from around the world to collaborate in developing pathways toward sustainable futures and policy frameworks needed for implementing the SDGs, and more importantly, for achieving the needed transformational change.

The SDGs set out very clear and ambitious global goals across social, economic and environmental areas with important interactions between and among these goals (e.g., between energy and climate, between food security and ecosystems, between development and the environment, etc.). What is lacking, but urgently required, is an assessment of the viability of achieving these multiple social-economic-environmental-planetary goals simultaneously using integrative and systemic methodological approaches. This is necessary to answer questions such as: How do we meet the hunger, poverty, energy, growth goals while meeting global environmental goals; What are the synergies and trade-offs; and what are the costs of pursuing social goals without meeting sustainability goals and the other way around?

Addressing critical knowledge gaps

An integrated understanding of sustainable development: There is an urgent need for a truly integrated, comprehensive quantitative understanding of sustainable development pathways, accounting for the inter-linkages between the economy, technology, institutions, environment, climate, human development and planetary boundaries. For example, when the leading organizations issue long-term projections for the world economy, these do not tend to account for the impact of climate change or different demographic developments. Similarly, models for climate change mitigation are poorly integrated with models for biodiversity or those for the use of land and water resources. Moreover, we lack a proper understanding of the interrelations between policies aimed at productivity growth, material welfare, energy access, and environmental sustainability. The need for regional perspectives: A large number of sectoral and integrated global models exist, but they often lack appropriate downscaling to the major regions. Where such downscaling exists, the 'sustainable development pathways' are rarely calibrated in such a way that every region can experience a sustainable future. Yet, the feasibility of sustainable development pathways in every region is a central political and ethical requirement for global sustainable development pathways. To this end, **TWI2050** will downscale and interpret its integrated analysis to provide a better understanding of how every major world region can achieve sustainable development. Exemplary country studies will complement the regional perspective.

A detailed understanding of the opportunities and needs for technological change and institutional development: Achieving sustainable development requires decoupling of environmental resource use from economic activity and social progress on historically unprecedented scales. For example, the remaining global carbon budget for achieving stabilization at 2 degrees Celsius above pre-industrial levels is limited to 1000 GtCO_{2e} (billion tons of carbon dioxide). This means that the global energy-related greenhouse gas emissions will need to fall by almost 300% by 2050 while world GDP is expected to increase several fold over the same period. Soon thereafter, net emissions will need to decline to zero. Such decoupling can only be achieved through massive advances in technologies and their widespread adoption. Such adoption, in turn, depends critically on the ability to harmonize climate change mitigation with the pursuit of socio-economic improvements. Similarly, modern ICT, local and traditional knowledge, biotechnology, and other technologies can help transform the way countries tackle major human development challenges. And finally, modern as well as local and traditional technologies for agriculture, water management, infrastructure design, and many other areas will be critical for enhancing local resilience and earth resilience to climate change and other environmental change. These processes of technological acceleration need to be fostered and embedded in specific institutions and transformative governance strategies. **TWI2050** will seek to develop a robust understanding of how modern technologies and associated policy frameworks can support and underpin sustainable development pathways. To this end, the initiative will partner with leading research institutions from around the world as well as businesses that work at the forefront of modern technologies in areas, such as energy, health, education, and agriculture.

Methodological Approach

By 'back-casting' from desired development outcomes in the second part of the century to a more immediate future, **TWI2050** will build upon shorter-term achievements as defined collectively by the 17 SDGs to explore options for achieving sustainable development pathways. **TWI2050** therefore aims to be normative but not policy prescriptive. Instead of developing a new suite of analytical models, the **TWI2050** initiative will combine, and build upon, recent advancements in Earth system governance, social, economic and technology advances and Earth system science (e.g., energy, food, population, education, macroeconomics, biodiversity, and climate). It will build on existing global assessments such as the IPCC, Global Energy Assessment, Human Development Report, World Economic Outlook, Global Biodiversity Outlook), on more recent advances in scenario building (e.g., RCPs and SSPs) on national (e.g., the Deep Decarbonization Pathway Project) and integrated assessment models (e.g., MESSAGE, IMAGE, and

IMPACT/ GLOBIOM/GAEZ), to evaluate the linked impacts of global food policy, population changes, ecosystem changes, climate change and energy use. TWI2050 will benefit from other scientific initiatives in advancing integrated assessment modeling and treatment of nexus problems such as the EU CD-LINKS initiative. In addition, it will use data from across the regional and national assessments, roadmaps and analytical scenarios as inputs to the global and regional perspectives. As such, TWI2050 constitutes a unique and ambitious undertaking.

This approach differs from the more standard approach of putting all elements of the SD framework into a single integrated assessment model (IAM) managed by a single research team. The goal, rather, is to harness the deep knowledge of specialized institutions from around the world (in energy, food, macroeconomics, climate, biodiversity, demography, etc.) in an integrated framework, but not necessarily in a single integrated mathematical model. We believe that the existing Integrated Assessment Models (IAMs), however impressive, generally fail to encompass the deeper insights of the highly specialized sector models, while the individual sector models fail to incorporate the general systems interactions built into the IAMs. TWI2050 aims to bridge that divide in a novel and constructive manner, by bringing specialized sector models managed by lead institutions into an integrated framework.

This approach has another long-term advantage or co-benefit: it will strengthen the performance of the key participating institutions, by forcing their modeling efforts to confront the critical parameters and issues arising from other sectors not described in their own models. The economic and financing institutions, for example, typically use short-term macroeconomic models that lack the benefit of a specific medium-term framework on climate change that has implications for long-term growth. Food modelers do not necessarily incorporate macroeconomic feedbacks; energy system modelers do not incorporate demographic feedbacks, etc. The longer-term benefit of TWI2050 will therefore be an enhanced global capacity and platform of leading institutions to engage in complex systems analysis. Again, this will be a first attempt to do so.

TWI2050 differs from standard integrated assessment models by asking a goal-based question. Rather than examining various future scenarios, the project will focus on describing a potential sustainable development pathway, that is, one in which social and economic development proceed in all regions of the world (including achieving the SDGs), while respecting the planetary boundaries at local to global scales. This is a normative approach that is not present (even potentially) in much of the world's analytical work on energy, macroeconomics, demography, and other issues of critical importance. The objective is to develop sustainable pathways (SDPs) that reach the two defined target spaces: all 17 SDGs and the transformation toward sustainability within planetary boundaries beyond 2050.

Furthermore, the current analytical and quantitative modeling capabilities fall short of being able to capture all 17 SDGs and their 169 targets. Instead, TWI2050 will use a flexible hybrid approach of linking the quantitative modeling approaches in such a way that a more holistic and qualitative treatment of all SDGs is possible. For example, financing and investment analysis might be limited to shorter periods of time while the investment needs across sectors could come from models that reach well into the second half of the century. Regional disaggregation will also need to be kept flexible to reflect different regional perspectives. Perhaps, most importantly, not all 17 SDGs and all aspects of a safe and equitable future in harmony with planetary boundaries need to be model-based. Rich narratives, consistent with the overall development pathways, could be used to fill-in the gaps left by quantitative analysis and furthermore help with the interpretation of policy, governance and other enabling dimensions of the great transformation toward sustainable futures. The proposed goal-oriented and hybrid modeling approach will examine the interactions among all the SDGs to explore the potential for co-benefits and/or trade-offs of addressing multiple SDGs at the same time. We anticipate that these analyses will provide critical information for policy and investment decisions. Initially – most likely during the first two years – these analyses will be conducted at the global and regional scales, yet over time, will be downscaled to sectoral and national levels to better inform policymaking.