

中央研究院 111 年度「永續科學研究計畫」

計畫徵求說明

壹、目標：

人類社會的永續力(the Sustainability of Human Society)是目前各界極為關心的議題。其包含的範圍非常廣泛，對國家社會的發展亦具深遠的影響。而其中許多待解決的問題，需要透過自然科學與人文社會科學進行跨域整合，尋求最佳實質解決問題的方法，並且找到實現的合適方式。本計畫為因應全球永續發展趨勢，並配合國家永續發展政策而設立之任務導向研究計畫。計畫考量重點在於研究完成後，應有明確的研究成果實際受惠者(the stakeholders)，且期許對全球永續發展、我國永續政策推動，具有實質的應用價值並能與國際接軌，計畫因此強調須於近程、中程皆有明確之里程碑。

貳、計畫類型：

為加強跨域合作成果之具體表現，本計畫徵求型態以整合型或單一整合型計畫提出申請。研究計畫以3年為期，整合型計畫每件計畫至少包含2件分支計畫，最多以不超過5件為原則。計畫總主持人負責該項整合型計畫行政及學術層面之領導暨協調。本永續科學研究計畫之徵求須著重於：

- 一、計畫應包含不同領域研究學者參與，且應進行整合以期成果相輔相成。
- 二、整合型計畫申請團隊各分支計畫間及其與總計畫之間，應具備共同的整體性主軸與整合性議題，使計畫具備「整合型計畫」之實質意義。
- 三、為促成跨領域合作與可實際應用的研究成果展現，計畫總主持人具領導、整合各分支研究之能力。

參、計畫申請作業

一、申請人資格

- (一)計畫總主持人需為本院專任助研究員(含)以上之專任人員；本院合聘之研究人員，得擔任計畫總主持人，但須有本院專任研究人員擔任共同總主持人。
- (二)分支計畫主持人其現職需相當於助研究員(含)以上人員。
- (三)為促進本院與國內外各大學校院及研究機構之永續科學交流合作研究，院外學術、研究機構專任人員得受邀擔任分支計畫主持人(或共同主持人)。然各研究計畫之分支計畫主持人須至少三分之一為本院研究人員。[作業要點 2]

二、計畫審查與核定

- (一)永續計畫審查作業分為：初、複審及預算決審三階段。依據年度徵求之主題內容，院方委請永續科學中心諮詢委員及相關專家學者共同組成年度審查委員會，經委員會逐案推薦複審委員，再徵詢複審委員後送請國內、外相關專家學者書面初審，複審委員彙集初審意見後得視需要送申請人回覆，之後予以計畫書面綜評。年度審查委員會再行召開專業複審會議，完成各主題申請案推薦建議。本院學術諮詢總會再依審查建議於永續科學研究計畫決審會議中議決各申請案。[作業要點 6]
- (二)經核定通過之計畫，所有主持人及共同主持人皆須簽署「中央研究院永續科學研究計畫執行同意書」。相關執行及管考規定應依該同意書內容辦理。[作業要點 7]

三、111 年度「永續科學研究計畫」申請推動時程

- 110 年 4 月 26 日 計畫徵求說明會
- 110 年 5 月初 公告永續計畫徵求
- 110 年 6 月 25 日 計畫申請書截止收件
- 110 年 7~10 月 計畫申請書審查(含必要時之申請人答辯)
- 110 年 11 月初 計畫核定

肆、111 年推動重點：

過去一年多以來，全球人類活動與社會運作因新冠肺炎疫情已明顯改變，在疫苗逐漸普及化、生活即將重啟的同時，許多舊有模式可能已無法恢復，例如：頻繁的跨國商務及旅遊。此外，今年開始的十年是許多全球永續議題開展的關鍵時期（2021-2030 年間），例如：減災、減碳、生物多樣性、海洋等永續發展目標。因此，在後疫情時代的現在，人類身處在一個朝向永續發展轉型的契機，科學研究者也應正面面對這些挑戰，扮演永續轉型的重要推手。

中央研究院推動「以解決問題為導向、跨領域跨學科、利害關係人參與」的整合型永續科學研究計畫，以橋接科研成果與社會需求，並期許計畫成果能付諸實務或實際行動中。另外，為發展本院南部院區的研究能量，111 年度「永續科學研究計畫」將優先考量以臺灣南部地區或其社經特點作為研究區域或標的的計畫，四項徵求主題分別為：

主題一：全球氣候變遷下社會與經濟轉型研究

目前全世界許多國家皆正面迎向 2050 Net Zero（淨零排放）的挑戰，意即 2050 年時，全球年二氧化碳排放量將至少等於或小於二氧化碳吸收量，以控制全球溫度在本世紀末前增加在 1.5°C 之內。這個目標代表著長久以來以化石燃料為主要能源的褐色經濟與消費性社會需要進行全面性、根本性的變革，一方面經濟發展必須與碳排放量脫鉤，另一方面能源與資源消耗量也需與生產力與產值脫鉤，社會與經濟方能成功轉型。

因此，本主題目的即在進行社會、治理體制、產業、經濟等面向的轉型研究，除了研提探討未來可能轉型的方向之外，更可探討轉型的促進或阻礙因素。

本項主題優先考量下列子題：

- **推動臺灣 2050 淨零排放目標之體系法規研究**：目前臺灣在邁向 2050 Net Zero 目標時，整體社會必須進行許多改革及技術研發，這些皆需要許多政府制度與法規的配套，也需要進行評估與研究，研究課題可包括（但不限於）：臺灣自然環境與社會經濟環境的長期變遷研究、推動淨零排放目標與技術之相關氣候與能源法規政策、中央與地方在氣候與低碳治理體系之跨部會跨層級整合、綠色金融與投資如何加速轉型、相關稅費徵收之釐清與整合、受影響產業與脆弱族群之公正轉型等等。
- **臺灣產業與經濟轉型之問題分析與解決方案**：臺灣早期的經濟發展是以農業為主，在產業升級經濟成長的過程中，我們開始仰賴化石燃料，但是，發展至現代，不僅高排碳、高耗能的產業未能帶來更大經濟效益，以農業為生的族群與社區也逐漸受到衝擊。因此，此主題亟待我國的學者研究產業與經濟轉型究竟面臨哪些問題，又有哪些可行的解決方案？研究課題包括（但不限於）：RE100 全面佈建我國企業之可

能性與供應鏈影響、我國國營事業之轉型問題、高排碳產業之未來轉型（傳統發電、鋼鐵、水泥、石化）、新興產業之發展（光能、風能、生質能、碳再利用、電動車、循環經濟）、農村社會之產業再生與轉型（農業生技、城鄉再造）等等。

主題二：環境劣化下的社區健康議題探討

臺灣森林占總國土面積約六成，其餘土地雖然較適合人類活動，但目前台灣大多數的人口集中居住在都市化地區，超過六成的人口居住在約一成的都市化地區，高人口密度及高密度工商業發展的情形也使得我們的居住環境品質不斷惡化。近年來環保相關法規逐漸嚴格、污染控制技術逐漸成熟，許多環境公害問題看似已逐漸改善，但是卻有許多新衍生的環境問題，例如：工業區旁社區空氣及臭味污染、河川及地下水污染、廢棄物非法傾倒農地、噪音及光害、電磁波、環境賀爾蒙、綠地缺乏等等，這些環境問題亦可能影響居民的生理及心理健康。

因此，本主題目的即在針對不同的環境問題，探討社區居民的健康議題，牽涉層面包括：污染的科學證據、指標與資訊、社區健康衝擊與風險因子評估、健康風險分布是否公平正義、社區管理與組織韌性、政府治理與個人健康預防管理問題等等。

本項主題優先考量下列子題：

- **臺灣環境劣化熱點區域之社區健康議題探討與解方**：針對臺灣環境惡化之熱點區域（各都會區、工業區、中南部問題等），界定環境問題與社區健康衝擊，進行科學評估與人文社會面向之探討，並研提可能的解方。
- **特定環境問題的健康衝擊評估與因應**：針對特定環境問題，進行其影響民眾生理或心理健康之評估，並研提可能的預防、控制或調適因應策略。

主題三：因應全球暖化之減碳策略與科技

為達到上述 Net Zero 的目標，各排放部門無不開始研擬朝向淨零排放目標的策略，例如：能源部門推動無碳電力；交通運輸部門推動運具電氣化；製造部門推動高能源效率、高能源生產力製程等等。即便如此，目前社會仍存在有難以減少的排放量，因此，「減碳策略及科技」便是當前最關鍵、最亟需投入研發的課題。

因此，本主題目的即在針對減碳的目標，研發環境友善、可大規模實踐、低成本、穩定性高、能源轉換效率高的關鍵減碳技術，除此之外，更可嘗試發展應用原型（prototype），並研提創新的減碳策略、營運模式、實踐方案等。

本項主題優先考量下列子題：

- **工業製程中關鍵減碳技術**：工業部門為我國溫室氣體排放量的主要貢獻部門之一，為達到淨零排放的目標，工業部門須由幾項製程系統著手技術及替代材料研發，例如：馬達、空調、空壓、汽電鍋爐、鍋爐、窯爐、照明等系統。一方面提高能源效率及能源生產力；另一方面研發關鍵減碳技術，降低溫室氣體排放，例如：裂解化石燃料氣化為氫氣技術、含氟氣體的替代材料或控制削減技術。
- **創新減碳策略與實踐方案**：除了新興科技研發之外，更可推動許多創新的減碳策略，

這些策略可能包含(但不限於):管理及營運模式的創新(Management and Business Model),如公民電廠的投資模式;低碳社區、生物炭/生質能社會企業等實踐方案等等。

主題四：水資源與生態系變遷和保育研究

臺灣為位於亞熱帶、西太平洋颱風路徑上的高山海島國家,擁有豐富且多元的水資源及生態資源,但是,受到氣候變遷(氣溫與海溫升高、降雨極端化、海洋酸化等),以及環境變遷(土地使用變遷、社會經濟影響、環境污染等)的影響,臺灣的水資源及生態系統受到極大的衝擊。近年來,我國常有水資源供需不平衡導致缺水的問題,更有許多生態系統遭到破壞,因此,本主題目的在探討水資源及生態系面對未來氣候與環境變遷的衝擊與因應。

本主題優先考量下列子題：

- **氣候與環境變遷下臺灣未來水資源研究與整合式治理：**臺灣水資源議題十分複雜，牽涉許多不同層面的問題，包含供給面（降雨季節與區域分布不均、河川水質受污染、地下水超抽導致地層下陷、海水淡化及再生水技術成本尚高）、需求面（農業栽種方式用水量大、工業區用水量大、民生節水瓶頸）、管理面（漏水、調度、水價、水庫、土地利用）等課題，當供需失衡再加上管理手段不足時，便導致缺水的問題，這也代表水資源問題並非單一領域、單一部會可解決的問題，需要系統性的整合治理，研究課題可能包含(但不限於):國家層級水資源跨部會治理(農委會之農業與糧食政策、經濟部與科技部之工業區發展政策、水利署之水資源規劃與管理政策等)、未來水資源創新技術與策略、水資源對臺灣農村社會關係的探討、農田對氣候調節、水循環、水資源需求之系統性研究等等。
- **氣候與環境變遷之生態衝擊與保育研究：**針對臺灣陸域生態系(高山冷溫帶針葉林、熱帶闊葉林、平地草原等)、水域生態系(溪流、湖泊、潮間帶及沼澤溼地、珊瑚礁及近海海域等)進行衝擊研究，包含棲地環境、動植物、微生物等，並提出可能的調適、保育或復育選項。

2022 Sustainability Science Research Program, Academia Sinica Proposal Submission Instructions

I. Objective

The sustainability of human society is one of the most challenging issues that humanity facing today. It involves a wide range of fields and subjects that have major impacts on our society, and is recognized that only through cross-disciplinary research integrating the relevant physical sciences and humanity / social sciences can we hope to develop practical solutions and the right solutions for problems to realize sustainable development. The Sustainability Science Research Program (the SSRP), Academia Sinica (AS) calls for proposals to meet the challenge mentioned above and to fit in concert with global and national sustainable development policy via mission-oriented research. Furthermore, the proposals should define stakeholders, focus on applicability, connect to the international community, and identify the short-term as well as mid-term milestones.

II. Research Project Types

To strengthen cross-disciplinary cooperation and practical applications of research results, integrated research projects (ITRP) / Collaborative Research Projects (CRP) are solicited. Each ITRP is allowed to have two to five subprojects. The term of each project is constrained to three years. The project director shall be responsible for coordinating all administrative and academic matters of the subprojects. The solicitation of the sustainability science research project emphasizes the following:

1. The project shall include researchers in different disciplines, and the research results shall be complementary to one another.
2. For the ITRP, all subprojects shall be “integrated” into the main theme of the integrated research project.
3. The project director shall be capable to lead and coordinate the subprojects, to ensure cross-disciplinary cooperation, and practically apply the research results.

III. Application

1. Eligibility

- (1) (Main) Project Directors must be full-time AS Assistant Research Fellows (equivalent or above). AS jointly-appointed research staff may serve as Main Project Directors, but only if a full-time AS research staff member is Co-Director for the Main Project.
- (2) Subproject Directors should be Assistant Research Fellows (equivalent or above).
- (3) In order to promote sustainable science exchange and collaboration between AS and domestic/foreign universities, colleges and research institutions, full-time employees of academic or research institutions outside the AS may be invited to serve as Subproject Directors (or Co-Directors). At least one third of Subproject Directors within a project must be AS research staff.

2. Proposals Review and Approval

- (1) SSRP proposals are reviewed in three stages: first round review, panel review, and final budget review.

First Round Review:

- i. Based on the selected topics for that year, AS will appoint Center for Sustainable Science (CSS) advisory committee members as well as other experts and scholars to form the Annual Review Committee.
- ii. Annual Review Committee members will recommend panel reviewers for each proposal.
- iii. After consultations with the referees, proposals will be submitted to relevant domestic and foreign experts and scholars for written peer review.
- iv. The panel reviewers will summarize the written peer review results and if necessary send them to the applicants for rebuttal.

Panel Review:

- i. The panel reviewers will conduct a final written peer review.
- ii. The Annual Review Committee will convene an Expert Panel Review Meeting in order to recommend proposals for each topic.

Final Budget Review:

The Central Academic Advisory Committee (CAAC) will approve proposals for each topic during the SSRP Project Resolution Meeting according to written peer review results and referee review recommendations.

- (2) A Project Execution Agreement (Academia Sinica Sustainability Science Research Program Project Execution Agreement) should be submitted prior to commencing a project. Project execution and evaluation should be processed in accordance with the Agreement.

3. Schedule of the 2022 Program

- April 26, 2021 Information Session
- Early May, 2021 Calls for Proposals
- June 25, 2021 Proposal Submission Deadline
- July-Oct. 2021 First Round and Panel Review (Including Applicants' Rebuttal), Final Budget Review
- Early Nov. 2021 Announcement of Awarded Projects and Budgets

IV. 2022 Research Focus Areas

Over the past year, human activities and social operations worldwide have significantly changed due to the COVID-19 pandemic. While vaccines are gradually becoming popular and life is on its way to restarting, some previous habits—such as frequent transnational business and tourism—may not be restored. In addition, this year is the beginning of a critical decade (2021–2030) for developments related to several global sustainability issues; these include disaster risk reduction, carbon mitigation, biodiversity, and the ocean conservation. Therefore, in this post-epidemic era, humans are at the point at which transformations toward sustainable development can occur. Research scientists should take up these challenges and act as catalysts toward sustainable transformation.

Academia Sinica promotes an integrated Sustainability Science Research Program that is “problem-solving-oriented, trans-disciplinary, and encourages stakeholder participation.” The Program aims to connect the results of scientific research to social needs, and it is hoped that its results can be put into practice or actual action. To develop the research capacity of the southern campus of the Academia Sinica, the “2022 Sustainability Science Research Program” will prioritize projects with southern Taiwan or its socioeconomic characteristics as the research area or target. The four main themes are as follows.

Theme 1: Societal and Economic Transformations under Global Climate Change

At present, many nations worldwide are facing the 2050 Net Zero (net zero emissions) challenge. Under this scenario, global annual carbon dioxide emissions should be less than or equal to (at least) the rate of the carbon dioxide absorption by 2050, to control the global temperature increase to within 1.5 °C before the end of this century. This goal represents the need for comprehensive and fundamental changes in the brown economy and consumer society, which have long used fossil fuels as their main source of energy. On the one hand, economic development must be decoupled from carbon emissions; on the other, energy and resource consumption must also be decoupled from productivity and output value, so that societies and economies can successfully transition.

Therefore, the purpose of this theme is research on transforming societies, governance systems, industries, and economies. In addition to researching and exploring the direction of possible future transformation, work on this theme can also explore what promotes or hinders such transformations. Priority will be given, in 2022, to the following:

- **Research on Institutions and Regulations to Promote the 2050 Net Zero Target in Taiwan:** Taiwan is moving toward the 2050 Net Zero goal. As a result, society must, overall, carry out many reforms and conduct technological research and development. All of this requires the support of government institutions and regulations, which in turn require further assessment and research. Research topics may include (but are not limited to) long-term changes in Taiwan’s natural and socioeconomic environments, climate and energy

regulations and policies related to the promotion of net-zero targets and technologies, interagency multilateral integration of climate and low-carbon governance systems between the central and local governments, accelerating the transition via green finance and investment, clarifying and integrating carbon taxes and fees, and transitioning related industries and vulnerable groups.

- **Analyses and Solutions to Problems with Taiwan's Industrial and Economic Transformation:** Taiwan's early economic development was based on agriculture; however, as industry was upgraded and the economy began to grow, a reliance on fossil fuels began. Yet in terms of modern development, not only have industries with high carbon emissions and energy consumption failed to produce greater economic benefits, but groups and communities that rely on agriculture for their livelihoods are also gradually impacted. Therefore, this topic urgently needs Taiwanese scholars to study the problems and feasible solutions of industrial and economic transformation. Research topics include (but are not limited to) the possibility of fully deploying RE100 in Taiwanese industries and its impact on supply chains, the transformation of state-owned enterprises, the future transformation of industries that generate high carbon emissions (e.g., traditional power generation, steel, cement, petrochemicals), the development of emerging industries (e.g., solar and wind energy, bioenergy, carbon capture and utilization, electric vehicles, and circular economies), and industrial regeneration and the transformation of rural society (e.g., agricultural biotechnology, rural revitalization).

Theme 2: Community Health Impact under Environmental Deterioration

Taiwan's forests account for approximately 60% of its total land area. Although the rest of the land is suitable for human activity, most of the population of Taiwan currently resides in urban areas, with more than 60% of the population living in approximately 10% of the urban areas. The high population density and industrial development have also deteriorated the quality of the living environment. In recent years, laws and regulations related to environmental protection have gradually become stricter, and simultaneously, pollution control technology has gradually matured. Many environmental pollution problems seem to have gradually improved, but they are replaced by many new environmental crises. The latter include air and odor pollution in communities near industrial areas, river and groundwater pollution, illegal dumping of waste on agricultural land, noise and light pollution, electromagnetic waves, environmental hormones, and lack of green space. These environmental problems may also affect the physical and mental health of urban residents.

Therefore, the main purpose of this theme is to study health-related responses of community residents to different environmental issues. The topics include scientific indicators and information on pollution, impacts on community health and assessments of risk factors, issues related to the justice of health risk distribution, community management and organizational resilience, governance, and issues related to personal health management. Priority will be given, in 2022, to the following:

- **Exploration of and Solutions for the Community Health Issues in Hotspots of Environmental Degradation in Taiwan:** Work proposing to focus on the hotspots of environmental degradation in Taiwan (e.g., in metropolitan and industrial areas, central and southern Taiwan) must define the environmental problems and community health impacts, conduct scientific assessments and discuss the human and social aspects related to the same, and develop possible solutions for them.
- **Health Impact Assessment and Responses to Specific Environmental Issues:** Work proposing to focus on specific environmental problems must conduct assessments of the impact of these on human physical or mental health and develop possible precautions against or control or adaptation strategies for the same.

Theme 3: Decarbonization Strategies and Technologies in Response to Global Warming

To achieve the Net Zero target, all carbon-emitting sectors have begun to develop mitigation strategies. For example, the energy sector promotes carbon-free power, the transportation sector promotes the electrification of motor vehicles, and the manufacturing sector promotes high energy efficiency and energy productivity. Despite this, reducing global emissions is still difficult. Therefore, “carbon reduction strategies and technologies” are the critical and urgent topics for research and development.

The purpose of this theme is to develop key decarbonization technologies that are environmentally friendly, large-scale, low-cost, stable, and highly efficient at energy conversion. In addition, proposals for work in this area can attempt to develop prototypes and suggest innovative carbon reduction strategies, business models, and practical plans. Priority will be given, in 2022, to the following:

- **Key Decarbonization Technologies for Industrial Processes:** The industrial sector is one of the main contributors to greenhouse gas emissions in Taiwan. To achieve net zero emissions goals, the industrial sector must start researching and developing technologies and alternative materials for several process systems including motors, air conditioners and compressors, steam-electric and other boilers, kilns, and lighting technologies. On the one hand, this will improve energy efficiency and productivity; on the other, it could develop key carbon reduction technologies—such as the gasification of fossil fuels into hydrogen via pyrolysis, alternative materials or control and reduction technologies for gases containing fluorine—as a means to reduce emissions of greenhouse gases.
- **Innovative and Practical Decarbonization Strategies and Solutions:** In addition to research and development of emerging technologies, many innovative carbon reduction strategies can be promoted. These strategies may include (but are not limited to) management and business models such as the civic power plant investment model, low-carbon communities, and biochar/bioenergy-based social enterprises.

Theme 4: Change and Conservation of Water Resources and Ecosystems

Taiwan, located on the subtropical and western Pacific typhoon tracks, is an island country with

high mountains and abundant water resources and ecological diversity. However, the influences of climate change (e.g., increased air temperature and water temperature, extreme rainfall, ocean acidification) and environmental change (e.g., land use change, socioeconomic impacts, environmental pollution) have greatly impacted the water resources and aquatic ecosystems in Taiwan. In recent years, imbalances of water supply and demand in Taiwan have often caused water shortages, and many aquatic ecosystems have been destroyed. Therefore, the purpose of this theme is to explore the impact on and response of water resources and aquatic ecosystems in terms of future climate and environmental changes. Priority will be given, in 2022, to the following:

- **Integrated Research and Future Governance for Taiwan's Water Resources under Climate and Environmental Changes:** Taiwan's water resource issues are very complex and involve many different levels of problems. These include some from the supply side (uneven seasonal and regional distribution of precipitation, pollution of river water, land subsidence caused by overdrawing groundwater, the high cost of seawater desalination and water reclamation technology), some from the demand side (high levels of water consumption for agricultural and industrial purposes and the bottleneck of water saving from daily human use), and others are related to management (leakages, dispatches, prices, reservoir storage capacities and land use). Water shortages are caused by problems of imbalances between supply and demand and a lack of management. Thus, dilemmas regarding water resources are not problems that can be solved within a single field or by a single department; it requires systematic and integrated governance. Research topics may include (but are not limited to) cross-sector governance of national-level water resources, e.g., via agricultural and food policies set by the Council of Agriculture, industrial zone development policies of the Ministry of Economic Affairs and the Ministry of Science and Technology, and water resource planning and management policies from the Water Resources Agency; future technologies and strategies to innovate the use of water resources; the exploration of the relationship between water resources and rural communities in Taiwan, and systematic studies of the relationship between farmland and water (e.g., via impacts on the microclimate, water cycle, and demand for water resources).
- **Research on the Ecological Impact of Climate and Environmental Changes and Related Conservation:** Work should focus on Taiwanese terrestrial ecosystems (alpine cold-temperate coniferous forest, tropical broad-leaved forest, and grassland plains) and aquatic ecosystems (streams, lakes, intertidal zones, marsh wetlands, coral reefs, and offshore waters); proposals can be for conducting impact studies on habitats, animals, plants, and microorganisms, and proposing possible adaptation, conservation, or restoration measures.