



Task 63

Solar Neighborhood Planning

Annex Plan

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Annex 63

Solar Neighborhood Planning

1. Definitions

(a) The building sector and the use of solar energy

A large portion of the potential for energy efficiency in existing buildings and the potential to utilize solar energy still remains unused. Globally, goals and specific targets are set up to reduce our environmental impact on climate and to secure future supply of energy^{1,2}. A combination of making buildings more energy-efficient – through refurbishment interventions and new developments – and increasing the use of renewable energy sources (RES) is therefore a key issue to reduce fossil energy use and greenhouse gas emissions, towards a low carbon energy transition. An increased use of solar energy is one of the important development paths, where the urban fabric needs to utilize passive solar gains and daylight to reduce the energy use in buildings, as well as to improve the inhabitants' comfort in indoor and outdoor areas. In addition, active solar energy systems integrated in the urban context contribute to the production of renewable energy as heat and electricity. All these strategies help cities and citizens in reaching sustainable developments.

Solar neighborhoods are increasingly important to achieve net zero energy districts and low carbon cities. The planning of neighborhoods that address the generation of renewable energy on site will enable solar thermal technologies and photovoltaics to be implemented or prepared for, as well as creating daylight and sunlight access to achieve healthier urban environments. Solar neighborhoods also create environments which are energy (resource) self-sufficient and resilient to energy price fluctuations or reliance on energy imports – helping future-proof towns and cities.

(b) Neighborhoods

In this Task, a neighborhood is defined as a group of buildings, a district/precinct. It is a spatially defined, specific geographic area, often including different types of buildings and functions, open space and infrastructure.

A neighborhood can be part of a larger city or a smaller village. It can be part of an urban area, a rural development, or represent an isolated community. Further, it can be connected to a district heating/cooling network or outside such, giving very different boundary condition challenges.

(c) Scope

The scope of the Task includes solar energy issues related to

1. New neighborhood development
2. Existing neighborhood renovation and development

¹ The revised Renewable Energy Directive (EU) 2018/2001 establishes a binding EU target of at least 32% for 2030 with a review for increasing this figure in 2023. Further, the revised Energy Efficiency Directive (EU) 2018/2002 sets a 2030 target of 32.5%, also with a possible upward revision in 2023. The Energy Performance of Buildings directive ((EU) 2018/844) is amending Directive 2010/31/EU on the energy performance of buildings and Directive 2012/27/EU on energy efficiency, stating further member state roadmaps with indicative milestones for 2030, 2040 and 2050.

² The Low Carbon Precincts program in Australia focuses on reducing the carbon footprint of the urban systems, with key consideration being given to integrating the interlinked aspects of energy, water, waste, transport and buildings - all of which have significant carbon signatures as well as human health impacts (<http://www.lowcarbonlivingcrc.com.au/research/program-2-low-carbon-precincts>)

Solar energy aspects include active solar systems (solar thermal and photovoltaics) and passive strategies. Passive solar strategies include passive solar heating and cooling, daylighting, and thermal/visual comfort in indoor and outdoor environments.

Making smart use of building surfaces as well as of open public areas/surfaces within neighborhoods is an important challenge, which may rise conflicts between competing uses of solar energy (e.g. daylight versus energy production) but also conflicts in using other solutions such as green façades/roofs. In addition, synergies are important to identify, for instance, different building functions within the neighborhood with different energy load profiles. Although the focus of the Task will be on solar energy aspects, these need to be dealt with in relation to other competing or synergetic goals. *The role of solar issues related to energy, environment, economy and inhabitants' comfort and health is in focus.*

Neighborhoods within district heating networks as well as outside will be considered. The deployment of district networks is becoming more frequent. A district heating network, supplying space heating and domestic hot water, gives rise to different barriers and energy strategies than in neighborhoods outside such networks. Therefore, concepts and strategies will be different and interesting to study.

Since renewable energy production often causes an uneven production over time, storages have become more important. Therefore, thermal and electrical storages as part of the energy system and of the concepts for solar neighborhoods will be considered in this Task. However, this will not include technical design of thermal storages, which already has been dealt with in the IEA SHC Task 42 and Task 39. In addition, material and component development for thermal energy storage is presently dealt with in SHC Task 58.

Energy economics of solar thermal systems in urban environments were dealt with in IEA SHC Task 52. Results from this project will be looked at when dealing with economic strategies in Task 63.

On a single building scale, work has been carried out on net zero energy solar buildings in IEA SHC Task 40/EBC Annex 52. Task 63 is an upscale of this concept and will explore different energy and environmental concepts for neighborhoods. Furthermore, IEA SHC Task 41 “Solar Energy and Architecture” focused on architectural building integration of solar thermal and PV. Both these projects will be useful for Task 63 when the planning and design of neighborhoods will be dealt with.

In IEA SHC Task 51 “Solar Energy in Urban Planning”, extensive work was carried out to identify barriers, challenges and potentialities to implement the use of solar energy in urban areas and landscapes. Issues on scale from regional planning, city planning and down to urban areas were handled. Together with landscape planning of solar fields, Task 51 covered a huge area to study and provide an overview of barriers, potentials, and what is needed to work further on. The results underlined the need of further work on a neighborhood scale, especially looking at solar planning strategies and concepts, economic strategies and stakeholder engagement. In addition, solar planning tools and their coupling in an efficient workflow (i.e. co-simulation approach) are becoming more and more important due to an increasing need of decision support tools in the early planning phases. Solar planning tools would be mainly implied for assessing active solar potential, daylighting, thermal and visual comfort, as well as other architectural issues.

2. Purpose and Objectives

The content of this project was defined based on knowledge from IEA SHC Tasks, the IEA PVPS and EBC programmes, and other international and national projects. Task 63 is based on the identified need for further research within SHC Task 51 by especially focusing on a specific scale, between single buildings and whole cities: neighborhoods. Due to the extensive and recent work within Task 51 (e.g. the state-of-the-art), the research can now build upon these findings and go further into developing strategies, methods and tools for planning of solar neighborhoods. Thus, it enables to start at a more advanced level.

The main objective of Task 63 is to support developers, property owners/associations, architects, urban planners, municipalities, institutions, and other key players to achieve solar neighborhoods that support long-term solar access for energy production and for daylighting buildings and outdoor environments – resulting in sustainable and healthy environments.

The types of support being developed in this Task include strategies for the design of new and existing communities with focus on solar energy, comprising methods to secure sunlight access (right to light). Furthermore, the Task aims to focus on economic strategies and business models for better use of passive and active solar energy. Apart from economic values, added values³ or co-benefits of solar energy are considered. Another objective is to study the workflow of tools needed to support decisions in all planning stages (tool chain). Finally, case studies in each participating country will be a central part to bind close ties to practice and implementation.

To achieve these objectives, work is needed on four main topics:

- A: Solar planning strategies and concepts for achieving net zero energy/emission neighborhoods.
- B: Economic strategies, including added values and stakeholder engagement.
- C: Solar planning tools for new and existing neighborhoods.
- D: Case studies and stories, to test Task developments in dialogue with key players, implement and disseminate.

Task 63 will require a dialogue and cooperation with key players in neighborhood planning in each participating country. These include developers, real estate owners, architects, consultants, urban planners, municipalities, and other institutions. This cooperation gives the possibility to identify barriers, and test strategies, methods and tools to get feedback on development needs. In addition, case studies and lessons learnt will be documented to show inspiring examples of solar neighborhoods. Local collaborations within municipalities are an important part that complements the international cooperation within the Task and links Task experts with the practice and implementation in each country.

The main objectives of the Task are subdivided into four key areas and involve:

A: Solar planning strategies and concepts

- Review existing concepts and targets that underlie neighborhood design, both new and existing.
- Develop (criteria for) the design of representative archetypes/prototypes in existing and new neighborhoods (e.g. spatial design and building design - types of buildings, mixes of buildings, density, open space -, passive solar design potential, various active solar strategies and technologies, synergies and conflicts with other potential usages – in connection with Subtask B).

³ Added values include aspects such as energy security, job creation, higher work productivity, image and publicity, higher rent/sale value, reduced demand on energy infrastructure and GHG emissions etc.

- Develop and test planning strategies and concepts for increased solar energy capture and utilization in neighborhoods, in view of achieving net zero energy (NZE), net zero carbon (NZC) status or other goals in the era of low-carbon energy transition.
- Recommend strategies and concepts for conceptual design of new and existing neighborhoods.
- Give a common definition/concept of urban surface usages relating to functions (e.g. energy production, microclimate regulation, permeability of surface, etc.) and materials (e.g. solar thermal panels, PV panels, green areas/facades/roofs, water, cool/reflective materials, etc.).

B: Economic strategies and stakeholder engagement

- Identify and describe conflicts and synergies of the different and potential usages of urban surfaces, with specific relevance to solar energy harvest.
- Identify financial mechanisms and suggest ways to finance the transition, moving from energy market to added value services.
- Develop a method to propose and assess alternative scenarios for urban surface usages.
- Identify the potential co-benefits related to the hybrid or/and integrated usage of urban surface, apart from the solar energy production.
- Analyse the potential integration of the Task outputs for the New Urban Agenda⁴ implementation.
- Recommend suitable activities for stakeholder engagement/nudging strategies, and integrate the lessons learnt in the urban planning practice.

C: Solar planning tools

- Identify the current solar planning tool workflows and related tools used by key actors for planning solar neighborhoods. This could include tools from all platforms (GIS, CAD, or BIM). Analyse the strengths, weaknesses and development needs.
- Identify relevant common indicators synthesizing solar energy and daylight performance of neighborhoods, to be used in a summary dashboard for easy comparison.
- Develop a roadmap for improved workflows and solar planning tools needed in all planning stages (tool chain).

D: Case studies

- Coordinate and collect case studies across subtask topics.
- Serve as a platform for exchange of experiences from practice, including testing strategies and tools and interview stakeholders.
- Describe and disseminate case studies and stories of new and existing solar neighborhoods.

⁴ New Urban Agenda (2017). United Nations. A/RES/71/256. ISBN: 978-92-1-132731-1. <http://habitat3.org/the-new-urban-agenda>

3. Activities

(a) Main activities

The Task is organized in four main activities/Subtasks, derived from the above described key areas:

Subtask A: Solar planning strategies and concepts

Subtask B: Economic strategies and stakeholder engagement

Subtask C: Solar planning tools

Subtask D: Case studies

Subtask A is looking at concepts for solar neighborhood planning in view of achieving high environmental goals (e.g. NZE, NZC), and the role of various strategies to reach them (including planning, design and technology implementation). Subtask B is focusing on strategies - business models and stakeholder engagement - to increase the solar energy utilization towards zero emission neighborhoods. Subtask C works on supportive tools, related to active solar energy systems and daylighting, within a chain of tools needed for neighborhood planning and design. Subtask D focuses on implementation issues and dissemination of case studies with solar planning of existing and new neighborhoods. Subtask D also gives input and serves as a testing platform for Subtask A, B and C, thus the case studies are a core activity for the Task work.

(b) Sub-activities

The following activities will be performed in the four Subtasks:

A: Solar planning strategies and concepts

A.1. Review of current neighborhood designs:

A.1.1. Review existing guidelines and common practices that underlie the design of existing and new neighborhoods, especially those aiming at increased efficiency and solar capture, and other compatible/hybrid usages, in the participating countries. These include examples in practice and literature (with Subtask D).

A.1.2. Based on the review conducted in A.1.1, determine the main parameters/design elements that can impact the design and performance of neighborhoods, and possible combinations in various prototypical neighborhoods (archetypes for existing and new) considering both solar and other surface usages.

A.2. Design and analysis of archetypes /prototypes to bridge gaps in practice and literature:

A.2.1. Develop a number of neighborhood prototypes (existing and new) that include the neighborhood variables determined in A1, and that can serve as a basis to analyse various impacts.

A.2.2. Develop methods to analyse scenarios developed in A.2.1, and carry out these analyses (including modelling (with Subtask C)).

A.2.3. Develop business models and financial studies for various scenarios (with Subtask B).

A.3. Develop recommendation on strategies, including a proposal for a common definition/understanding of urban surface usage (link to Subtask B).

B: Economic strategies and stakeholder engagement

- B.1. Analysis of the potential integration of the outputs for the New Urban Agenda (NUA) implementation:
 - B.1.1. Analysis of the articles of the NUA that relate to the urban surface usages with special focus on energy production / resilience to climate change.
 - B.1.2. Definition of a pathway to contribute to the implementation of NUA within the results of the Task.
- B.2. Identify and describe conflicts and synergies of the different and potential urban surface usages, with specific relevance to solar energy harvest (link to Subtask A, activity A.3):
 - B.2.1. From literature: extraction of evidences of conflicts and synergies.
 - B.2.2. Presentation and discussion within the expert group the results from the literature review on conflicts and synergies; focusing in particular on the potentialities of integration of functions, and on the possible improvements to the state-of-the-art.
- B.3. Develop a method to propose and assess alternative scenarios for urban surface usage (e.g. pareto optimization, multi criteria, etc.) (link to Subtask C):
 - B.3.1. Modelling of scenarios using also outputs from Subtask A - archetypes - and, when possible of selected real neighborhoods (link to Subtask D case studies).
 - B.3.2. Discussion within the expert group in relation to the integration of the outputs in the participating countries' urban planning procedures.
- B.4. Develop a framework to assess the multiple-benefits created by the adoption of hybrid and integrated strategies for urban surface usages (link to Subtask A, activity A.3).
- B.5. Recommend suitable activities for stakeholder engagement/nudging strategies and integrate lessons learnt into the urban planning practice:
 - B.5.1. Framework development for the integration of the traditional stakeholders engagement approaches (e.g. governance approaches) with behavioural economics⁵.
 - B.5.2. Discussion/workshop on the added value of the proposed framework.
- B.6. Identify financial mechanisms and suggest ways to finance the transition, moving from energy market to added value services (link to Subtask D):
 - B.6.1. Analysis from literature and selected case studies of innovative financial models and trends (connection with the new concepts of smart grids, block chain, etc.).
 - B.6.2. Discussion of the results within the expert group in order to find connection with country specific characteristics.

C: Solar planning tools

- C.1. Identification of current tools and tool workflows on all platforms:
 - C.1.1. Determine main strengths and weaknesses of available tools, including readiness level (from proof of concept to licensed software), usability (which target users) and accessibility (which competences needed by target users).

⁵ Behavioural economics studies the effects of psychological, cognitive, emotional, cultural and social factors on the economic decisions of individuals and institutions and how those decisions vary from those implied by classical theory.

- C.1.2. Contact with local urban planners and key actors, maybe also Task experts, to identify which key performance indicators are meaningful, which tools they use and when, and to extract which data, etc.
- C.1.3. Combine and generalise existing workflows.
- C.2. Discussion and development of workflow of tools needed in all planning stages (tool chain):
 - C.2.1. Complement the missing parts of the current workflow(s) as found in C.1, based on existing software developments, including novel contributions from Task experts.

D: Case studies

Every participating country should contribute with at least one (1) case study. The following activities are planned.

- D.1. Coordination of database of solar neighborhoods (link to Subtask A/B/C):
 - D.1.1. Gather performance indicators and key aspects each subtask will use to identify and describe relevant case studies. Decide which aspects are mandatory to document and which are optional, depending on case study.
 - D.1.2. Create a template for documenting case studies based on the aspects identified.
 - D.1.3. Collect case study documents, based on the template and filled in by experts.
 - D.1.4. Publish the case studies of existing and new solar neighborhoods on the website.
- D.2. Communication and dissemination of results from selected case studies (link to Subtask A/B/C):
 - D.2.1. Organize workshops/seminars to present developed strategies and methods/tools in conjunction with Task meetings, inviting practitioners (feedback and dissemination).
 - D.2.2. Organize local workshops/seminars in neighborhoods/cities, by local experts.

(c) Workshops and seminars

Seminars or workshops will be held in conjunction with at least four (4) Task meetings. The seminars/workshops will be organized in the host country of the meeting and relevant target groups will be invited (link to Subtask D/all Subtasks).

In addition, minimum one (1) local seminar or workshop will be held in each country/region to get input to the work and/or to disseminate results from the Task or Subtasks. These seminars/workshops will be organized by Task participants from the specific country (link to Subtask D/all Subtasks).

(e) Publications/Newsletters

An overall description of the Task will be available on the Task Website. All main publications/deliverables will be posted on the Task Website or made available via a link, for free access or purchase.

4. Expected Results/Deliverables

The main deliverables, allocated to the four Subtasks, will be:

A: Solar planning strategies and concepts

D.A1. Report on example strategies to protect solar design and technologies.

D.A2:

D.A2.1. A summer school for at least 2 consecutive years to allow advanced PhD and Master students to contribute to the study of neighborhood archetypes. These summer schools can target students from various backgrounds such as business, engineering/architecture, planning, social to work on business plans, modelling etc.

D.A2.2. Report on neighborhood archetypes: Design and analysis.

D.A3. Strategies for the design of new and existing high energy performance solar communities. These strategies can be designed as an interactive web based documentation (link to Subtask B).

B: Economic strategies and stakeholder engagement

D.B1. Report on surface uses of neighborhoods focused on how to define most suitable uses, prevent conflicts and create synergies (link to Subtask A, activity A.3.).

D.B2. Report on economic incentives and business models, including added values, to promote the diffusion of solar neighborhoods (link to Subtask A, outputs from activity A.2.3.).

D.B3. Report on strategies for stakeholder engagement and citizen involvement in solar neighborhoods, developed and tested in case studies (link to Subtask D).

C: Solar planning tools

D.C1. Report on the identification of existing tools and workflows.

D.C2. Roadmap for improved workflows and development needs of solar planning tools.

D: Case studies

D.D1. Report on case studies and stories.

D.D2. Carry out seminars and workshops, which provide feedback and support the knowledge exchange.

5. Rights and Obligations of Participants

In addition to the obligations enumerated in Article 4 (Expected Results/Deliverables) of the Implementing Agreement:

- (a) A Participant must undertake and complete all agreed activities and contribute to all or to a specific of the tasks outlined in Section 3 and 4 of this Annex in a timely manner.
- (b) Each Participant must actively participate in working meetings and other activities such as seminars and workshops.

- (c) Attendance at Experts meetings of the Task will be mandatory. Task meetings will be carried out at intervals of approximately six months. Experts meetings may be accompanied by national workshops dedicated to target audiences of the Task, mainly from the national industry of the host country of the Experts meeting.
- (d) Each Participant shall provide timely, detailed reports on the results of their work carried out to the Subtask Leader and Operating Agent.
- (e) Every six months, before each Expert meeting, each Participant shall provide a brief status report of their work including a list of publications and organized seminars/workshops, to the Operating Agent.
- (f) Each Participant must contribute to one or more Task deliverables and shall participate in the editing and reviewing of draft reports and other outputs of the Task and Subtasks.

(g) *Individual Financial Obligations*

Each country will bear the costs of its own participation in the Task, including reporting and necessary travel costs. Task meetings will be held twice annually and hosted in turn by Participants. The cost of organizing meetings will be paid by each Participant to the host, by a meeting fee.

(h) *Task-Sharing Requirements*

The Participants agree on the following funding commitment:

- (1) Each Participant (country) will contribute to this Task a minimum of 4 person months per year of the Task (corresponding to 33% of full time work for one person). This means that each participating country shall commit to the Task a minimum of 16 person months over the period of 4 years.
- (2) Participation in the Task requires participation in at least one of the Subtasks.
- (3) Subtask Leaders will contribute with a minimum of 4 person months per year for the duration of the Subtask.
- (4) The Operating Agent will contribute with a minimum of 6 person months per year to the Task.
- (5) Participation may partly involve funding already allocated to a national (or international) activity, which is substantially in agreement with the scope of work outlined in this Annex.
- (6) Aside from providing the resources required for performing the work of the Subtasks in which they are participating, all Participants are required to commit the resources necessary for activities which are specifically collaborative in nature and which would not be part of activities funded by national or international sources. Examples include the preparation for and participation in Task meetings, co-ordination with Subtask Participants, contribution to the documentation and dissemination work and Task related R&D work which exceeds the R&D work carried out in the framework of the national (or international) activity.

The level of effort to be contributed by each country will be specified in a "Letter of National Participation" which is signed by the Operating Agent and the Executive Committee representative within 3 months from the start date of the Task.

6. Management

6.1 Operating Agent

- (a) Lund University (Sweden), acting through Maria Wall, is designated as Operating Agent.
- (b) In addition to the rights, obligations and responsibilities enumerated in the main body of the Implementing Agreement and the organisation of the work under this Annex enumerated in Section 5, the Operating Agent shall:
 - (1) Be responsible for the overall management of the Task, including overall co-ordination and communications with the Executive Committee.
 - (2) Prepare the detailed Programme of Work for the Task in consultation with the Subtask Leaders and the Participants and submit the Programme of Work for approval to the Executive Committee.
 - (3) Provide semi-annually, periodic reports to the Executive Committee on the progress and the results of the work performed under the Programme of Work.
 - (4) Manage the preparation and distribution of the results described in Section 4 in this Annex.
 - (5) At the request of the Executive Committee organise workshops, seminars, conferences and other meetings.
 - (6) Provide to the Executive Committee, within six months after completion of all work under the Task, a final report for its approval and transmittal to the Agency.
 - (7) In co-ordination with the Participants, use its best efforts to avoid duplication with activities of other related programmes and projects implemented by or under the auspices of the Agency or by other competent bodies.
 - (8) Provide the Participants with the necessary guidelines for the work they carry out and report with minimum duplication.
 - (9) Perform such additional services and actions as may be decided by the Executive Committee, acting by unanimity.

6.2 Subtask Leaders

- (a) A Subtask Leader shall be a Participant that provides to the Subtask a high level of expertise and undertakes substantial research related to the Subtask.
- (b) The Subtask Leaders shall be proposed by the Operating Agent and designated by the Executive Committee, acting by unanimity of the Participants. Changes in the Subtask Leaders may be agreed to by the SHC Executive Committee, acting by unanimity of the Participants.
- (c) In addition to the obligations enumerated in Section 5 of this Annex, the Subtask Leader for each of the Subtasks shall:
 - (1) Assist the Operating Agent in preparing the detailed Programme of Work.
 - (2) Co-ordinate the work performed under that Subtask.

- (3) Actively participate in the dissemination activities.
- (4) Subtask leaders may arrange, direct and provide summaries of Subtask meetings and workshops in between or in association with Task meeting.
- (5) Provide the Operating Agent with timely written summaries of Subtask work, action items and results after each Task meeting.
- (6) Edit technical reports resulting from the Subtask and organize their publication.
- (7) Collaborate with the Operating Agent and other Subtasks and contribute to the preparation, production and distribution of the results described in Section 4 in this Annex within the framework of the Task dissemination plan.

6.3 Meetings

There will be Experts meetings of the Task at intervals of approximately six months. Subtask Leaders may arrange meetings in between or in association with Experts meetings of the Task. Attendance at the Experts Meetings of the Task will be mandatory.

7. Admission, Participation and Withdrawal of Participants

In addition to the specific obligations, the Operating Agent will produce, promote and distribute the results of the Task. The Participants will support these activities by contributing respective papers and by dissemination activities financed by the individual Participants.

8. Information and Intellectual Property

For purpose of this Annex, in case of conflict with the provisions of the Implementing Agreement, the following provisions shall prevail:

- (a) For arising information regarding inventions the following rules shall apply:
 - (1) Arising information regarding inventions shall be owned in all countries by the inventing Participant. The inventing Participant shall promptly identify and report to the Executive Committee any such information along with an indication whether and in which countries the inventing Participant intends to file patent applications.
 - (2) Information regarding inventions on which the inventing Participant intends to obtain a patent protection shall not be published or publicly disclosed by the Operating Agent or the other Participants until a patent has been filed, provided, however, that this restriction on publication or disclosure shall not extend beyond twelve months from the date of reporting of the invention. It shall be the responsibility of the inventing Participants to appropriately mark Task reports that disclose inventions that have not been appropriately protected by filing a patent application.
- (b) The inventing Participant shall license proprietary information arising from the Task for non-exclusive use as follows:
 - (1) To participants in the Task:
 - a. On the most favourable terms and conditions for use by the Participants in their own country.

- b. On favourable terms and conditions for the purpose of sub-licensing others for use in their own country.
- (2) Subject to sub-paragraph a.1 above, to each Participant in the Task for use in all countries, on reasonable terms and conditions.
- (3) To the government of any Agency Member country and nationals designated by it, for use in such country in order to meet its energy needs.

Royalties, if any, under licenses pursuant to this paragraph shall be the property of the inventing Participant.

9. Entry into Force, Term and Extension

This Annex shall enter into force on 1st of September 2019 and shall remain in force for a period of four years/50 months, until 31st of October 2023. At the conclusion of that period, this Annex can be extended by at least two Participants, acting in the Executive Committee, for a period to be determined at that time, provided that in no event shall the Annex continue beyond the current term, or actual termination, of the Implementing Agreement.