GEF-6 REQUEST FOR PROJECT ENDORSEMENT/APPROVAL

PROJECT TYPE: Medium-sized Project
TYPE OF TRUST FUND:GEF Trust Fund

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PART I: PROJECT INFORMATION

Project Title: Integrated Solutions for Water, Energy, and Land			
Country(ies):	Global	GEF Project ID:[1]	6993
GEF Agency(ies):	UNIDO	GEF Agency Project ID:	140312
Other Executing Partner(s):	International Institute for Applied Systems Analysis	Submission Date:	
GEF Focal Area (s):	Multi-focal Areas	Project Duration (Months)	36
Integrated Approach Pilot	IAP-Cities ☐ IAP-Commodities ☐ IAP-Food Security ☐	Corporate Program: SGP ☐	
Name of Parent Program	[if applicable]	Agency Fee ($)	180,500

A. FOCAL AREA STRATEGY FRAMEWORK AND OTHER PROGRAM STRATEGIES[2]

Focal Area Objectives/Programs	Focal Area Outcomes	Trust Fund	(in $) GEF Project Financing	(in $) Co-financing
CCM-1 Program 2	Outcome B. Policy, planning and regulatory frameworks foster accelerated low GHG development and emissions mitigation	GEFTF	950,000	950,000
IW-2 programe 4	Outcome 4.1 Increased water/food/energy/ecosystem security and sharing of benefits on basin/sub-basin scale underpinned by adequate regional legal/institutional frameworks for cooperation.	GEFTF	950,000	950,000
	Total project costs		1,900,000	1,900,000

B. PROJECT DESCRIPTION SUMMARY

Project Objective: The project will establish a long-term systems approach to developing, refining and applying the tools, and skills essential for identifying integrated approaches to energy, water, food, and ecosystem security in selected regions in line with the GEF 2020 strategy.

Project Components/ Programs	Financing Type[3]	Project Outcomes	Project Outputs	Trust Fund	(in $) GEF Project Financing	(in $) Confirmed Co-financing
1. Development of a systems analysis framework for assessing solutions to nexus challenges	TA	1.1. Future trends and drivers systematically explored	1.1.1 Stakeholder-informed regional scenario design for exploring nexus challenges, drivers and solutions	GEFTF	230,000	230,000
	TA	1.2 Method and tool developed	1.2.1 Nexus modeling tool developed and presented with preliminary results: Tool will illuminate trade-offs among sectors and explore solutions for	GEFTF	660,000	660,000

[1] Project ID number remains the same as the assigned PIF number.
[2] When completing Table A, refer to the excerpts on *GEF 6 Results Frameworks for GETF, LDCF and SCCF*.
[3] Financing type can be either investment or technical assistance.

			achieving multiple development and environmental objectives			
2. Regional nexus solutions in the context of global developments	TA	2.1 Understanding of sectorial trade-offs, synergies, and solutions for meeting nexus challenges improved among regional stakeholders	2.1.1 Tangible strategies for improving regional decision-making across sectors identified for two selected regions	GEFTF	255,000	255,000
	TA	2.2 Multi-sectorial vulnerability hotspots under different socioeconomic and hydro-climatic scenarios identified	2.2.1 Global assessment of multi-sectorial hotspots and transformation pathways	GEFTF	195,000	195,000
3. Capacity building and knowledge management: Building the foundation for a knowledge and capacity network on nexus decision support	TA	3.1 A foundation of a regional and global knowledge and capacity network established	3.1.1 Establishment of connections and interactions among stakeholders from a wide array of institutions and sectors established, including formation of an advisory board	GEFTF	145,000	145,000
	TA	3.2 Capacity building: Regional capacity for nexus assessment and solution identification improved	3.2.1 Foundation of a regional knowledge and capacity network for systems analysis and nexus decision support established	GEFTF	145,000	145,000
	TA	3.3 Knowledge dissemination: Infrastructure established to disseminate findings of the project	3.3.1 Dissemination of project outcomes through publications, events, and data sharing, including participation in IW:Learn	GEFTF	65,000	65,000
4. Monitoring & Evaluation	TA	4. 1 Effectiveness of the outputs assessed, corrective actions taken and experience documented	4.1.1 End of project M&E report	GEFTF	55,000	55,000
			Subtotal		1,750,000	1,750,000
			Project Management Cost (PMC)[4]	GEFTF	150,000	150,000
			Total project costs		1,900,000	1,900,000

C. CONFIRMED SOURCES OF CO-FINANCING FOR THE PROJECT BY NAME AND BY TYPE

Please include evidence for co-financing for the project with this form.

[4] For GEF Project Financing up to $2 million, PMC could be up to10% of the subtotal; above $2 million, PMC could be up to 5% of the subtotal. PMC should be charged proportionately to focal areas based on focal area project financing amount in Table D below.

Sources of Co-financing	Name of Co-financier	Type of Cofinancing	Amount ($)
GEF Agency	UNIDO	Grants	75,000
GEF Agency	UNIDO	In-kind	375,000
Others	IIASA	In-kind	1,450,000
Total Co-financing			1,900,000

D. TRUST FUND RESOURCES REQUESTED BY AGENCY(IES), COUNTRY(IES) AND THE PROGRAMMING OF FUNDS

GEF Agency	Trust Fund	Country Name/Global	Focal Area	Programming of Funds	(in $)		
					GEF Project Financing (a)	Agency Fee[a)] (b)[2]	Total (c)=a+b
UNIDO	GEFTF	Global	Climate Change	Cross-Cutting Capacity	950,000	90,250	1,040,250
UNIDO	GEFTF	Global	International Waters	Cross-Cutting Capacity	950,000	90,250	1,040,250
Total Grant Resources					1,900,000	180,500	2,080,500

a) Refer to the Fee Policy for GEF Partner Agencies

E. PROJECT'S TARGET CONTRIBUTIONS TO GLOBAL ENVIRONMENTAL BENEFITS[5]

Provide the expected project targets as appropriate.

Corporate Results	Replenishment Targets	Project Targets
1. Maintain globally significant biodiversity and the ecosystem goods and services that it provides to society	Improved management of landscapes and seascapes covering 300 million hectares	*hectares*
2. Sustainable land management in production systems (agriculture, rangelands, and forest landscapes)	120 million hectares under sustainable land management	*hectares*
3. Promotion of collective management of transboundary water systems and implementation of the full range of policy, legal, and institutional reforms and investments contributing to sustainable use and maintenance of ecosystem services	Water-food-ecosystems security and conjunctive management of surface and groundwater in at least 10 freshwater basins;	*Number of freshwater basins*
	20% of globally over-exploited fisheries (by volume) moved to more sustainable levels	*Percent of fisheries, by volume*
4. Support to transformational shifts towards a low-emission and resilient development path	750 million tons of CO_{2e} mitigated (include both direct and indirect)	metric tons
5. Increase in phase-out, disposal and reduction of releases of POPs, ODS, mercury and other chemicals of global concern	Disposal of 80,000 tons of POPs (PCB, obsolete pesticides)	*metric tons*
	Reduction of 1000 tons of Mercury	*metric tons*
	Phase-out of 303.44 tons of ODP (HCFC)	*ODP tons*
6. Enhance capacity of countries to implement MEAs (multilateral environmental agreements) and mainstream into national and sub-national policy, planning financial and legal frameworks	Development and sectoral planning frameworks integrate measurable targets drawn from the MEAs in at least 10 countries	*Number of Countries:*
	Functional environmental information systems are established to support decision-making in at least 10 countries	*Number of Countries:*

Please note: The corporate targets in Table F are not directly applicable for this type of project. This is a global, strategic project and not focused on specific impact interventions, but strategically positions the GEF and its partners to take account of nexus dimensions, including synergies and trade-offs, in future programming decisions. Improvements should be made in each of these areas through implementation of GEF projects using the integrated assessment methods developed in this project.

F. DOES THE PROJECT INCLUDE A "NON-GRANT" INSTRUMENT? NO

(If non-grant instruments are used, provide an indicative calendar of expected reflows to your Agency and to the GEF/LDCF/SCCF Trust Fund) in Annex D.

[5] Update the applicable indicators provided at PIF stage. Progress in programming against these targets for the projects per the *Corporate Results Framework* in the *GEF-6 Programming Directions*, will be aggregated and reported during mid-term and at the conclusion of the replenishment period.

PART II: PROJECT JUSTIFICATION

A. DESCRIBE ANY CHANGES IN ALIGNMENT WITH THE PROJECT DESIGN WITH THE ORIGINAL PIF[6]

A.1. *Project Description.* Elaborate on: 1) the global environmental and/or adaptation problems, root causes and barriers that need to be addressed; 2) the baseline scenario or any associated baseline projects, 3) the proposed alternative scenario, GEF focal area[7] strategies, with a brief description of expected outcomes and components of the project, 4) incremental/additional cost reasoning and expected contributions from the baseline, the GEFTF, LDCF, SCCF, and co-financing; 5) global environmental benefits (GEFTF) and/or adaptation benefits (LDCF/SCCF); and 6) innovativeness, sustainability and potential for scaling up.

During the PPG phase, an extensive scoping study was conducted to review the current state-of-the-art in nexus assessment and to identify the limitations and gaps associated with existing assessments. The main opportunities for future research and development identified through this study are reflected in the design of the proposed project, particularly in Component 1 (section A.1.3). Findings of the study are summarized in the Scoping Study report (Annex E).

An informal consultative expert meeting was convened for the first time on October 30th at IIASA in Laxenburg, Austria. The following experts participated:

- Inger Andersen, Director-General, International Union for Conservation of Nature (IUCN), Switzerland
- Rosina Bierbaum, Professor, University of Michigan, United States of America
- David Grey, Professor, Oxford University, United Kingdom
- Johan Rockstroem, Professor, Stockholm University, Executive Director, Stockholm Resilience Center, Sweden (could not participate in the scoping meeting but has provided input)
- Roberto Schaeffer, Professor - Energy Planning Program, Federal University of Rio de Janeiro (UFRJ), Brazil
- Ralph Sims (participated remotely), Professor, School of Engineering and Advanced Technology, Massey University, New Zealand
- Youba Sokona, Special Advisor, South Centre, Switzerland
- Eric Wood, Professor, Princeton University, United States of America

GEF, IIASA, and UNIDO representatives also participated in this meeting. The purpose of the half-day scoping meeting was to solicit advice on the partnership design and project documentation, which were shared prior to the meeting, and to gain feedback on the selection of case study regions. The overall sentiment was that the GEF-IIASA-UNIDO partnership comes at the right time and that it will be the first step on a long journey in advancing the integrated assessment of nexus challenges for the purpose of providing strategic advice to policy makers (see Annex F for further information on the expert meeting).

A.1.1) The global environmental and/or adaptation problems, root causes and barriers that need to be addressed

To this date, humanity has accomplished incredible development achievements along various fronts: science, technology, health, and even lowering the percentage of people living under extreme poverty, to name but a few. These

[6] For questions A.1 –A.7 in Part II, if there are no changes since PIF , no need to respond, please enter "NA" after the respective question.

[7] For biodiversity projects, in addition to explaining the project's consistency with the biodiversity focal area strategy, objectives and programs, please also describe which Aichi Target(s) the project will directly contribute to achieving..

impressive achievements have occurred over the past two centuries since the industrial revolution, and have significantly accelerated during the past three to four decades. Despite these major accomplishments, we are experiencing an exceedingly unequal distribution of wealth. The benefits associated with economic progress and human wellbeing are not shared evenly across the global population. Today, almost three billion people in the world do not have access to modern cooking fuels or sanitation [1]. One and a half billion do not have access to electricity or clean water, and almost one billion go hungry every day [1, 2]. All told, some 400 million people own 85% of the global wealth, while the rest of humanity is left with a 15% share [3]. Consequently, the majority of mankind does not have much of a voice in reducing the deep inequalities in the world or in shaping our shared future.

Another exceedingly concerning result of the impressive material development is the dangerous level of human interference with the earth system. Anthropogenic climate change is the telltale example of our civilization's impacts on planetary processes. Other instances of disruption caused by human economic activity are the depletion of the easily accessible phosphorus resources, land degradation, loss of ecosystem diversity, and air and water pollution.The global socioeconomic trends such as population growth, urbanization, and the swelling middle class in many developing countries drive the pace of environmental degradation and lead to increasing planetary pressure.

Humanity has already reached or even exceeded the carrying capacity of several of the earth's ecosystems. Growing needs for food, energy and water will only exacerbate existing challenges over the next decades. Across many fronts, it is becoming evident that we have transgressed the planetary boundaries permitting a sustainable way of life for mankind – or that we are coming tantalizingly close to tipping points of the earth system. At the same time, human-induced environmental degradation makes reaching ambitious development goals ever more difficult - as evidenced by growing numbers of refugees fleeing, at least in part, environmental crises resulting from prolonged droughts (e.g., it has been argued that the Syrian refugee crisis has been partly triggered by climate-induced water scarcity [4]). Sea level rise, coastal flooding, and the potential disappearance of small island nations will only increase the number of environmental refugees and potential for social unrest over the next century. The World Economic Forum has identified water crises and large-scale involuntary migration as two of the top ten global risks for economic development [5].

Consequently, the acceptance of "business as usual" is eroding and we are being challenged to adopt new, more integrated, and more inclusive development pathways that avoid dangerous interference with the local environment and global planetary boundaries. This challenge is embodied in the United Nation's 17 Sustainable Development Goals Goals (SDGs), which endeavor to set a global agenda for moving towards more sustainable development strategies [6]. There are many pioneers of change from which we can learn, and innovative inclusive business models have been developed, tested and adopted around the world. Nevertheless, old paradigms die hard, and the global economy and a large part of the population rely on fossil fuels and unsustainable consumption patterns. A deep and fundamental transformation of our societies is needed to avert dangerous interference with the planetary systems, while we must at the same time improve the lives of the three billion people excluded today from the major scientific and technological advances of the past decades.

To improve and sustain human welfare, it is critical that access to modern, reliable, and affordable water, energy, and food is expanded and maintained. However, this task will be challenging in a world in which population growth and economic development will place larger demands on the requisite resources. Looking ahead to 2050, up to 70% more food production [7] will be required globally, with an even larger increase in developing countries, while electricity generation is expected to double and access to energy will be universal. With increasing energy and food demands, water demands are also expected to increase by 55 percent, with 40 percent of the world's population living under severe water stress by 2050 [8]. Greater resource demands have historically acted as conflict multipliers, leading to social unrest and even the collapse of civilizations.

The world is now increasingly interconnected and rapidly growing primarily in the poorest regions, with the global population expected to increase by more than 2 billion by 2050 and the urban population increasing by nearly 70% to almost 7 billion, many in mega-cities [9]. Urbanization puts increased pressure on energy, water, and land resources and the associated ecosystems. Most mega-cities will develop along rivers and near the coast, importing their resources from the surrounding, and sometimes distant, regions and posing significant waste disposal challenges. As a result, the resource requirements and environmental footprint of urban areas is expected to expand in the future with significant implications for regional water, food, energy, and ecosystem security.

Moving beyond cities, many freshwater sources, both surface and ground water, are transboundary. Local policy decisions can therefore be felt regionally, and resource management is no longer confined to urban administrative units or national boundaries but must be coordinated across all sectors and scales. As a consequence, transboundary water management can lead to either increased tension and conflict among countries or, with the right incentives and planning, act as a catalyst for improved coordination and joint benefit sharing. Global markets for food and energy mean that, on the one hand, regional demand growth and resource scarcity (e.g., droughts) can have global impacts on market prices while, on the other hand, international trade can help to alleviate regional constraints and thus provide price stability at the local scale. Thus, the interconnectedness of energy, water, food, and ecosystems, combined with increasing scarcity and risk, require integrated strategies from local to global scales to improve efficiency, cost effectiveness, human benefits, international collaboration, and sustainability.

A further dimension of the challenge is that the hydro-climatic regime in low-latitude regions (including much of Africa, South and Southeast Asia and Latin America) is uniquely complex. Without sufficient investment in infrastructure for flood control and water storage, largely unmitigated hydrological variability, including floods and droughts, poses a tangible threat in the global South and can lead to immediate and devastating consequences for local communities and economies. Given that climate change is expected to amplify this variability, solutions are needed to help the global South adapt. Meanwhile, these same regions are characterized by unique and important ecosystems, rapidly growing and urbanizing populations, and many large surface water and groundwater basins shared by numerous nations, in part at least a consequence of recent boundaries drawn by colonial powers. For example, Africa has more river basins shared by three or more countries than any other continent, and the Ganges Basin has a population of about 650 million in four riparian states. The water futures in these regions are particularly uncertain, with largely unknown impacts of rapidly changing populations, economies, and climate on fresh water fluxes, on which all terrestrial life and biodiversity depend.

Energy poverty coupled with absent or unreliable water supply, sanitation, and irrigation services severely impact the health and well-being of one half of the planet's population. Women are disproportionately impacted given that they are often responsible for collecting water and fuel wood, often spending much of their day in these tasks. In addition, women tend to be responsible for cooking and are therefore exposed to greater health risks from indoor air pollution associated with traditional cooking methods [1]. However, the fact that women are disproportionately impacted by poor access to modern energy, water, and food supply systems also means that they will have the most to gain from efforts to improve this access.

It is clear that: (1) water, energy, and land resources will come under increasing pressure in the future from growing demands and a changing climate; (2) the poorest (low latitude) parts of the world will be most vulnerable to socioeconomic and climatic change; (3) integrated resource management is one essential key to human development, adaptation and ecosystem security; and (4) much of this management will require transboundary cooperation and institutions capable of managing multiple sectors, with consequent institutional and legal challenges.

Thus, new approaches are needed to enable institutions from the water, energy, and agricultural sectors to better understand the synergies and trade-offs among sectors and to identify holistic solutions for the sustainable management of water, energy, and land resources that both improve and sustain human welfare and avoid environmental degradation. In particular, the project will explore the following environmental problems: (1) climate change impacts on resource availability and supply systems, including implications for adaptation and mitigation strategies; (2) terrestrial ecosystem impacts associated with land, water, and energy management strategies with a focus on land use change; and (3) maintenance of minimum environmental flows for aquatic ecosystems. Moreover, the project will provide strategic insights for accomplishing several of the SDGs, including those related to hunger (2), water (6), energy (7), infrastructure (9), cities (11), sustainable consumption and production (12), climate (13), and ecosystem security (15). Moreover, SDG 17 (global partnership for sustainable development) represents an umbrella for this wide-ranging policy area. The case studies will specifically work with regional institutions and country-based stakeholders to inform cross-sectorial assessments and to provide strategic advice on nexus interactions, infrastructure investments, and opportunities for transboundary cooperation.

A.1.2) The baseline scenario or any associated baseline projects

i) The baseline scenario

The identification of technologies and management and development options that will keep us below key tipping points and within planetary boundaries, beyond which recovery will either be impossible or excessively costly and complex, is at the core of the GEF mission. Managing more severely constrained resources without exceeding tipping points will require better understanding of the drivers of change (e.g., demographics, economic development, human behavior and preferences) which lead to demands for goods and services and impacts on environmental and social systems. Addressing these challenges requires a new approach to identifying evidence-based policy options and long-term, inter-sectorial pathways that will inform decision making in an increasingly complex and rapidly changing world. Responses to the challenges must be based on evidence derived from scientific endeavor and translated into strategic recommendations. Previous studies have demonstrated potential strategies for each sector in isolation and in areas where good information is available, but trade-offs and synergies for achieving multiple Sustainable Development Goals (SDGs) still remain unclear even in such areas. A few studies, such as the Global Energy Assessment, in which IIASA partnered with GEF, UNIDO and other UN agencies, and both public and private sectors, have provided examples of the potential co-benefits of integrated policies: in that case a potential reduction in costs of up to a third [10, 11] if energy security, greenhouse gas mitigation and air pollution policies are integrated rather than treated separately.

Assessments of this type for energy, water, and land resources are essential, particularly in regions where these resources are most stressed and climate is most variable. This is particularly challenging for water, where adequate monitoring data, which are essential to define the system, calibrate and verify models, and assess solutions, either do not exist or are scarce. Unfortunately, these data challenges are increasing as many established monitoring networks are poorly maintained, creating immense data and knowledge gaps, particularly – and perversely – in low-latitude regions where needs are greatest but financial and human capacity is typically low. Beyond the challenges of data availability, there are further challenges in building frameworks and models that link processes acting on very different spatial and temporal scales in order to assess synergies and tradeoffs and to formulate effective strategies for addressing the water, energy, and land nexus. Furthermore, cooperation across sectors and countries in transboundary basins is often hampererd by up- and downstream inequalities of political power and wealth. A lack of trust among riparian countries is often rooted deeply in the history of country relations and engrained in society and culture, thus posing additional challenges to transboundary cooperation.

Energy, water, and land resources tend to be managed, studied, and assessed within sector-specific silos, including within research, government, and business institutions. However, there are a myriad of interactions among these sectors [12, 13]. For example, energy is used for pumping, moving, heating, and treating water [14], with the share of energy attributed to water supply expected to increase in arid regions that rely more heavily on energy-intensive approaches, such as interbasin transfers, desalination, and groundwater pumping. Furthermore, energy is used in the agro-forestry sector for fertilizer production, irrigation, cultivating and harvesting crops, and drying and processing products. Water is also an important resource for the energy and agricultural sectors. About 15% of global water withdrawals are associated with the energy sector in which water is used for thermoelectric power plant cooling, hydropower, resource extraction, fuel processing, and bioenergy cultivation [15]. However, the industrial share of water withdrawal, of which energy constitutes a large portion, ranges from 4% in Africa to 50% in Europe [16], suggesting that development will greatly increase industrial water demands in the future. The agricultural sector is the largest user of water, accounting for 70% of global water withdrawals, largely for irrigation [16]. Finally, land resources are required for the agriculture, energy and water sectors, primarily for the cultivation of food, feed, fiber, and bioenergy, but also for water and energy infrastructure (e.g., manmade reservoirs). These land pressures may pose a threat to natural landscapes and biodiversity [17].

As a result of these interdependencies, solutions designed for an individual sector can have negative consequences for others. For example, strategies for alleviating water scarcity, such as interbasin transfers, groundwater pumping, and desalination, require significant energy with consequences for greenhouse gas (GHG) emissions and climate change [14]. Despite these trade-offs, synergies among solutions also exist. For example, policies that reduce the consumption of water, food, or energy will have synergistic benefits for the other sectors given that each sector is a resource for the other [18]. Given these interdependencies, the sustainable management and provision of water, energy, and land resources should be conducted using integrated approaches that are based on a broader systems perspective [19]. The concept of nexus thinking has gained traction and been applied in the context of the linkages among water, energy, and

land resources [13, 20-22]. This approach focuses on all three sectors and strives to identify the linkages and interactions among sectors to better understand the synergies and trade-offs involved in meeting future resource demands of both human and natural systems in a sustainable way. The ultimate objective is to identify solutions that capitalize on potential synergies and co-benefits, minimize counterproductive policies and investments, and ensure that humanity remains within planetary boundaries.

Several studies have expressed the need for improved quantitative integrated assessment tools to identify the synergies, trade-offs, and feedbacks among sectors and to identify holistic solutions at multiple scales for managing water, energy, and land resources [23, 24]. However, current efforts to develop such tools have been limited and many opportunities exist for developing tools and approaches that can provide greater value to stakeholders (e.g., development banks, resource managers, investors, and policy-makers). As identified in the scoping study (Annex E) completed during the PPG phase, specific opportunities for improving nexus assessment tools include: (1) the development of integrated assessment frameworks based on consistent, scalable, and regionally-transferable platforms; (2) the development of spatially-explicit tools for the energy and water sectors; (3) improved representation of nexus impacts on environmental quality; (4) improved tracking of energy and land requirements across sectors; (5) improved representation of the role of distribution infrastructure in alleviating resource challenges; and (6) dynamic multi-sectorial hotspot analysis. In addition, improved tools are needed that can quantify the benefits of integrated resource management across not only sectors but also countries and provide broad strategic advice to guide future investment and policy priorities.

The baseline scenario is a world where future scenarios, modeling tools, policies, management plans, and projects continue to be developed and implemented within sector-based 'silos', without consideration of the potentially conflicting strategies being developed in other sectors and disciplines or at other management scales. Current sectorial approaches and strategies will be assessed within the project to determine the effectiveness of those strategies when considering developments in other sectors and potential opportunities for transboundary collaboration.

ii) The baseline projects

The baseline knowledge and information for this project are provided by the vast experience accumulated by IIASA and UNIDO together with their partners and collaborators through decades of regional and global analyses focused on various drivers and economic sectors. The project, for example, builds on IIASA's groundbreaking advances in:

- demographic projections, including probabilistic population projections and the inclusion of human capital in demographic projections;
- energy systems modeling and analysis (e.g., the Global Energy Assessment), including quantitative assessment of multiple pathways toward global energy security and sustainability while meeting climate change targets and the provision of tools to visualise tradeoffs among options;
- forestry, agriculture and land use assessments, which have not only explored the trade-offs among agricultural production, land conservation, and biodiversity goals, but have advanced understanding of land use and carbon management options, such as those associated with REDD+;
- global agricultural, land-use, energy, climate change, technology and demographic databases, assessments, and online tools;
- crowd-sourced data collection through the Geo-Wiki project, which has helped to advance the quality and accessibility of global land cover datasets and provides an example of how to improve data collection in areas with poor information (http://www.iiasa.ac.at/web/home/research/modelsData/Geo-Wiki/Geo-Wiki.en.html);
- climate and socio-economic scenario development, such as the IPCC Special Report on Emissions Scenarios (SRES) and now the Shared Socio-economic Pathways (SSPs);
- global water assessments through IIASA's co-leadership of the Water and global Change (WATCH) project, the Water Model Inter-comparison Project (WaterMIP), the Inter-Sectoral Impact Model Inter-comparison Project (ISI-MIP), and the recently launched Water Futures and Solutions Initiative (WFaS).

These initiatives, and many more like them, have collected and harmonised global data and knowledge, involved broad-based collaboration with stakeholders and partners across industry, government, academia, and NGOs, and have been linked with a wide range of complementary initiatives. However, most of these studies rely on sector-specific modeling tools and have been conducted using baselines or reference developments that do not include future policies but rather

extend the current trends and dynamics into the future. This means that past studies have not adequately considered the nexus and past modeling tools have been inadequate for assessing the potential synergies and benefits of integrated policies that address simultaneously energy, water, food, urbanisation and ecosystem security developments. Thus, an integrated approach is needed that can capture the trade-offs and synergies among sectors and provide strategic recommendations for addressing multiple nexus challenges and their associated SDGs.

A.1.3) The proposed alternative scenario, GEF focal area[8] strategies, with a brief description of expected outcomes and components of the project

This project will lay the foundations for developing integrated approaches to identify evidence-based policy and investment strategies that will inform decision making across the water, energy, and land nexus, underpinning the GEF 2020 Strategy and long term vision and serving to inform GEF in the medium to long-term. The causal chain of environmental change provided in the document GEF 2020-Strategy for the GEF [25] provides a valuable conceptual framework for the nature of the global challenges that need to be addressed.

This project will build upon IIASA's expertise in systems analysis and assessment of the water, energy, and land sectors to develop and demonstrate a next-generation systems analysis framework capable of exploring and identifying synergistic technical and policy solutions to environmental and human development challenges related to the nexus. This framework will be applied in both regional and global contexts to help stakeholders to better understand: (1) the trade-offs and synergies among strategies to address nexus challenges; (2) the benefits of coordinated versus sector-specific approaches; (3) solution portfolios that consider uncertainties in future socioeconomic, technological, and climatic trends; and (4) the location and evolution of nexus hotspots under global change. This approach will assess the benefits of coordinated action across sectors to help regional stakeholders to identify mutually beneficial strategies for concurrently meeting future energy, water, and land resource needs while remaining within a "joint, just and safe operating space" [26].

The systems analysis framework will be tested and refined within the context of two case study regions characterized by hydro-climatic complexity, multiple energy, water, and land use challenges, and rapid demographic, socioeconomic, and climatic change. In each region, stakeholders will be involved in scoping relevant nexus challenges and solutions, helping to refine the systems analysis framework, and translating insights to policy guidelines and investment strategies that are relevant to governments, development agencies, resource managers, and the GEF. In addition, stakeholder interactions and collaborations, as well as capacity building workshops and a scientific exchange program, will build the foundation for knowledge and capacity networks within each case study region. While a stakeholder-informed approach will be used for the case studies, an approach using globally-comprehensive data and tools will be employed for exploring nexus solutions in the context of global developments and solutions (e.g., international trade) and to identify nexus hotspots globally. The systems analysis framework will be used to provide strategic advice to the GEF on how to leverage the findings of this project to inform its future programming directions and funding strategy.

In the PPG phase, an extensive scoping study and literature scan were completed to synthesize the state-of-the-science in nexus assessment and to identify knowledge gaps (see Annex E and G). The project will address several of these knowledge gaps, including the need for: (1) integrated assessment frameworks based on consistent, scalable, and regionally-transferable platforms; (2) spatially-explicit tools for the energy and water sectors; (3) improved representation of nexus impacts on environmental quality; (4) improved tracking of energy and land requirements across sectors; (5) improved representation of the role of distribution infrastructure in alleviating resource challenges; and (6) dynamic multi-sectorial hotspot analysis. In addition, a preliminary analysis of potential case study regions was completed (see Annex H) and an informal consultation with experts was held to discuss the project scope and objectives (see Annex F). The proposed project consists of four interlinked components: two concentrating on research, one on capacity building and stakeholder engagement, and one on monitoring and evaluation.

The project's four components include:

1. Development of a systems analysis framework for assessing solutions to nexus challenges;
2. Regional nexus solutions in the context of global developments;

[8] For biodiversity projects, in addition to explaining the project's consistency with the biodiversity focal area strategy, objectives and programs, please also describe which Aichi Target(s) the project will directly contribute to achieving.

3. Building the foundation for a knowledge and capacity network on nexus decision support; and
4. Monitoring and evaluation.

Component 1: Development of a systems analysis framework for assessing solutions to nexus challenges

A next-generation systems analysis framework will be developed that is capable of exploring a wide range of potential strategies for concurrently managing water, energy, and land resources under global change (Figure 1). To accomplish this objective, several global change pathways will be developed in consultation with regional stakeholders to explore how strategies change under uncertainties about future drivers and developments (Outcome 1.1). In addition, existing and new sectorial modeling tools will be developed and integrated into a new nexus analytical framework (Outcome 1.2). This will involve the development of new methods for linking tools across sectors and scales to enable integrated assessment of the water-energy-land nexus at sub-national and global scales.

1.1 Exploration of future trends and drivers

Using stakeholder consultations, a set of scenarios will be developed that accounts for future demographic, socioeconomic, behavioral, technological, and climatic trends and their uncertainties. At least two global change pathways will be defined and will include a mix of qualitative narratives and quantitative projections until the end of the century. The quantitative projections of climatic and socioeconomic mega-trends will be downscaled to regional levels to assess their biophysical (e.g., land productivity), hydro-climatic (e.g., water availability and variability), and resource demand impacts. An assessment of uncertainties associated with these impacts will be conducted to explore how policy and investment strategies vary across the range of possible futures. Specific quantification of the differences in energy and water demands between urban and rural areas will be undertaken to enable an assessment of how urbanization trends impact the sustainable management of water, energy, and land resources. As an example, growing urbanization may extend the resource footprints of cities with implications for land use and ecosystems in the hinterlands as well as the extent and energy requirements of distribution infrastructures.

Existing socioeconomic and climatic pathways that could be used in this project include the Shared Socioeconomic Pathways (SSPs) and Representative Concentration Pathways (RCPs), which are currently used for the study of climate change impacts, mitigation and adaptation. For each of the selected global change pathways, a range of scenarios will be explored to assess the role of technology, management practices, and human behavior in fulfilling future resource needs while remaining within planetary boundaries. In addition, scenarios will be identified to explore how solutions change when policies are implemented to meet various human welfare and environmental objectives (e.g., relevant SDGs). The scenarios will be designed to explore the interactions among socioeconomic and climatic trends, policies, and technical options with the objective of identifying sustainable solution strategies across sectors and national boundaries. Regional stakeholders within each case study region will be engaged in the development of regional narratives and scenarios to ensure that the relevant nexus challenges, solutions, and policies are adequately represented.

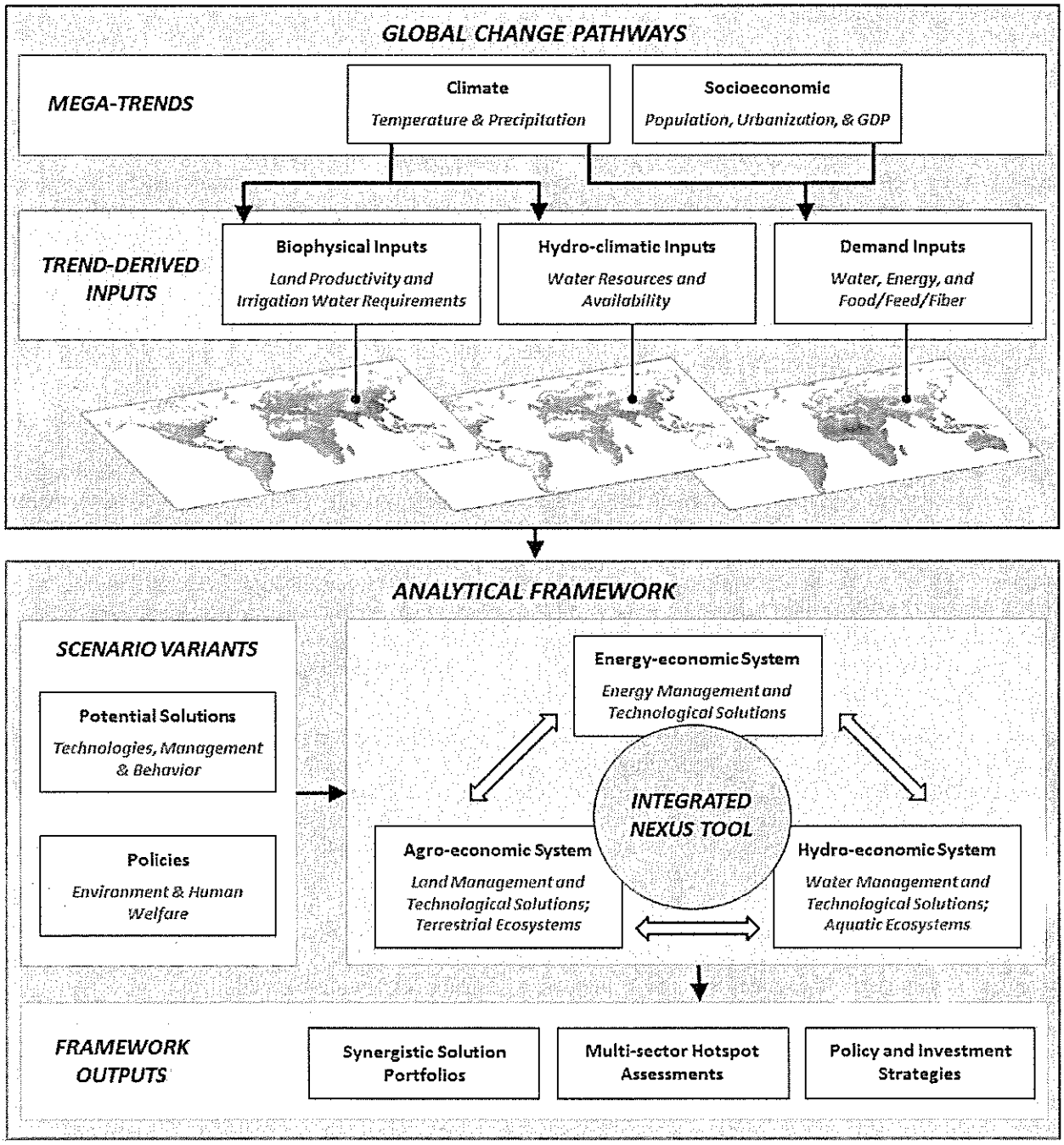


Figure 1 Schematic of Systems Analysis Framework

1.2 Method & tool development

A nexus modeling tool will be developed to explore and identify holistic solutions for the sustainable management of water, energy, and land resources under the scenarios developed in Outcome 1.1. Sectorial modeling tools will be developed and upgraded in Output 1.2.1 and these tools will be linked into an integrated modeling tool of the water-energy-land nexus in Output 1.2.2.

1.2(a) Development and improvement of tools appropriate for sectorial nexus assessments

The focus of this research activity is the development and improvement of sectorial modeling tools to better incorporate nexus elements and trade-offs. These tools will use consistent datasets, software platforms, and storylines to ensure that they can be readily integrated. In addition, the tools will be designed to be scalable (i.e., capable of application at multiple spatial scales), flexible (i.e., able to be adapted to new questions and inputs), and transferable (i.e., capable of application in different locations). Modeling tools for the following systems will be developed as part of Output 1.2.1 and these tools will be integrated into an integrated nexus assessment modeling tool in Output 1.2.2.

Energy-economic system

Most energy-sector water use occurs in the cooling systems associated with thermoelectric power generation. We will develop a next-generation energy-economic modeling tool that is capable of incorporating localized water constraints into future assessments of energy system transformations. This tool will be able to identify the implications of water availability and variability for energy system investments as well as the projected impacts of the energy system on water stress and thermal pollution. This tool will be linked to and build upon IIASA's global energy-economic model, MESSAGE, to ensure consistent analysis across scales.

Hydro–economic system

We will build upon IIASA's expertise in hydrological assessment to develop a next-generation hydro-economic modeling tool that represents the economic trade-offs among water supply technologies and demands. The tool will track water use from all sectors and will identify the least-cost solutions for meeting future water demands under policy constraints. In addition, the tool will track the energy requirements associated with the water supply system (e.g., desalination and water conveyance) to facilitate the linkage with the energy-economic tool. The tool will also incorporate environmental flow requirements to ensure sufficient water for environmental needs and a representation of how water storage and hydropower impact the availability and variability of water.

Agro-economic system

Climate change is expected to reduce water availability for irrigation in some regions with potential impacts for localized crop productivity. Here, we will further develop the irrigation module of IIASA's global agricultural and forest sector tool (GLOBIOM) and enhance the representation of localized water constraints to better understand how management practices can alleviate agricultural pressures on land and water resources. Furthermore, we will add the capability to track the energy requirements associated with the agricultural sector, including for cultivation, groundwater pumping, irrigation, and fertilizer production in order to facilitate the linkage with the energy-economic tool. Being a spatially-explicit land use model coupled with biophysical models representing full carbon and nutrient cycling, GLOBIOM will be used to assess not only food security, but also land-based GHG emissions and ecosystem security. Building on extensive experience in REDD+ modeling on both global and regional scales, biodiversity and pollution indicators will be further developed within this project.

1.2(b) An integrated decision support framework for the water-energy-land nexus

The "integration-ready" sectorial modeling tools developed in Output 1.2(a) will be integrated to create a next-generation nexus modeling tool for assessing synergistic solutions and strategies for the sustainable management of water, energy, and land resources while avoiding environmental degradation. As a first step, key linkages among sectors will be identified using literature review and exploratory modeling. For example, some important linkages among sectors include:

- Energy-water: Trade-offs among the water requirements of the energy sector (e.g., power plant cooling), the energy requirements of the water supply sector (e.g., desalination and conveyance), and impacts on aquatic ecosystems.
- Land-Energy: Competition for land and water resources between bioenergy, food production, and ecosystems.
- Water-land: Implications of water scarcity for agricultural productivity, cropland expansion, and environmental degradation.

Methodologies will be developed for linking the relevant parameters among the energy-, hydro-, and agro-economic tools while handling feedbacks among sectors. Narratives and other qualitative methods will be used where formal model linkages are either not possible or not useful. The linkages among the economic tools will be implemented with the goal of creating an integrated framework for exploring the water-energy-land nexus. A key methodological advancement will include strategies for handling feedbacks among the sectors and between spatial scales (e.g., basins and regions). The main output will be an integrated nexus modeling tool that elucidates synergies and trade-offs among sectors and facilitates the exploration and discovery of strategies that simultaneously achieve multiple objectives related to the water-energy-land nexus and ecosystem security.

Component 2: Regional nexus solutions in the context of global developments

The systems analysis framework developed in Component 1 will be used to investigate nexus challenges and strategic advice at both global and regional levels. The global and regional assessments will be aligned to enable exploration across scales and to facilitate identification of global and regional nexus hotspots as well as strategies that address nexus challenges. While the regional case studies will be stakeholder-driven and focus on providing tangible strategies for improving regional decision-making across sectors and national boundaries, the global assessment will be used to capture how nexus challenges are distributed over the planet and to provide insight into important interactions and solutions that transcend basin and national boundaries.

2.1 Regional assessment of nexus challenges and solutions

Water, energy, and land resources tend to be managed in isolated silos with little consideration of how planning and policy decisions in one sector may impact the management and objectives of the other sectors. Thus, new modeling tools and assessments are needed that not only help to identify synergistic solutions across sectors and national boundaries, but also provide convincing evidence that integrated approaches can yield strategies that are mutually beneficial to many stakeholders. Two transboundary basin-level case studies (one in Africa and one in Asia) will be conducted as a means for testing, refining, and applying the systems analysis framework developed in Component 1. To ensure that the regional assessments yield insights and strategies that are regionally relevant, stakeholders will play a substantial role in: (1) defining the regional challenges and potential solutions; (2) providing feedback on interim approaches and results; and (3) translating final insights to policy and investment strategies that can help guide decision-making within their respective organizations on regional, national, and sub-national levels.

The main objectives of the regional assessments will include: (1) evaluating resource scarcity hotspots; (2) identifying synergies and trade-offs among sectors and countries; (3) distilling portfolios of holistic solutions under various future urbanization, socioeconomic, climatic, behavioral, institutional, and technological trends; (4) formulating policy and investment strategies for addressing regional SDGs; (5) quantifying the benefits of integrated versus sectorial and regional versus nationalistic approaches; 6) identifying knowledge and data gaps that would improve future assessments; (7) highlighting the potential for conflict, collaboration, and benefit sharing among basin countries; and 8) building institutional capacity for analyzing and implementing solutions across sectors and countries. Specific analysis will be undertaken to identify to what extent urbanization trends amplify or ameliorate nexus stress at the regional scale and to explore the spatial reach of future urban areas in terms of water, energy, and land resources.

A wide set of transboundary basins was initially considered before selecting the two basins for the case studies (see Annex G): The Indus and Zambezi River Basins. These transboundary regions were selected after consultation with experts and stakeholders and upon careful assessment of the following criteria: (1) rapid change of drivers and impacts; (2) data availability and quality; (3) local capacity and interest; (4) diversity of nexus challenges; (5) transferability and

universality; (6) complementarity and diversity of basins; and (7) novelty and value added. Annex I includes an initial assessment of organizations that could be potential stakeholders in each region and regional stakeholders have already expressed strong interest in the project. One of the first tasks of the project will be to follow-up with our contacts within regional stakeholder organizations to better assess their interest and regional data availability and to conduct more detailed scoping studies for each region. In the unlikely event that this process indicates that one or both of the basins is untenable, backup basins will be pursued, such as the Mekong, Congo, or Nile River Basins.

The Indus region is the breadbasket for more than 250 million people, yet is already facing water scarcity and groundwater overexploitation . With expected population growth, urbanization, and substantial climate change impacts, especially in relation to glacier melt, the future management of water, energy, and land resources will become increasingly challenging and will benefit from a nexus approach that can assess the trade-offs among regional options, such as increased irrigation efficiency, cropland expansion, and hydropower development. Agricultural pollution and overexploitation of water resources will also pose a threat to aquatic ecosystems and biodiversity, especially in the delta. Moreover, there are growing water conflicts between Pakistan and Afghanistan as proposed hydropower projects in Afghanistan will impact downstream water availability in Pakistan. Although many sectorial studies have been conducted within the Indus Basin, there have not been any integrated nexus assessments of land, water, and energy [27]. Stakeholders that have shown interest in nexus challenges within the Indus are the World Bank, the Asian Development Bank (ADB), the International Centre for Integrated Mountain Development (ICIMOD), the International Water Management Institute (IWMI), various government ministries within riparian countries, and academic researchers from the Centre for Water Informatics and Technology at Lahore University of Management Sciences (LUMS) as well as Massachusetts Institute of Technology (MIT) in the United States.

The Zambezi basin is heterogeneous in terms of climate (e.g., it has large seasonal and intra-annual variation in precipitation), income distribution and economic development. Conflicts among the eight riparian countries, rapid population growth, and the need to expand and improve access to water, food, and modern energy suggests that this region will face serious challenges in implementing sustainable development goals and solutions. The region also faces environmental challenges related to mining, deforestation, and soil degradation. Although the basin has significant potential for renewable energy and increased irrigation, large investments will be required for improving water and energy infrastructure to meet future resource demands. However, financial capacity remains low and thus a nexus approach will be needed to identify cost-effective and efficient strategies for meeting multiple development goals simultaneously. Several studies examining the water-energy-land nexus have been conducted in or around the Zambezi Basin [28-34]. However, few studies have addressed all three sectors and none have applied an integrated assessment tool that can explicitly evaluate the trade-offs and synergies among sectors. Some of the key stakeholders within the region are the Southern African Development Community (SADC), the Zambezi Watercourse Commission (ZAMCOM), the World Bank, the African Development Bank, the International Union for the Conservation of Nature (IUCN), the Infrastructure Consortium for Africa (ICA), the International Water Management Institute (IWMI), and the International Water Association (IWA).

Although some socioeconomic and environmental drivers are expected to be similar in the Indus and Zambezi Basins, some drivers will be distinctly different. As a result, the basins will provide complementary, yet diverse insights into regionally-distinct nexus challenges and solutions. Futhermore, neither basin is heavily studied, which means that the project will be able to provide substantial added value to regional resource managers, policy-makers, and planners.

2.2 Global nexus hotspots and transformation pathways

The case studies will provide a proof-of-concept of the systems analysis framework and insights regarding nexus solutions within two individual basins. However, they will illuminate neither how nexus challenges are distributed over the globe nor how nexus solutions might change in the context of global developments (e.g., globalization). To gain a broader picture of global nexus challenges and solutions, a global assessment will be conducted in which the systems analysis framework is applied with globally-comprehensive datasets, aggregated tools, and a few pathways.

One application of the global assessment will be the identification of multi-sectorial vulnerability hotspots under different socioeconomic and hydro-climatic scenarios. The hotspot analysis will provide insight into where conflicts among sectors may arise and how resource scarcity hotspots may evolve with economic development, population

growth, climate change, and the implementation of various response strategies. Such an analysis will enable the development of global maps that illustrate global hotspots and how regional resource scarcity and stress change with the implementation of solutions, including how strategies applied in one location might exacerbate challenges in others. In addition, this analysis will strive to identify whether specific regional attributes (e.g., development stage, climate, latitude, resource endowment) act as predictors of nexus challenges and solutions.

A second application will be the exploration of how nexus dynamics might impact global transformation pathways as identified by previous studies. For example, will water constraints impact the energy system transformations identified in climate change mitigation efforts? This analysis will help indicate the conditions under which previously reported transformation pathways are no longer feasible and illuminate how the transformation pathways change when using a nexus approach. A global assessment is also useful for identifying solutions that can only be captured with a large geographic scope, such as international trade. Given that trade (virtual and physical) is a valuable strategy for alleviating resource constraints, basin-level assessments that ignore trade will likely overestimate resource stress.

Component 3: Capacity building and knowledge management: Building the foundation for a knowledge and capacity network on nexus decision support

The third component of the project will build the basis for a knowledge and capacity 'Network for Integrated Solutions in Low Latitudes', including consultative meetings and exchange programs with premier scientific institutions in the case study regions. The objective of the 'Network for Integrated Solutions' is to start building the foundation for systems analytic capacity at existing scientific institutions in low latitude regions, so that they can become local centers of nexus decision support. Within this project, the main objective is to identify the "Network institutions", establish the connections, and facilitate interactions among stakeholders from a wide array of institutions within each case study region. Project partners, the expert advisory board, and early stakeholder meetings can help identify the best local institutions and individuals to lead these knowledge hubs. The foundation for a knowledge and capacity network will be built on three pillars: (1) stakeholder engagement; (2); capacity building; and (3) knowledge dissemination.

3.1 Knowledge and capacity network

Involvement of stakeholders as partners in the co-development of knowledge is one of the distinct features of this project. The importance of stakeholder engagement comes from recognizing multiple gaps that exist between science and policy, policy and practice, and science and practice. In order to build a foundation for a regional knowledge and capacity network, stakeholders will be engaged in several activities throughout the duration of the project, such as identifying the questions, challenges, and strategies of relevance to a particular location, providing feedback and data for improving tool development and effectiveness, and sharing in the translation of findings to policy and investments that will influence positive change. Regional knowledge and capacity networks will be built through active engagement of diverse institutions representing food, water, energy, and environmental management, including private industry (dam operators, agricultural producers, etc.), government, regional economic commissions, regional basin institutions, academia, and NGOs. To help identify stakeholders and partners, existing networks and linkages will be leveraged – including, foremost, GEF agencies active in the basins (e.g. WWF, IUCN, and the World Bank), Water Futures and Solutions, the Global Energy Assessment, the Integrated Assessment Modeling Consortium (IAMC) and the regional offices of other international organizations active in the countries selected for the case studies, which may include, among others, UNEP, FAO, UNESCO, UNDP, and GWP. A list of potential stakeholder organizations in each region are listed in Annex I and further information on the stakeholder process is described in section A.3.

One stakeholder meeting will be organized per year in each case study region for a total of six meetings over the course of the three-year project. The purpose of these meetings will be to catalyze the formation of regional knowledge and capacity networks though engagement of stakeholders in the design, development, and interpretation of the regional assessments, to collect feedback and input, and to report and discuss findings. Our approach to participatory integrated assessment will be to develop scenarios together with stakeholders and then analyze key elements and uncertainties of these scenarios with a combination of participatory and modeling techniques. This approach has been demonstrated in a number of projects in which IIASA had a leading role, including participatory scenario development processes related

to the Shared Socio-economic Pathways (SSPs), the scenarios of the World Energy Council, REDD-PAC, and Water Futures and Solutions.

3.2 Capacity Building

As an integral part of the project, partners will take tangible measures to build scientific capacity within the case study regions for understanding and assessing nexus challenges and solutions. Capacity building workshops, held concurrently with stakeholder meetings, will be the first component of this effort by serving as a forum for interactions and frank discussions among practitioners representing multiple sectors and viewpoints. The second component will be the establishment of an informal exchange program for early- to mid-career scientists from partner academic institutions to collaborate on nexus projects within the case study regions. The goal is to engage in joint research and enable knowledge sharing on systems analysis, nexus decision support, and regional nexus challenges. This exchange program may also leverage existing IIASA programs, such as the long-standing Young Scientists Summer Program (YSSP) and the Post-Doc Program. In these cases, the ambition is to train advanced graduate students from the case study regions on research topics related to the water-energy-land nexus, thereby fostering next-generation research expertise in the field. The third component will be a series of online lectures on the nexus by project partners and distinguished scientists. These lectures will be publicly available online and will provide a mechanism for sharing knowledge on nexus challenges and solution strategies.

In line with the GEF IW strategy, project activities will also build regional capacity for improving transboundary policy planning. The tools developed on the regional level could be very valuable in advising governments and other stakeholders in the development of Transboundary Diagnostic Analyses (technical assessments of transboundary challenges and opportunities) for informing Strategic Action Programmes (politically-endorsed action plans to address transboundary threats and opportunities through regional and national reforms and investments).

3.3 Knowledge Dissemination

Central to the dissemination of knowledge created in this project will be a *Joint GEF-IIASA-UNIDO Summary for Policymakers*, which will synthesise the project's main findings and provide policy and investment recommendations geared towards helping governments and resource managers identify mutually-beneficial strategies for meeting development and environmental goals. This document will be widely distributed through the extensive and far-reaching networks of the project partners.

Building on the strong publication record of IIASA, a number of white papers and scientific publications in high-impact peer-reviewed, interdisciplinary journals are planned to complement the project deliverables. This will contribute to the visibility of the project within a number of disciplines of the academic community (e.g., integrated modeling; climate change risk, vulnerability and adaptation; water; energy; land use and forestry; and public policy analysis). In addition, presentations at scientific conferences, side events at high-level meetings (e.g., World Water Week, Africa Water Week, SDSN, and UNFCCC COPs), and collaborations with other major international initiatives (e.g., Sustainable Energy for All (SE4ALL), the Sustainable Development Solutions Network (SDSN), and the UN's Sustainable Development Goals (SDGs)) will be pursued.

UNIDO has developed a large knowledge sharing network which can be exploited to facilitate effective sharing of the findings and experiences of the project at both regional and global levels. Examples of such networks include the Global Network of Regional Sustainable Energy Centres, the Global Network for Resource Efficient and Cleaner Production (RECP*net*), and the Climate Technology Centre & Network (CTCN). Additionally, findings of this project will be reflected by UNIDO in its future technical cooperation to inform practical and science-based solutions.

With an eye toward the general advancement of knowledge, the core data and results of the project will be easily accessible in user-friendly formats so that project outputs can be further exploited by the science and policy communities, thus facilitating others to leverage the work of the project. This will include an online database of all global and regional development pathways resulting from the scenario analyses in Component 2, which will provide functionality for downloading and visualizing scenario outcomes. In addition, 1% of the grant will be allocated for participation in IW:Learn (International Waters Learning Exchange & Resource Network) as a mechanism for sharing

project experiences with other projects and regions. Project participation will include attending IW conferences, drafting of two experience notes, and establishing and contributing to a project website.

Component 4: Monitoring and Evaluation

This project component covers project monitoring and evaluation in accordance with the GEF Monitoring and Evaluation Policy 2010, UNIDO Guidelines on Technical Cooperation Programmes and Projects, and UNIDO Evaluation policy. A detailed M&E plan is included in section C.

A.1.4) Incremental/additional cost reasoning and expected contributions from the baseline, the GEFTF, LDCF, SCCF, and co-financing

Previous studies and tools have demonstrated potential investment and policy strategies for each sector in isolation and in areas where good information is available. However, these tools are limited in their applicability and incapable of evaluating the trade-offs and synergies among sectors or identifying sustainable solutions across sectors. The proposed project will develop a nexus assessment framework that is transferable, scalable, and integrated and thus able to identify nexus solutions at multiple scales and locations. Such a framework will enable the identification of investment and policy strategies for different geographic locations and development stages and will help the GEF to make better informed funding decisions in the future. The value added by the framework will be demonstrated in two case studies and by a global assessment of nexus hotspots under different socioeconomic and hydroclimatic futures. Within the case studies, the project will build regional capacity for systems analysis and nexus decision support by facilitating interactions among regional scientists and other stakeholders and through the exchange of scientists between regional academic institutions and IIASA. The project will develop foundations for regional knowledge and capacity networks in each case study region that will facilitate future interactions and capacity growth beyond the life of the project.

It is expected that additional co-finansing would be raised during implementation of the project. This joint GEF-IIASA-UNIDO partnership has great potential to attract additional contributing partners and to increase financial resources. It can also provide an important input to implementation of 2030 Agenda for development and Paris Agreement. In particular, activites such as the Sustainable Development Solutions Network and its new initiative The World in 2050 could represent additional co-financing and an excellent platform for disseminating the results of the GEF-IIASA-UNIDO partnership. Another way to leverage cooperation and co-finance will be to approach development partners and financial institutions in the context of the case studies. Furthermore, several ongoing initiatives at IIASA, such as CD-Links, ADA Water, ISI-MIP, and Water Futures and Solutions provide opportunities for additional co-financing.

A.1.5) Global environmental benefits (GEFTF) and/or adaptation benefits (LDCF/SCCF)

The project will develop a framework that will enable the systematic analysis of possible transformation pathways to achieve multiple desired objectives and nexus targets for energy, water, food, and ecosystem security. This framework of analysis will also enable the identification of priority areas for investment and the multiple benefits associated with various strategies. Relevant nexus targets will be examined in the context of related Sustainable Development Goals (SDGs), such as SDG 2 (hunger), 6 (water), 7 (energy), and 13 (climate), to illuminate tradeoffs and potential synergies in reaching them. The integrated assessment of which policies and investments will provide the biggest impact in terms of achieving the SDGs will assist countries and the GEF in prioritizing projects and establishing strategic roadmaps. Furthermore, the GEF-IIASA-UNIDO partnership can help identify the immediate and long-term global environmental priorities that can be illuminated with an integrated nexus approach, such as holistic strategies for addressing multiple SDGs while avoiding environmental degradation.

The project will primarily deliver global environmental benefits for the two GEF focal areas of climate change mitigation (CCM) and international waters (IW), but will also yield insights in the areas of land degradation (LD) and sustainable forest management (SFM). The implications for climate change mitigation of competition among sectors

for water, energy, and land resources will be explored to better understand how resource constraints in one sector may impact the mitigation potential of another. Mitigation strategies will be evaluated in the energy sector (e.g., shifting to low-carbon renewables and improving energy efficiency) as well as the agriculture and forestry sectors (e.g., enhancing carbon stocks of various land uses and reducing agricultural emissions through better land management). Strategies to reduce greenhouse gas (GHG) emissions associated with land use change also have implications for sustainable forest management and land degradation (e.g., reducing emissions through afforestation and examining the trade-offs between deforestation and intensification of forest and cropland management). Moreover, the project will provide insight into how forest and agriculture management can sustainably meet growing resource demands while meeting environmental goals, such as REDD+ objectives. Finally, the project will identify opportunities for collaboration among countries in managing international waters and help regional decision-makers to identify mutually-beneficial strategies for optimizing the use of transboundary water resources. In particular, the project will identify potential conflicts among riparian countries, provide strategic advice for mitigating these conflicts, and highlight mutually beneficial strategies for enhancing regional resource efficiency. In addition, the project will examine different climate change scenarios in an effort to highlight possible adaptation strategies for reducing vulnerability to hydro-climatic change.

A.1.6) Innovativeness, sustainability and potential for scaling up

Previous studies have demonstrated feasible long-term transformational strategies for individual sectors and a few studies have quantified some of the benefits of integrated policies. This project goes beyond this previous work to develop an innovative 'state-of-the-science' systems analysis framework for assessing integrated policy and management options for the sustainable management of energy, water, and land resources, particularly in regions with limited data and significant socioeconomic and hydro-climatic change. At the same time, the project will strive to address the key challenges of linking various sectors and solutions acting on different spatial and temporal scales in order to assess synergies and tradeoffs and support holistic decision-making across the water-energy-land nexus. The project will develop a novel approach for assessing integrated strategies for achieving Sustainable Development Goals. This outcome will be crucial to help inform the development of GEF strategies for addressing drivers of environmental degradation through integrated approaches across GEF focal areas as a means to increase GEF's sustainability impact. The initial two regional case studies and the global hotspot assessment provide an ideal starting point for the future application of the framework to additional basins and regions.

A.2. Child Project? If this is a child project under a program, describe how the components contribute to the overall program impact.
N/A

A.3. Stakeholders. Identify key stakeholders and elaborate on how the key stakeholders engagement is incorporated in the preparation and implementation of the project. Do they include civil society organizations (yes ☒ /no ☐)? and indigenous peoples (yes ☐ /no ☒)? [9]

Stakeholder groups will be engaged for several purposes within the project. At the highest level, an expert advisory board will be formed that will provide guidance to ensure that the project is policy relevant and provides useful insights and outputs for the scientific, development, and policy communities. The board will consist of representatives from academia, civil society organizations (e.g., environmental NGOs), and development organizations with expertise in the water-energy-land nexus. At least one representative will come from each of the case study regions. At the start of the project, the expert advisory board will be formed, building upon the experts who attended the consultative meeting. The board will be tasked with providing technical and policy-oriented feedback during project implementation to ensure that

[9] *As per the GEF-6 Corporate Results Framework in the GEF Programming Directions and GEF-6 Gender Core Indicators in the Gender Equality Action Plan, provide information on these specific indicators on stakeholders (including civil society organization and indigenous peoples) and gender.*

the project remains relevant to decision-makers and complementary to other projects related to the nexus and SDGs. The terms of reference (TOR) for the expert advisory board are included in Annex J.

At the case study level, regional stakeholders from government, regional development commissions, industry, NGOs and academia will be engaged in defining and guiding regional nexus assessments. These regional stakeholders will play a substantial role in: (1) defining the regional challenges and potential solutions; (2) providing feedback on interim approaches and results; and (3) translating final insights to policy and investment strategies that can help guide decision-making within their respective organizations. Three stakeholder consultations will be held concurrently with capacity building workshops in each case study region over the 3-year lifetime of the project (i.e., one stakeholder consultation per year in each region). Annex I lists the potential stakeholder organizations in each case study region and initial contact has already been established with key institutions. Furthermore, the participation of women will be encouraged and promoted in all stakeholder consultation activities, including the expert advisory board, regional stakeholder meetings, capacity building workshops, and scientific exchange programs.

A.4. Gender Equality and Women's Empowerment. Elaborate on how gender equality and women's empowerment issues are mainstreamed into the project implementation and monitoring, taking into account the differences, needs, roles and priorities of women and men. In addition, 1) did the project conduct a gender analysis during project preparation (yes ☐ /no☒)?; 2) did the project incorporate a gender responsive project results framework, including sex-disaggregated indicators (yes ☐ /no☒)?; and 3) what is the share of women and men direct beneficiaries (women 50%, men 50%)? [10]

UNIDO recognizes the mutual benefit among gender equality, the empowerment of women, and sustained economic growth, which are key drivers of poverty alleviation and social progress. To maximize the mutual benefits, UNIDO pays especial attention on capturing opportunities to mainstream gender in its projects and programmes in line with its Policy on Gender Equality and the Empowerment of Women, adopted in 2009 and revised in 2015, UNIDO's Gender Equality and Empowerment of Women Strategy 2016-2019, as well as with the Lima Declaration adopted in 2013. To ensure that men and women equally benefit from the project and that gender inequalities in activities and outcomes are minimized, gender dimensions are considered where applicable throughout the entire project implementation.

It is widely acknowledged that gender is an important dimension of developments in demography, energy, food, water, urbanization, technological change and ecosystems security, and in terms of the use and management of resources. For example, women bear the primary responsibility for collecting fuel wood and water in regions with poor access to modern infrastructure, which poses significant opportunity costs given that the time spent gathering fuel and water impedes their opportunities for personal development, such as going to school or starting a small business. Moreover, cooking responsibilities also expose women to greater levels of wood smoke and indoor air pollution with grave consequences for their health. Thus, the solutions and policies that will be explored in the project to improve access to modern, clean, and reliable supply infrastructure will provide insights that highlight significant potential benefits for women by reducing the time required to collect food, water, and energy as well as their exposure to harmful indoor air pollution.

Given the broad global scope and use of relatively coarse datasets that do not include gender disaggregation, the project will not be able to explicitly quantify the gender implications of specific future scenarios. However, every effort will be made to be inclusive and to promote the participation of qualified female candidates, wherever possible and appropriate, in stakeholder consultation activities, capacity building efforts, training programs and the scientific exchange program.

In addition, the following specific measures are incorporated in the project design to include gender dimensions in all project activities under the proposed project:

- Where feasible and appropriate, efforts will be made to promote balanced participation of women and men throughout the project, for instance in training activities, stakeholder consultations, and knowledge

[10] Same as footnote 8 above.

dissemination activities with the aim to secure gender balance, both at managerial and technical levels, as participants as well as facilitators.

- Decision-making processes, where feasible and appropriate, will consider gender dimensions through gender-balanced composition of stakeholder groups and the project advisory board. An UNIDO gender focal point will periodically review and provide guidance on gender dimensions throughout the implementation of the project.
- All monitoring and evaluation activities will include reporting on gender dimensions, e.g. the participation of women in trainings.

The indicated shares of women and men benefiting from the project are suggestive. These shares assume equal access to all governments and researchers around the world, regardless of gender, to the nexus framework and knowledge base that are created during the project.

A.5 Risk. Elaborate on indicated risks, including climate change, potential social and environmental risks that might prevent the project objectives from being achieved, and, if possible, the proposed measures that address these risks at the time of project implementation.(table format acceptable):

Risk	Rating	Assessment / Mitigation
1. **Social/ Economic/ Environmental risks:** Assessment activities themselves will carry negligible risks.	Low	The main component of this project is the development of a systems analysis framework for assessing solutions to nexus challenges. The assessment activities will carry negligible physical, environmental, economic, or social risks. In case study regions, risks will be assessed and informed through stakeholder dialogue and addressed through participation of regional stakeholders in the design of scenarios and the identification of regionally-relevant nexus challenges and solutions.
2. **Technical and coordination risks**: Regions where case studies are conducted may have information and capacity constraints, such as security risks. Moreover, the time spent with regional stakeholders may be too limited to fully understand and incorporate political and historical realities.	Medium	In the first phase of the project, careful selection of case study regions will be done to limit these risks. For instance, regions will be identified with limited accessibility to and availability of important datasets. Yet, the project will work with development partners who are already active within the case study regions, which should mitigate some of this risk.
3. **Institutional risks:** Lack of commitment from stakeholders	Low	The project has attracted sufficient interest from stakeholders. In order to maintain this interest, the project will involve experts in participatory process management to ensure effective management of the stakeholder processes.

A.6. Institutional Arrangement and Coordination. Describe the institutional arrangement for project implementation. Elaborate on the planned coordination with other relevant GEF-financed projects and other initiatives.

UNIDO will be responsible for the overall implementation of the project. IIASA as the executing agency will be responsible for the day-to-day project management. Both organizations will share in the writing of the Joint GEF-IIASA-UNIDO Summary for Policymakers at the conclusion of the project.

The project will build the foundations of knowledge and capacity for integrated solutions across energy, water, food and ecosystems, which are relevant to all GEF focal areas, particularly Climate Change Mitigation, International Waters, Land Degradation, and Sustainable Forest Management. The project will also provide relevant insights to the Sustainable and Resilient Cities Integrated Approach Pilot and the Food Security Integrated Approach Pilot. In addition, the project is relevant to each of the GEF-6 IAPs: Fostering Sustainability and Resilience for Food Security in Sub-Saharan Africa (addressing water, energy, soil and food in an integrated manner); Sustainable Cities (where resource-sensitive cities must accommodate growing water and energy demands and manage water-related risks); and Taking Deforestation out of the Commodity Supply Chain (where the conservation of forests is central to watershed, livelihood, and biodiversity protection, as well as carbon sequestration). It also provides vital input for the implementation of the SDGs by assessing tradeoffs and synergies among options to achieve multiple SDGs and suggesting effective strategies.

UNIDO as a recognized implementing agency of the Global Environment Facility has a comparative advantage in the development and implementation of such global projects focusing on nexus issues. It has in-house expertise to deal with energy, water, resource efficiency, trade and agri-business issues in a holistic manner. With its mandate to promote inclusive and sustainable industrial development, UNIDO has positioned itself as one of the most relevant players in assisting industries to become more productive and competitive. Since this proposal seeks to address multi focal areas and proposes integrated solutions for energy, water, food, and ecosystem security, the UNIDO team will apply its in-house expertise in the fields of Energy, Agri-Business Development, and Environment. In addition, UNIDO has closely collaborated with IIASA for over two decades in the areas of energy, environment and sustainable development. To ensure the success of project implementation, the UNIDO team will coordinate closely with its field offices, investment offices, NCPCs, technical and regional centers, as well as strategic partners and networks such as REEEP and TERI.

Specific examples of UNIDO's experience in the relevant GEF Focal Areas include:

- Climate Change Mitigation: UNIDO has an ample trackrecord of projects implemented under this Focal Area, including those providing access to sustainable energy for productive activities in rural area. Examples include:
    - Renewable Energy Based Electricity Generation for Isolated Mini-Grids in Zambia;
    - Promoting investments in small to medium-scale renewable energy technologies in the electricity sector of Guinea-Bissau;
- International Waters: UNIDO expertise in capacity building and knowledge dissemination is deployed throughout this project to ensure a cost-effective and systematic integration of transboundary water management:
    - Guinea Current Large Marine Ecosystem project Implementation of the Strategic Action Plan for the Gulf of Mexico Large Marine Ecosystem.
    - Transfer of Environmentally Sound Technologies to industries in the Niger basin.

In addition, in partnership with other GEF implementing agencies, UNIDO is contributing to the following Integrated Approach Pilot Programmes:

- IAP Sustainable Cities: Senegal, Malaysia, Cote dÍvoire, China and India.
- IAP Food Security: Fostering Sustainability and Resilience for Food Security in Sub-Saharan Africa.

In addition to synergies with the GEF Focal Areas and IAPs, this project is seen as integral to a number of ongoing global projects and processes and will seek and exploit synergies with the related programs. For example, IIASA and UNIDO work closely with SE4ALL, UN-Energy, UN-Water, the World Water Council, the International Water

Association, the Austrian Development Agency, the US Water Partnership, USAID, and a large number of research institutes and planning agencies through the Water Futures and Solutions Initiative (WFaS).

Moreover, IIASA is co-coordinating the development of the Shared Socio-economic Pathways (SSPs), which are the latest generation of global change scenarios and narratives to be used for long-term climate change impact, adaptation, and mitigation assessments. IIASA has worked with a number of institutes to develop consistent energy and land use storylines for the SSPs and is collaborating within WFaS to develop water storylines and demand projections. The SSPs will form the basis for comparative scenario analysis for the IPCC and will likely be used to define the global change narratives that are used in this project. WFaS is also linked with the DFID-supported REACH project, which builds upon the work of the GWP/OECD Task Force on Water Security and Sustainable Growth to examine water security in a few case study observatories. Although the observatories do not align with the case study regions proposed in this project, we will strive to have a representative of REACH (David Grey) on our expert advisory board so that we can more easily share learning between the projects.

IIASA is also a leading partner of the Inter-Sectoral Impact Model Inter-comparison Project (ISI-MIP), headquartered at the Potsdam Institute for Climate Change Research (PIK), part of Germany's NEXUS platform for research, and is involved in many other model inter-comparison projects in the areas of both agriculture (e.g., AgMIP) and energy (e.g., the Energy Modeling Forum (EMF) and ADVANCE). This project will have many synergies with ISI-MIP, which brings together impact models from multiple sectors to examine biophysical and socioeconomic impacts of climate change. Outputs from ISI-MIP will be used as inputs to our assessment framework (e.g., climate change impacts on water availability) and this project will also contribute to ISI-MIP in that it will apply a multi-sectorial model to explore the implications of climate change for the sustainable management of water, energy, and land resources.

Finally, the project has synergies with two research networks associated with Future Earth: The Sustainable Water Future Programme (SWFP) and the Sustainable Development Solutions Network (SDSN). Given the SWFP's interest in sustainable water management, this project could contribute by identifying the impacts of changes in water availability on the energy and agricultural sectors and by evaluating trade-offs and synergies among sectors. The SDSN is collaborating with IIASA, the Stockhom Resilience Centre, the Earth Institute at Columbia University and the Alpbach-Laxenburg Group on a new initiative entitled The World in 2050. This project intends to develop integrated assessment tools for identifying synergistic solutions for meeting multiple SDGs while remaining within planetary boundaries. Given that the water-energy-land nexus encompasses at least three SDGs, it is expected that this project and the resulting nexus assessment framework will play a central role in The World in 2050. For a synopsis of other related initiatives and projects, see Annex E.

Additional Information not well elaborated at PIF Stage:

A.7 *Benefits.* Describe the socioeconomic benefits to be delivered by the project at the national and local levels. How do these benefits translate in supporting the achievement of global environment benefits (GEF Trust Fund) or adaptation benefits (LDCF/SCCF)?

The project will focus on the water-energy-land nexus in the context of major global challenges such as urbanization, environmental pressure, and equitable and sustainable futures. It will develop a consistent framework for looking at the nexus and identify strategies and approaches for achieving the needed transformational outcomes, as indicated in the GEF 2020 Strategy, through an advanced assessment framework. The water-energy-land nexus is characterized by trade-offs as well as multiple benefits across distinct policy objectives. The latter will support GEF in addressing a range of drivers of environmental degradation in a very cost-effective manner through integrated project and solution planning in its diverse areas of work. In particular, the project will deliver global environmental benefits for the two GEF focal areas of climate change mitigation (CCM) and international waters (IW), but will also yield insights in the areas of land degradation (LD) and sustainable forest management (SFM). The implications for climate change mitigation of competition among sectors for water, energy, and land resources will be explored to better understand how resource constraints in one sector may impact the mitigation potential of another. Mitigation strategies will be

evaluated in the energy sector (e.g., shifting to low-carbon technologies and improving energy efficiency) as well as the agriculture and forestry sectors (e.g., enhancing carbon stocks of various land uses and reducing agricultural emissions through better land management). Strategies to reduce greenhouse gas (GHG) emissions associated with land use change also have implications for sustainable forest management and land degradation (e.g., reducing emissions through afforestation and examining the trade-offs between deforestation and intensification of forest and cropland management). Moreover, the project will provide insight into how forest and agriculture management can sustainably meet growing resource demands while meeting environmental goals, such as REDD+ objectives. Finally, the project will identify opportunities for collaboration among countries in managing international waters and help regional decision-makers to identify mutually-beneficial strategies for optimizing the use of transboundary water resources. In addition, the project will examine different climate change scenarios in an effort to highlight possible adaptation strategies for reducing vulnerability to hydro-climatic change.

IIASA has been on the forefront of methodological advances to tackle the nexus. Its integrated assessment analysis framework has been deployed to investigate potential land-use conflicts between food and energy production, and these tools are used for policy evaluation and decision making in many parts of the world. In addition, IIASA has been a leader in developing tools to quantify the benefits of policies designed to achieve multiple objectives, particularly related to universal energy access, air pollution reduction, energy security enhancement, and climate change stabilization at 2°C over preindustrial levels [10, 11]. A salient conclusion of this research concerns the important synergies to be realized through integrated and harmonized measures across different policy areas. Achieving all of these objectives simultaneously in an integrated and holistic manner reduces global costs by approximately a third compared with the case where they are pursued independently of each other. The issues of development, technology, urbanization, and impacts across sectors and scales are other elements of the new emerging analyses.

Overall, the project will provide integrated modeling tools that provide strategic advice for addressing nexus challenges that are useful to both the GEF itself, as well as to policy and decision makers who benefit from GEF's efforts. As such, the project will assist GEF in strengthening its role as a champion of the Global Commons and in accelerating its role as an innovator at the forefront of transformational change under the new global development agenda of the SDGs.

A.8 *Knowledge Management.* Elaborate on the knowledge management approach for the project, including, if any, plans for the project to learn from other relevant projects and initiatives (e.g. participate in trainings, conferences, stakeholder exchanges, virtual networks, project twinning) and plans for the project to assess and document in a user-friendly form (e.g. lessons learned briefs, engaging websites, guidebooks based on experience) and share these experiences and expertise (e.g. participate in community of practices, organize seminars, trainings and conferences) with relevant stakeholders.

Due to the nature of the project, knowledge management is an integral part of each component. Throughout the project, researchers will follow and learn from other relevant projects and initiatives identified during the scoping study and beyond, network with key institutions, and document best practices and results from case studies for dissemination to wider stakeholder groups. The project will follow a comprehensive knowledge management approach by collating information on exisiting and new data, tools and methodologies, as well as innovative projects and initiatives on nexus issues. This approach will also seek to foster partnerships, networking and collaborations among agencies and organizations working in the field of energy, water, food and ecosystem security, especially with regards to regional knowledge for the two selected case studies (see also section A.1.3). Some key institutions will include SADC, ZAMCOM, IWMI, IUCN, the World Bank, the Asian Development Bank, and the African Development Bank.

Tangible knowledge outputs of the project are planned to be an online lecture series on the nexus, a Summary for Policymakers describing project insights and outcomes, and scientific publications in high-impact journals and white papers. Furthermore, the project will be presented at high level panels and side events and at scientific and policy conferences and meetings. A freely accessible web-database will be made available, providing both transparency and options for further exploitation of project results. One of the key activities with regards to knowledge management also involves capacity building, especially in the regional case studies (see also section A.1.3 – Component 3).

The project will also contribute to knowledge sharing through IW:Learn by participating at IW conferences, contributing to the project website, and drafting two experience notes. In addition, efforts will be undertaken to make

knowledge management activities gender mainstreamed. This includes gender sensitive language in publications, photos showing both women and men (if applicable), and avoiding the presentation of stereotypes. In addition, we will ensure that women and men have equal access to the knowledge created.

B. DESCRIPTION OF THE CONSISTENCY OF THE PROJECT WITH

B.1 *Consistency with National Priorities.* Describe the consistency of the project with national strategies and plans or reports and assessements under relevant conventions such as NAPAs, NAPs, ASGM NAPs, MIAs, NBSAPs, NCs, TNAs, NCSAs, NIPs, PRSPs, NPFE, BURs, etc.:

The project is a global project. The consistency of the project with international priorities under a new global paradigm will be described below. However, wherever feasible, the project will try to build upon and identify linkages with reports and information contained within national/regional/global plans, strategies and assessments under relevant conventions and treaties.

The year 2015 was, in many ways, an important historical turning point with three major events that took place and will no doubt influence the development agenda for decades to come.

- The 3rd International Conference on Financing for Development was held in July in Addis Ababa.
- The 17 Sustainable Development Goals (SDGs) were adopted by the UN General Assembly in September.
- The COP 21 in December 2015 brought about a new climate deal, the Paris Climate Agreement, which provides an ambitious roadmap and in many ways is also a turning point for humanity.

Together, these three international processes provide a universal political and societal agenda for fundamental change and a transformation toward sustainable development. They are testimony that joint action is ever more crucial, and that the international community is – after much dithering – taking action. There exists unprecedented awareness and agreement that change is overdue across the world and within different communities. Equitable and sustainable development is the new development agenda.

As the GEF has put it rightly in its report on GEF's work and the SDGs, the *"SDGs represent an integrated, holistic vision for development at the global, national, local and individual levels"* and thus provide the best framework and mandate for action in the context of this new social contract and development agenda for all stakeholders: governments, the private sector, and citizens. Yet, how we implement them and our ability to enhance the positive synergies while mitigating the trade-offs will be the key factor for success or failure. Policy- and decision-makers will face many challenges and thus, there is ever more need for tools and frameworks of analysis that could support and assist them in designing more integrated approaches. Bolder and more imaginative solutions are needed to bring about the transformational change required to overcome current and future challenges.

To achieve innovative, inclusive, and scalable transformative change requires analytical approaches that are geared towards integrated systems analysis. This is reflected in many modeling frameworks from earth-systems to integrated assessment modeling approaches. They are usually accompanied with some normative goals either in the form of narratives and/or quantitative targets. These complementary modeling approaches have been the main method of analyzing future climate change mitigation options and human adaptation strategies. Recently, these methodologies have also been moving away from the dichotomy of *"climate-only"* or *"development-only"* approaches to include various nexus issues, from transboundary air pollution to water and potential land-use conflicts. The separation between development and the environment has been overturned and they are now accepted as being co-dependent policy areas.

For instance, the integrated management of energy, water and land resources presents both challenges and opportunities for simultaneously addressing rising global GHG emissions, unsustainable agricultural production, loss of biodiversity and transboundary water dilemmas. The challenge to identify integrated solutions for the nexus will have to be aligned with the new global paradigm under the SDGs. The partnership is distinct from other nexus-related research at IIASA or technical cooperation projects at UNIDO, but will greatly benefit from exchange with other research and initiatives at IIASA or UNIDO and beyond, such as The World in 2050. Partnering with the GEF in supporting the vision embodied in the SDGs provides both UNIDO and IIASA with a unique opportunity.

This project reflects all of the five strategic priorities of the GEF 2020 strategy, which are (a) address the drivers of environmental degradation; (b) deliver integrated solutions; (c) enhance resilience and adaptation; (d) ensure complementarity and synergies, especially in climate finance; and (e) focus on choosing the right influencing model, with a special emphasis on (b) and (e). For instance, jointly tackling energy, water, land and food challenges in an intergrated approach is closely consistent with the GEF's strategic priority of delivering integrated solutions. Additionally, the multiple focal areas of this project draw from lessons learned by past UNIDO, IIASA and GEF projects and are consistent with the GEF's delivery of its vision in choosing the right influencing models. Choosing the right influencing models increases the catalytic effects of GEF interventions and the ability for UNIDO and IIASA in providing the foundation for developing integrated approaches to identify evidence based policy and investment strategies for the water, energy and land nexus. The two regional case studies will be informed by relevant national and regional sectorial policies and development strategies. Understanding existing and planned regional strategies and incorporating them into the assessment framework and scenarios will be a key topic of discussion during the early stakeholder meetings.

C. DESCRIBE THE BUDGETED M &E PLAN:

Formal monitoring and evaluation (M&E) of the project will follow the principles, criteria and minimum requirements set out in the GEF Monitoring and Evaluation policy in its current version and the respective guidelines and procedures issued by the GEF Evaluation Office and/or the GEF Secretariat. At the same time, M&E will comply with the rules and regulations governing the M&E of UNIDO technical cooperation projects, in particular the UNIDO Evaluation Policy and the Guidelines for Technical Cooperation, both in their respective current versions. In addition, all monitoring and evaluation documents, such as the monitoring plan, progress reports, and final evaluation report will include gender dimensions wherever appropriate.

According to the M&E policy of the GEF and UNIDO, a final evaluation will be conducted. All project partners and contractors are obliged to (i) make available studies, reports and other documentation related to the project; and (ii) facilitate interviews with the staff and key stakeholders involved in the project activities.

A comprehensive M&E framework will be used to assess the project's impact on establishing a long-term systems approach to developing, refining and applying the tools and skills essential for identifying integrated approaches to the management of energy, water, and land resources in selected regions in line with the GEF 2020 strategy. The overall objective of the monitoring and evaluation process is to ensure successful and quality implementation of the project by:

i) Tracking and reviewing the execution of project activities and actual accomplishments;

ii) Monitoring the project processes so that the project team can take early corrective action if performance deviates significantly from original plans;

iii) Adjusting and updating project strategy and the implementation plan to reflect possible changes on the ground, results achieved and corrective actions taken; and

iv) Ensuring linkages and harmonisation of project activities with that of other related projects at national, regional and global levels.

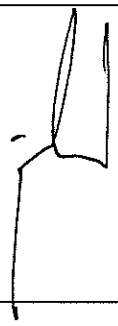
Tracking of project milestones and accomplishments will be conducted by IIASA and reported in brief semi-annual progress reports (see Annex K for workplan and milestones). These reports will be available for official use and submitted by IIASA to UNIDO, which will share these reports with the GEF. The UNIDO project manager will be responsible for overseeing and tracking overall project milestones and progress towards the attainment of the agreed project outputs. IIASA will be responsible for providing brief progress reports on a semi-annual basis.

The Project will undergo an independent Final Evaluation (FEV) six months after the closure of project activities. The FEV will focus on the delivery of the project's results as initially planned (and as corrected if any such correction took place during the project). It will examine the project's performance with respect to the planning and adaptive management requirements of both UNIDO and GEF (The GEF Monitoring and Evaluation Policy 2010) and it will determine progress made toward the achievement of the project's outputs and outcomes. The TOR for this evaluation will be prepared by the UNIDO Project Manager based on guidance from the UNIDO Office for Independent

PART III: CERTIFICATION BY GEF PARTNER AGENCY(IES)

A. GEF Agency(ies) certification

This request has been prepared in accordance with GEF policies[11] and procedures and meets the GEF criteria for CEO endorsement under GEF-6.

Agency Coordinator, Agency Name	Signature	Date (MM/dd/yyyy)	Project Contact Person	Telephone	Email Address
Philippe R. Scholtès, Managing Director, Programme Development and Technical Cooperation (PTC), UNIDO GEF Focal Point		02/24/2016	Yuko Nagata, Industrial Development Officer, UNIDO Y. N.	3857	y.nagata@unido.org

[11] GEF policies encompass all managed trust funds, namely: GEFTF, LDCF, and SCCF

Evaluation (ODG/EVA). The FEV will also provide recommendations for follow-up activities and requires a management response.

The following table provides the tentative budget for the M&E, which has been included in Component 4 of the project. UNIDO as the Implementing Agency will involve the executing partner and project stakeholders in order to ensure the use of the evaluation results for further planning and implementation.

Type of M&E activity	**Engaged Parties**	**Budget US$** *Excluding project team Staff time*	**Time frame**
Measurement of Means of Verification for Project Progress and Performance	UNIDO, M&E expert	10,000	Start verification of projects annually and at the project end
Semi-Annual project progress reports	IIASA, UNIDO	0	Every six months
Project Terminal Report	UNIDO, PMU	10,000	At end of project implementation
Project Final Evaluation	Independent evaluator, PMU, UNIDO PM, and UNIDO Evaluation Group	35,000	Within 6 months of completion of project implementation
TOTAL indicative COST		**USD 55,000**	

ANNEX A: PROJECT RESULTS FRAMEWORK (either copy and paste here the framework from the Agency document, or provide reference to the page in the project document where the framework could be found).

Project Objective: The project will establish a long-term systems approach to developing, refining and applying the tools and skills essential for identifying integrated approaches to energy, water, food, and eco-system security in selected regions in line with the GEF 2020 strategy.				
	Indicators	**Targets**	**Means of Verification**	**Assumptions**
Component 1. Development of a systems analysis framework for assessing solutions to nexus challenges				
Outcome 1.1. Future trends and drivers systematically explored				
Output 1.1.1 Stakeholder-informed regional scenario design for exploring nexus challenges, drivers and solutions	• Number of stakeholder-informed regional scenarios • Number of stakeholder consultations	• At least two stakeholder-informed regional scenarios per case study region • One stakeholder consultation in each study region	• Document summarizing the stakeholder-informed scenarios • Agenda, minutes, and presentations from stakeholder consultation posted to project website	• Good attendance at stakeholder consultations and interest in the development of regional scenarios; data availability and access to implement the scenarios • Interest in regional stakeholder meetings to discuss scenario design and nexus challenges
Outcome 1.2 Method and tool developed				
Output 1.2.1 Nexus modeling tool developed and presented with preliminary results: Tool will illuminate trade-offs among sectors and explore solutions for achieving multiple development and environmental objectives	• Nexus modeling tool developed (yes/no) • Number of presentations of nexus modeling tool and preliminary results	• A completed nexus modeling tool • Two presentations of the nexus modeling tool and preliminary assumptions and results (one in each region)	• Preliminary results based on model runs presented at stakeholder meetings (ppt) • Minutes from regional stakeholder meetings and demonstration (ppt) available on project website	• Model development is not delayed by unforeseen technical challenges; required data are available and accessible • Model development is not delayed by unforeseen technical challenges; required data are available and accessible
Component 2. Regional nexus solutions in the context of global developments				
Outcome 2.1 Regional assessment of nexus challenges and solutions : Understanding of sectorial trade-offs, synergies, and solutions for meeting nexus challenges improved among regional stakeholders				
Output 2.1.1 Tangible strategies for improving regional decision-making across sectors identified for two selected regions	Identification and documentation of key regional insights (yes/no)	Joint GEF-IIASA-UNIDO Summary for Policymakers (SPM)	SPM available on project website	Regional model development is successful and yields clear insights regarding trade-offs, synergies, and solutions for regional nexus challenges

Outcome 2.2 Global nexus hotspots and transformation pathways: multi-sectorial vulnerability hotspots under different socioeconomic and hydro-climatic scenarios identified				
Output 2.2.1 Global assessment of multi-sectorial hotspots and transformation pathways	• Global assessment of multi-sectorial hotspots and transformation pathways (yes/no) • Identification and documentation of knowledge and data gaps (yes/no)	• Documentation and communication of key insights from global assessment in publications and SPM • Inclusion of knowledge and data gaps in SPM	• Scientific publications and white papers completed; SPM available on project website • SPM available on project website	• Global model development is successful and yields clear insights into global nexus hotspots and sustainable transformation pathways • Global and regional model development is successful and yields insights regarding knowledge and data gaps
Component 3. Capacity Building and Knowledge Management: Building the foundation for a knowledge and capacity network on nexus decision support				
Outcome 3.1 A foundation of a regional and global knowledge and capacity network established				
Output 3.1.1 Establishment of connections and interactions among stakeholders from a wide array of institutions and sectors, including formation of an advisory board	• Number of stakeholder meetings per case study region • Advisory Board formed (yes/no)	• Three total stakeholder meetings in each case study region (includes consultation on study design) (~one per year) • Form an advisory board	• Minutes and participant lists from stakeholder meetings • List of Advisory Board members and minutes from advisory board consultations	Interest in regional stakeholder meetings from a wide array of institutions and sectors; willingness of stakeholders to interact; progress on project to enable stakeholder feedback
Outcome 3.2 Capacity building: Regional capacity for nexus assessment and solution identification improved				
Output 3.2.1 Foundation of a regional knowledge and capacity network for systems analysis and nexus decision support established through:				
3.2.1.a Two capacity building workshops per case study region, held concurrently with stakeholder meetings	Number of capacity building workshops	Two capacity building workshops per case study region	Minutes and presentations from capacity building workshops posted on project website	Interest and engagement from regional scientists and practitioners
3.2.1.b Exchange of scientists with partner academic institutions	Number of scientists exchanged	At least one scientist per case study region	Report by exchange scientist on their research and contribution to the project	Interest from regional and IIASA scientists; sufficient quality of scientists
Outcome 3.3 Knowledge dissemination: Infrastructure established to disseminate findings of the project				
Output 3.3.1 Dissemination of project outcomes through publications, events, and data sharing through:				

3.3.1.a Participation in high-level panels, conferences, and events	Number of presentations and events at high level events	Presentations at a minimum of three high level events per year	Links to event agendas and/or presentations posted on project website	External interest in project, model, and insights
3.3.1.b Online database for sharing of scenario results	Development of online database (yes/no)	Online database accessible and populated with scenario results	Link to online database on project website	Successful implementation of model and generation of scenario results
3.3.1.c Online lecture series on nexus topics	Development of an online lecture series (yes/no)	Lecture series available online	Link to online lecture series on project website	Lectures given by project scientists and partners videotaped and suitable as an online lecture
3.3.1.d Two experience notes shared via IW:Learn	Number of experience notes shared	One experience note per case study completed	Link to experience notes on IW:Learn website	Material available for drafting of experience notes
3.3.1.e Joint GEF-IIASA-UNIDO Summary for policymakers describing project insights and outcomes	Development of a Joint GEF-IIASA-UNIDO Summary for Policymakers (SPM) (yes/no)	Joint GEF-IIASA-UNIDO Summary for Policymakers (SPM)	SPM available on project website	All components of model development are successful and yield valuable insights for inclusion in the SPM
3.3.1.f Scientific publications in high-impact journals and white papers	Number of publications	At least eight scientific publications and/or white papers submitted over the life of the project	Links to scientific publications and white papers on project website	All components of model development are successful and yield insights worthy of scientific publication

ANNEX B: RESPONSES TO PROJECT REVIEWS (from GEF Secretariat and GEF Agencies, and Responses to Comments from Council at work program inclusion and the Convention Secretariat and STAP at PIF).

N/A

ANNEX C: STATUS OF IMPLEMENTATION OF PROJECT PREPARATION ACTIVITIES AND THE USE OF FUNDS[12]

A. Provide detailed funding amount of the PPG activities financing status in the table below:

PPG Grant Approved at PIF: **100,000 USD**			
Project Preparation Activities Implemented	*GEF/LDCF/SCCF Amount ($)*		
	Budgeted Amount	*Amount Spent Todate*	*Amount Committed*
Contractual Arrangement for conducting scoping study and preparation of the CEO Endorsement document	85,000	80,001.20	4998.80
International expert to assist in the preparation of the CEO Endorsement document	4,900	0	4,900.00
Administrative assistance	5,100.00	0	5,100.00
Local travel	5,100.00	0	5,100.00
Communication and other direct costs	2,000.00	158.67	1,841.33
Total	100,000	80,159.87	19,840.13

ANNEX D: CALENDAR OF EXPECTED REFLOWS (if non-grant instrument is used)

Provide a calendar of expected reflows to the GEF/LDCF/SCCF Trust Funds or to your Agency (and/or revolving fund that will be set up) N/A

SEPARATE ATTACHMENTS :

ANNEX E: SCOPING STUDY

ANNEX F: EXPERT MEETING DOCUMENTATION (LIST OF PARTICIPANTS, AGENDA)

ANNEX G: ANNOTATED BIBLIOGRAPHY

ANNEX H: FACT SHEETS ON EXEMPLARY REGIONS

ANNEX I: LIST OF POTENTIAL STAKEHOLDER ORGANIZATIONS

ANNEX J: EXPERT ADVISORY BOARD TERMS OF REFERENCE

ANNEX K: WORK PLAN

ANNEX L: GEF GRANT PROJECT BUDGET

[12] If at CEO Endorsement, the PPG activities have not been completed and there is a balance of unspent fund, Agencies can continue to undertake the activities up to one year of project start. No later than one year from start of project implementation, Agencies should report this table to the GEF Secretariat on the completion of PPG activities and the amount spent for the activities. Agencies should also report closing of PPG to Trustee in its Quarterly Report.

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