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IEA Solar Task 63 – Solar Neighborhood Planning

Final report on the Swiss activities carried out in the framework of the Task.



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h e p i a

Haute école du paysage, d'ingénierie
et d'architecture de Genève



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HEPIA
4 avenue de la Prairie
1202 Genève
<https://www.hesge.ch/hepia/>

Author:

Gilles Desthieux, HEPIA, gilles.desthieux@hesge.ch

SFOE project coordinators:

Andreas Eckmanns, andreas.eckmanns@bfe.admin.ch
Stephan A. Mathez, stephan.a.mathez@solarcampus.ch

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The authors bear the entire responsibility for the content of this report and for the conclusions drawn therefrom.



Zusammenfassung

Task 63 (<https://task63.iea-shc.org/>) ist ein Projekt, das zum Solar Heating&Cooling Programme (SHC) der Internationalen Energieagentur (IEA) beiträgt. Der Task fand von September 2019 bis April 2024 statt. 20 Institutionen aus 10 Ländern haben sich aktiv an der Task beteiligt und zu den Ergebnissen beigetragen. Unter ihnen trug HEPIA (Haute Ecole du paysage, d'ingénierie et d'architecture de Genève, Fachhochschule Westschweiz, HES-SO) als Schweizer Experte durch verwandte Projekte zur Modellierung des solaren Zugangs in der bebauten Umwelt zum Task bei. Dieser Bericht beschreibt die wichtigsten Ergebnisse und Erkenntnisse der Task 63 sowie die Aktivitäten und Beiträge von HEPIA.

Das Hauptziel der Task 63 ist die Unterstützung von Bauträgern, Immobilieneigentümern/-verbänden, Architekten, Stadtplanern, Gemeinden, Institutionen und anderen wichtigen Akteuren, um solare Nachbarschaften zu schaffen, die den langfristigen Zugang zu Sonnenenergie für die Energieerzeugung und die Tageslichtbeleuchtung von Gebäuden und Außenbereichen unterstützen - was zu einer nachhaltigen und gesunden Umwelt führt. Um diese Ziele zu erreichen, wird an vier Hauptthemen (Unteraufgaben) gearbeitet.

Im Rahmen des Subtasks **STA** (*Solarplanungsstrategien und -konzepte zur Erreichung von Netto-Null-Energie-/Emissionsquartieren*) wurde ein Entscheidungsinstrument entwickelt, das die Planung passiver und aktiver Solarstrategien auf der Ebene bestehender oder neuer Quartiere unterstützt. Dieses Instrument wurde anhand von Fallstudien getestet, die verschiedenen Archetypen entsprechen. Darüber hinaus wurde eine vergleichende Studie über Vorschriften und Finanzierungsmechanismen im Zusammenhang mit der Stadt- und Energieplanung in Kanada, Italien, Schweden, Norwegen und der Schweiz durchgeführt. In **STB** (*Wirtschaftliche Strategien, einschließlich Mehrwert und Einbeziehung von Interessengruppen*) wurden städtische Oberflächen für die Nutzung in aktiven Solarprojekten untersucht, darunter Dächer, Fassaden, Carports, Solarpflaster und Wände. Darüber hinaus wurde die Untersuchung über diese Flächen hinaus auf andere ergänzende Nutzungen ausgedehnt, wie z. B. die Begrünung zum Zwecke des städtischen Klimakomforts. Diese Unteraufgabe konzentrierte sich auch auf die Einbeziehung von Interessengruppen und Finanzierungsmechanismen zur Unterstützung von aktiven und passiven Solarprojekten. **STC** (*Solarplanungsinstrumente für neue und bestehende Wohngebiete*) widmete sich der Entwicklung von städtischen Solarmodellierungswerkzeugen und der Verfeinerung des Datenworkflows und der Verwaltungsprozesse für diese Werkzeuge. Darüber hinaus wurden auf der Grundlage einer Bestandsaufnahme der am häufigsten verwendeten Indikatoren relevante Leistungsindikatoren (Key Performance Indicators - KPIs) entwickelt, um die Entscheidungsfindung zu unterstützen. **STD** (*Fallstudien und Geschichten zur Erprobung von Aufgabenentwicklungen im Dialog mit Schlüsselakteuren, Umsetzung und Verbreitung*) lieferte eine Sammlung von 20 Fallstudien, die sowohl aktive als auch passive Solarprojekte in unterschiedlichen Kontexten zeigen.

Die Kernpunkte und wichtigsten Ergebnisse der Task sind die folgenden. Die Integration von Solarsystemen in die Architektur sollte im Hinblick auf Flexibilität und Akzeptanz verbessert werden. Eine effiziente Nutzung städtischer Flächen für Solarenergie, Grünflächen und die lokale Nahrungsmittelproduktion ist für nachhaltige Städte unerlässlich. Für die Planung und Gestaltung von Stadtvierteln sind angepasste digitale Werkzeuge zu Leistungsindikatoren erforderlich. Die Planung von „solartauglichen“ Gebieten sollte Teil von Entwicklungsplänen sein. Gesetzliche Reformen sind erforderlich, um den Zugang zur Solarenergie zu schützen und Investitionen in erneuerbare Energien zu gewährleisten. Verbesserte Planfeststellungsverfahren sind erforderlich. Geschäftsmodelle für Solarnachbarschaften müssen die langfristige Rentabilität sicherstellen und Mehrwerte wie Gesundheit, Widerstandsfähigkeit und Energiesicherheit hervorheben. Der Wissenstransfer sollte Interessengruppen und Bürger in die Planung und Entwicklung einbeziehen.



Résumé

La tâche 63 (<https://task63.iea-shc.org/>) est un projet contribuant au programme Solar Heating&Cooling (SHC) de l'Agence internationale de l'énergie (AIE). La tâche s'est déroulée de septembre 2019 à avril 2024. 20 institutions de 10 pays ont participé activement à la Tâche et ont contribué aux résultats. Parmi elles, HEPIA (Haute école du paysage, d'ingénierie et d'architecture de Genève, Haute école spécialisée de Suisse occidentale, HES-SO) a contribué à la Tâche en tant qu'expert suisse à travers des projets connexes sur la modélisation de l'accès solaire dans l'environnement bâti. Ce rapport décrit les principaux résultats et conclusions de la tâche 63 ainsi que les activités et contributions de l'HEPIA.

L'objectif principal de la tâche 63 est d'aider les promoteurs, les propriétaires/associations, les architectes, les urbanistes, les municipalités, les institutions et autres acteurs clés à créer des quartiers solaires qui favorisent l'accès au soleil à long terme pour la production d'énergie et pour l'éclairage naturel des bâtiments et des environnements extérieurs - ce qui se traduit par des environnements durables et sains. Pour atteindre ces objectifs, le travail est effectué sur quatre sujets principaux (sous-tâches).

Dans la sous-tâche **STA** (*Stratégies et concepts de planification solaire pour la réalisation de quartiers à énergie/émissions nettes zéro*), un outil de décision a été développé pour accompagner la conception de stratégies solaires passives et actives au niveau des quartiers existants ou nouveaux. Cet outil a été testé avec des études de cas correspondant à différents archétypes. En outre, une étude comparative des réglementations et des mécanismes financiers liés à la planification urbaine et énergétique au Canada, en Italie, en Suède, en Norvège et en Suisse a été réalisée. Dans le cadre du projet **STB** (*Stratégies économiques, y compris les valeurs ajoutées et l'engagement des parties prenantes*), les surfaces urbaines ont été étudiées en vue de leur utilisation dans des projets solaires actifs, y compris les toits, les façades, les abris de voiture, les chaussées solaires et les murs. En outre, l'étude s'est étendue au-delà de ces surfaces pour envisager d'autres utilisations complémentaires, telles que la végétation à des fins de confort climatique urbain. Cette sous-tâche s'est également concentrée sur l'engagement des parties prenantes et les mécanismes financiers pour soutenir les projets solaires actifs et passifs. **STC** (*Outils de planification solaire pour les quartiers nouveaux et existants*) a consacré ses efforts au développement d'outils de modélisation solaire urbaine et à l'affinement du flux de données et des processus de gestion de ces outils. En outre, des indicateurs clés de performance pertinents ont été développés sur la base d'un inventaire des indicateurs les plus couramment utilisés pour soutenir la prise de décision. **STD** (*Etudes de cas et récits, pour tester les développements de Task en dialogue avec les acteurs clés, les mettre en œuvre et les diffuser*), a fourni une collection de 20 études de cas qui présentent des projets solaires actifs et passifs dans différents contextes.

Les points clés et les principales découvertes de la tâche sont les suivants. L'intégration des systèmes solaires dans l'architecture devrait être améliorée pour plus de flexibilité et d'acceptation. L'utilisation efficace des surfaces urbaines pour l'énergie solaire, les espaces verts et la production alimentaire locale est essentielle pour des villes durables. L'échelle du quartier nécessite des outils numériques adaptés aux indicateurs clés de performance pour la planification et la conception. La planification de zones « prêtes pour l'énergie solaire » devrait faire partie des plans de développement. Des réformes juridiques sont nécessaires pour protéger l'accès à l'énergie solaire et garantir les investissements dans les énergies renouvelables. Il est nécessaire d'améliorer les processus d'approbation des plans. Les modèles commerciaux pour les quartiers solaires doivent garantir la viabilité à long terme et mettre en évidence les valeurs ajoutées telles que la santé, la résilience et la sécurité énergétique. Le transfert de connaissances doit impliquer les parties prenantes et les citoyens dans la planification et le développement.



Summary

Task 63 (<https://task63.iea-shc.org/>) is a project contributing to the Solar Heating&Cooling Programme (SHC) from the International Energy Agency (IEA). The Task took place from September 2019 to April 2024. 20 institutions from 10 countries actively participated in the Task and contributed to the results. Among them, HEPIA (Haute Ecole du paysage, d'ingénierie et d'architecture de Genève, University of Applied Sciences of Western Switzerland, HES-SO) contributed to the Task as a Swiss expert through related projects on solar access modelling in built environment. This report describes the main results and findings of the Task 63 and the activities and contributions of HEPIA.

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 neighbourhoods that support long-term solar access for energy production and for daylighting buildings and outdoor environments – resulting in sustainable and healthy environments. To achieve these objectives, work is performed on four main topics (subtasks).

In the subtask **STA** (*Solar planning strategies and concepts for achieving net zero energy/emission neighbourhoods*), a decision tool was developed to support the design of passive and active solar strategies at the level of existing or new neighbourhoods. This tool was tested with case studies corresponding to different archetypes. In addition, a comparative study of regulations and financial mechanisms related to urban and energy planning in Canada, Italy, Sweden, Norway, and Switzerland was conducted. In **STB** (*Economic strategies, including added values and stakeholder engagement*), urban surfaces were investigated for use in active solar projects, including roofs, facades, carports, solar pavements, and walls. In addition, the investigation extended beyond these surfaces to consider other complementary uses, such as vegetation for urban climate comfort purposes. This subtask also focused on stakeholder engagement and financial mechanisms to support both active and passive solar projects. **STC** (*Solar planning tools for new and existing neighbourhoods*) dedicated efforts to developing urban solar modelling tools and refining the data workflow and management processes for these tools. In addition, relevant Key Performance Indicators (KPIs) have been developed based on an inventory of the most commonly used indicators to support decision making. **STD** (*Case studies and stories, to test Task developments in dialogue with key players, implement and disseminate*), provided a collection of 20 case studies that showcase both active and passive solar projects in different contexts.

The key points and main finding of the Task are the following. Solar system integration in architecture should be enhanced for flexibility and acceptance. Efficient urban surface use for solar energy, green spaces, and local food production is essential for sustainable cities. Neighbourhood-scale required adapted digital tools to Key Performance Indicators for planning and design. Planning for "solar-ready" areas should be part of development plans. Legal reforms are needed for solar access protection, ensuring renewable energy investments. Improved planning approval processes are required. Business models for solar neighbourhoods must ensure long-term viability and highlight added values like health, resilience, and energy security. Knowledge transfer should involve stakeholders and citizens in planning and development.

Main findings

- Importance of the neighbourhood scale for passive and active solar planning and design.
- Solar planning and design require adapted digital tools.
- Efficient use approach of urban surfaces to achieve healthy environments and sustainable cities.
- Definition of business models and knowledge transfer to involve stakeholders in the process.



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Abbreviations

HELIOS: enHancing optimal ExpLoitatiOn of Solar energy in Nordic cities through the digitalization of the built environment

HEPIA: Haute Ecole du Paysage, d'Ingénierie, d'Architecture de Genève (Geneva School of Landscape, Engineering and Architecture)

HES-SO: Haute Ecole Spécialisée de Suisse Occidentale (University of Applied Sciences and Arts Western Switzerland)

KPIs: Key Performance Indicators

NTNU: Norwegian University of Science and Technology

PAV: Praille-Acacias-Vernets

RES: Renewable Energy Sources

SFOE: Swiss Federal Office of Energy

SITG: Système d'Information du Territoire Genevois (Geneva Information System)

STA-B-C-D: Substaks A, B, C, D

VALES: Valorisation Energétique des Façades (Enhancing the energy value of façades)

ZIBAY: Zone Industrielle de Bois-de-Bay (Industrial area of Bois-de-Bay)



1 Introduction

1.1 Background information and current situation

Much of the potential for energy efficiency in existing buildings and solar energy remains untapped. Globally, goals and specific targets are being set to reduce our impact on the climate and to secure future energy supplies. A combination of making buildings more energy efficient - through retrofits 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. Increased use of solar energy is one of the important development paths, where the urban fabric needs to take advantage of passive solar gains and daylight to reduce energy consumption in buildings, as well as to improve indoor and outdoor comfort for occupants. In addition, active solar energy systems integrated into the urban context contribute to the production of renewable energy in the form of heat and electricity. All these strategies help cities and citizens to achieve sustainable development.

Solar neighbourhoods are becoming increasingly important to achieve net zero energy districts and low carbon cities. Planning neighbourhoods that focus on onsite renewable energy production allows for the implementation or preparation of solar thermal and photovoltaic technologies, as well as providing access to daylight and sunlight for healthier urban environments. Solar neighbourhoods also create environments that are energy (resource) self-sufficient and resilient to energy price fluctuations or dependence on energy imports - helping to future-proof cities.

1.2 Purpose of the project

The scope of the Task includes solar energy issues related to:

1. New neighbourhood development
2. Renovation and development of existing neighbourhoods

Solar energy aspects include active solar systems (solar thermal and photovoltaic) and passive strategies. Passive solar strategies include passive solar heating and cooling, daylight, and indoor and outdoor thermal/visual comfort.

The smart use of building surfaces as well as open public spaces/areas within neighbourhoods is an important challenge, which can lead to conflicts between competing uses of solar energy (e.g. daylight versus energy production), but also conflicts in the use of other solutions such as green facades/roofs. In addition, synergies are important to identify, for example, different building functions within the neighbourhood with different energy load profiles. Although the focus of the Task was on solar energy issues, these needed to be addressed in relation to other competing or synergistic goals. The role of solar issues in relation to energy, environment, economy, and occupant comfort and health was in focus.

1.3 Objectives

The main objective of Task 63 (<https://task63.iea-shc.org/>) is to support developers, property owners/associations, architects, urban planners, municipalities, institutions, and other key players to achieve solar neighbourhoods 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 values 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 was carried out through 4 subtasks:

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

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

2 Procedures and methodology

2.1 Methodological approach in the Task 63

The following content is taken from the position paper of the Task 63 (Wall, 2024) and the publication of Manni et al., 2023.

It is important first to define the notion of neighbourhood and then of solar neighbourhood.

A **neighbourhood** is a spatially defined, specific area, often including different types of buildings and functions, open spaces, and infrastructure. A neighbourhood can be part of a larger city or a smaller village. It can be part of an urban area or a rural development or represent an isolated community. It can also be connected to a district heating/cooling network or outside of it, resulting in very different boundary conditions and challenges related to the energy system. Solar planning of neighbourhoods is pertinent when new areas are being developed, and existing neighbourhoods need renovation and development.

Planning solar neighbourhoods takes into account the onsite generation of renewable energy to enable photovoltaics (PV) and solar thermal technologies to be implemented or prepared for, as well as creating access to daylight and sunlight to achieve healthier urban environments. Solar neighbourhoods also create environments that increase energy self-sufficiency and resiliency to energy price fluctuations, reducing the dependence on energy imports and thus helping future-proof towns and cities. Solar neighbourhoods contribute to advancing the United Nations' Sustainable Development Goals (UN SDG).

The methodological approach of the Task 63 is founded on 3 pillars as described thereafter.

2.1.1 Solar access

Although the extensive use of passive and active solar strategies can pave the way for more sustainable urban environments, pressures from population growth and the lack of adequate legislative frameworks to facilitate energy transition in cities are major challenges.

In ancient English law, the “right-to-light” regulates the right to a reasonable proportion of the natural unobstructed flow of direct solar radiation onto one’s property. This “right-to-light” relates to windows



and indoor daylighting. Today, we need a “right-to-light” for indoor daylighting, a healthy outdoor environment, and to ensure solar access for active solar panels on buildings and outdoor areas. In some countries, solar easements are in place to protect the installed capacity of solar energy systems. Climate change and increasing heat waves also highlight the need for “right-to-shade,” especially in urban areas experiencing urban heat island (UHI) effects. However, there is a lack of specific standards regulating these aspects at a neighbourhood level.

2.1.2 Solar strategies

Passive solar strategies utilize sunlight to improve thermal and visual comfort indoors and outdoors while reducing energy consumption for heating, cooling, and lighting (see Report A1, Hachem-Vermette et al., 2022). In addition to solar gains through windows, passive strategies include materials and devices that interact with solar radiation to control surface temperatures and their impact on the outdoor and indoor environment. Further, urban greening is a passive strategy that contributes to energy saving, surface and air temperature cooling, and can provide food, as in the case of urban agriculture.

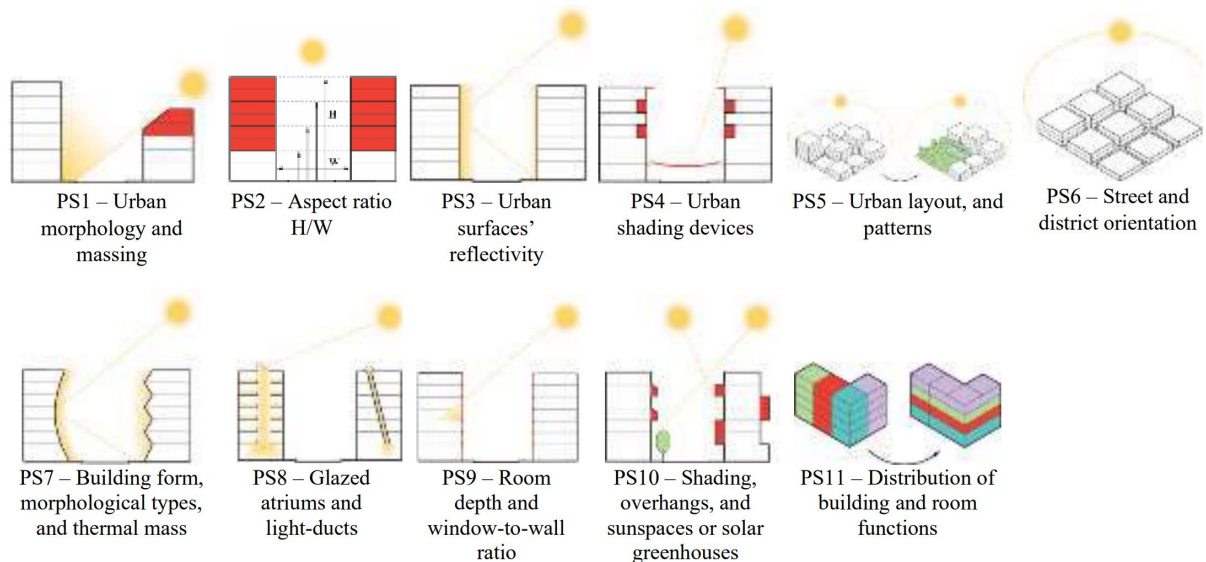


Figure 1. Passive solar strategies applied to the planning and design at the neighbourhood and building scale, from M. Manni et al. (2023)

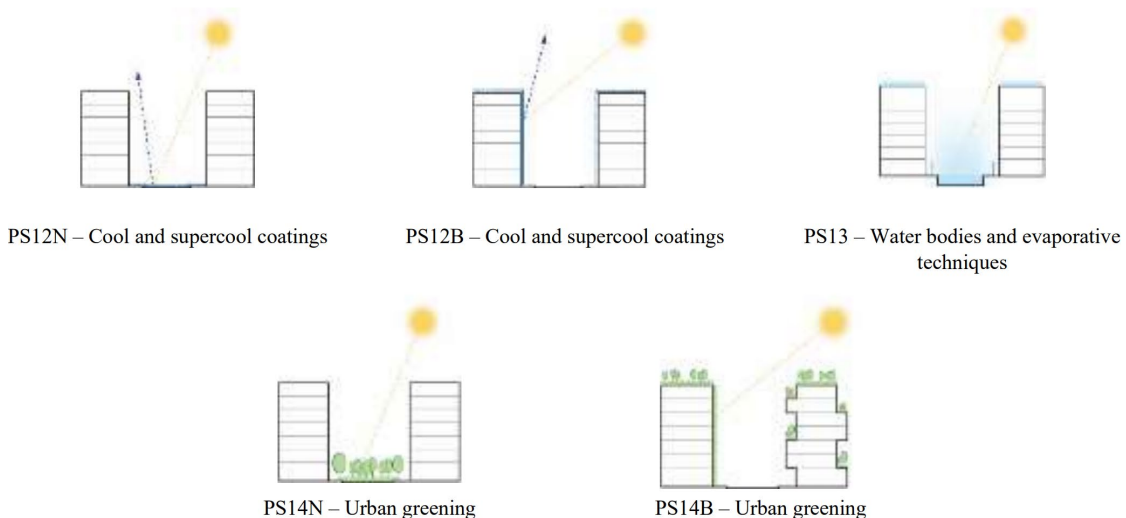


Figure 2. Other passive solar strategies applied to the planning and design at the neighbourhood and building scale, from M. Manni et al. (2023)



Active solar energy systems can be efficiently implemented in urban environments. Solar thermal and in particular, photovoltaic (PV) panels producing electricity are increasingly being used, especially when integrated into or added to building envelopes. Inter-building areas, pavements, roads, and urban furniture are also suitable surfaces for integrating solar systems and energy generation (see Report B1, Croce et al., 2022). Sun-tracking reflector systems for active daylighting control, concentrating and redirecting sunlight onto otherwise dark areas, are also labelled as active solar strategies.

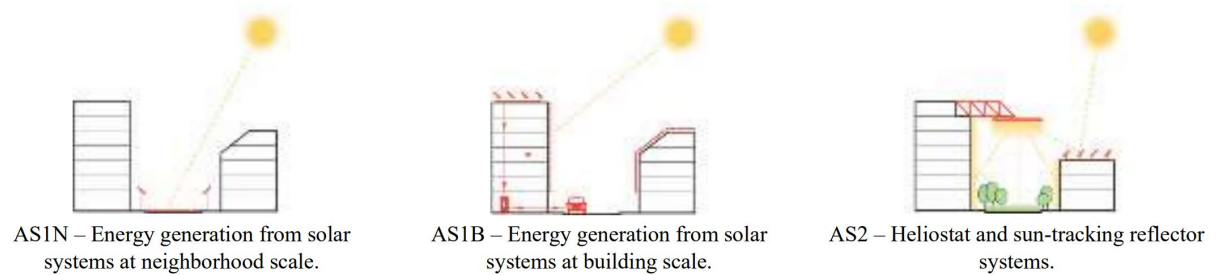


Figure 3. Active solar strategies applied to the planning and design at the neighbourhood and building scale, from M. Manni et al. (2023)

Challenges arise from the competing uses of urban surfaces and around the implementation of active and passive solar strategies in urban planning. The same surface can have multiple potential usages (e.g., green facade and roof, building integrated solar panels), and the same strategy can impact different parameters. For example, solutions to enhance access to daylight may also increase solar thermal stress, worsening the users' thermal comfort on hot days if the solar radiation is uncontrolled.

2.1.3 Digital tools

Many cities have developed solar cadastres for building roofs to inform stakeholders of areas with solar potential through various key performance indicators (KPIs). Such KPIs can, e.g., relate to energy, environmental or economic performances. However, estimating the solar potential of whole neighbourhoods is much more complex, in particular, the solar potential for facades due to inter-building reflections and shading phenomena taking place at the neighbourhood scale. Solar cadastres can be a valuable and useful source of information as urban and energy planning supporting tools, but still, developments are needed to identify and use common KPIs, standardized outputs, and visualizations to communicate technical information in a more user-friendly way (see Report C2, Kanters et al., 2024).

The digitalization of the built environment allows us to carry out performance predictions, analyse and compare different urban planning and design strategies in the early urban design phases (see Report A1, Hachem-Vermette, 2022), and assess, for example, the impact of climate change on the urban environment. Digitalization is also a key aspect for visualizing relevant solar data that, together with intelligible KPIs and a user-friendly interface, can (i) facilitate stakeholder involvement and citizen participation in the design process, (ii) promote the social acceptance of solar applications, and (iii) support municipalities in the development of roadmaps for solar energy implementation (see Report C1, Kanters et al., 2022).

2.2 Methodological contribution from the Swiss Partner

The Swiss partner (HEPIA) contributed to Task 63 methodological approaches both by working directly on the Taks activities and through related research projects that reflect many of the subtasks as shown in Figure 4.

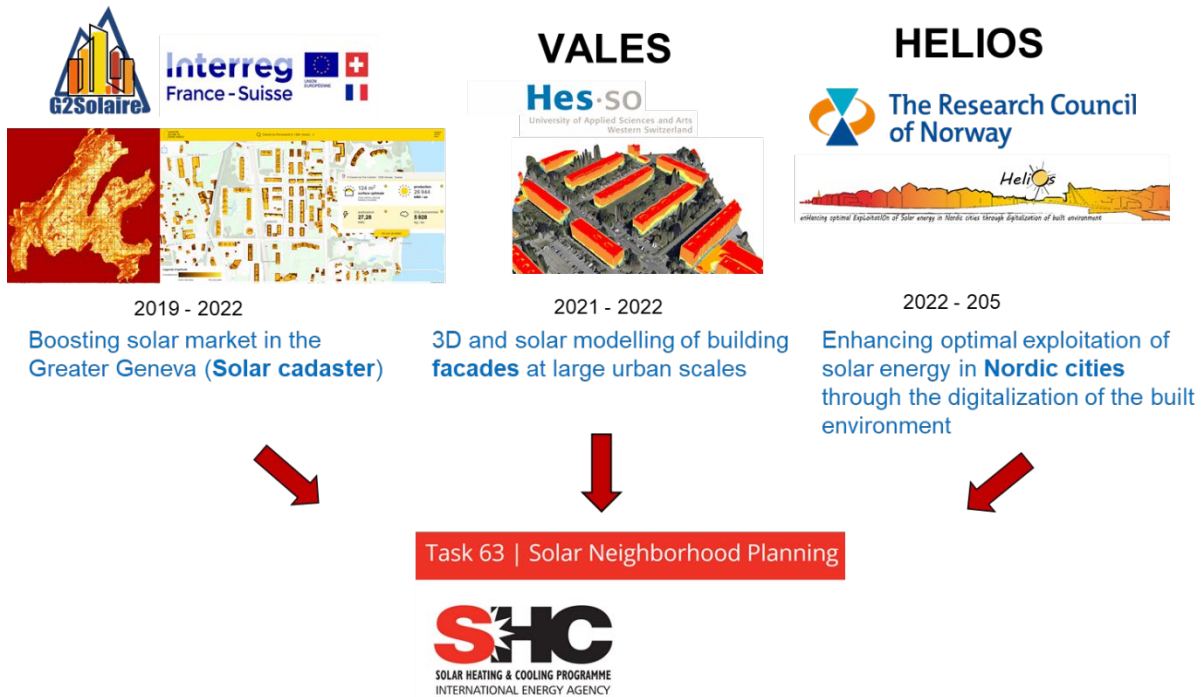


Figure 4. Overview of the HEPIA's contribution to Solar Task.

The Interreg G2 Solar project started in 2019 and ended in May 2022. It produced a solar cadastre of roofs for the Greater Geneva area (Swiss French region of 2000 km²). The main output is a web tool (<https://apps.sitg-lab.ch/solaire/>) (Figure 5) that allows anyone to simulate the self-consumption of solar energy in the building. Upcoming activities are planned for 2025 to develop and improve the web tool and to update the solar cadastre with new lidar and digital surface models.

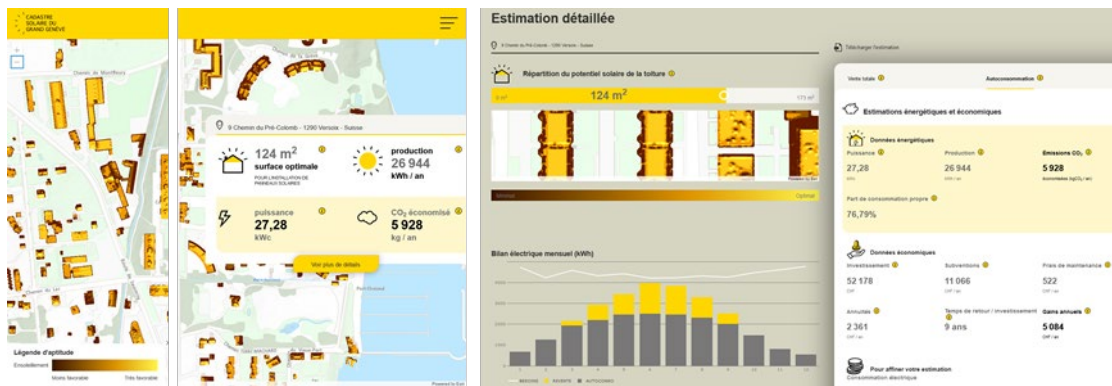


Figure 5. Extract from the solar cadastre of the Greater Geneva.

The VALES project (supported by HES-SO and SIG-Genève) aimed at developing an integrated tool to model the potential for solar energy production on facades, improving the level of detail of facades (using photogrammetry, machine learning, twin modelling) to detect windows and focusing on solar reflection at large scale in urban canyons. Concerning machine learning, a neural network has been trained on terrestrial images of buildings has been applied to aerial oblique orthophotos in order to detect windows. All the methodological background of the approaches are presented in Desthieux et al. (2023).

The image below illustrates for a building how such modelling can provide an energy balance for both roofs and facades.

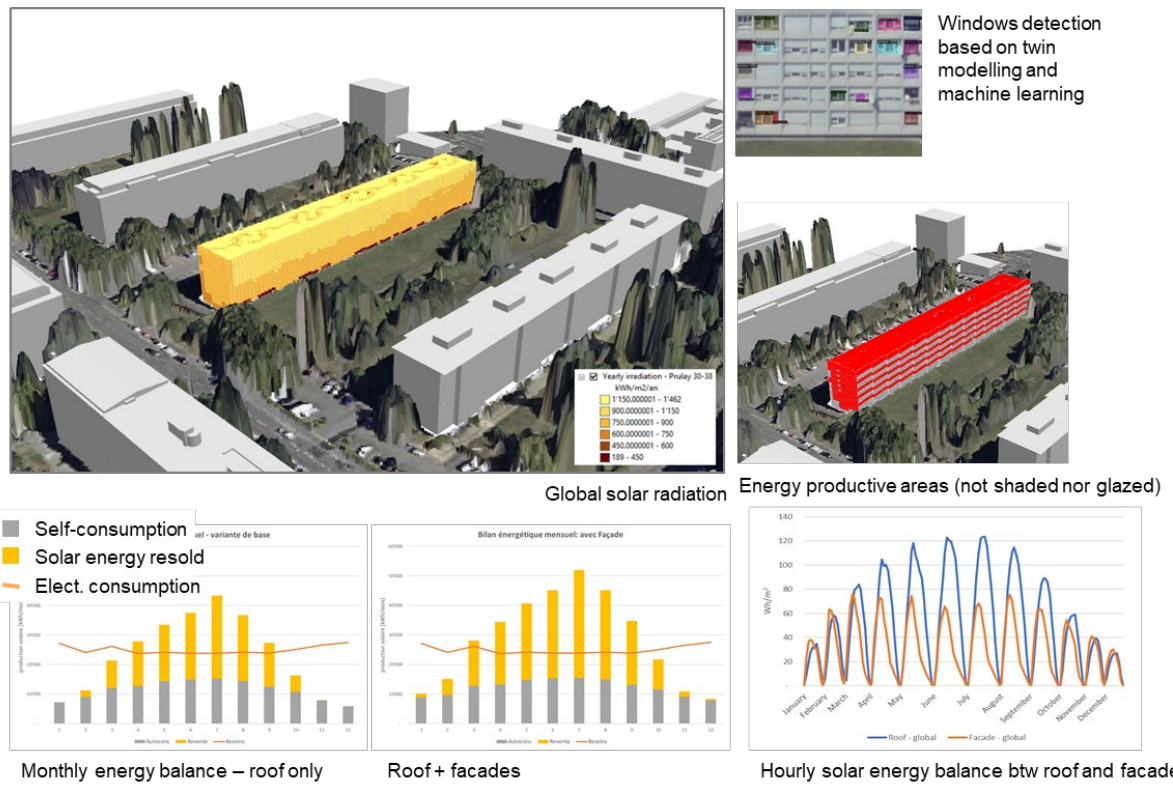


Figure 6. Example of solar energy balance on roofs and facades using modelling tools developed in VALES.

The VALES project started in 2020 and ended in December 2022. However, at the end of the project, a solar monitoring station (using a pyranometer) was installed in a real urban canyon in Geneva to compare real measurements with the solar model. The measurements have been collected during 2023 and are available to the partners of the Solar Task, among others.



Figure 7. Solar radiation monitoring station on an urban canyon in Geneva (rue des Grottes).



The project HELIOS (<https://www.ntnu.edu/helios>) (2023 – 2027) aims to accelerate the use of solar energy and the deployment of solar systems in the Nordic built environment through digital techniques using Trondheim as a pilot city. Contrary to popular belief, sunshine is significant at high altitudes, particularly between March and September. But solar heights remain low, so the project will focus on the solar potential of vertical façades. The project allows to further develop and consolidate the solar planning and modelling tools developed in the HEPIA projects and Task 63 through 4 PhD theses, and to apply them to the specific context of Nordic cities.

3 Results and discussion

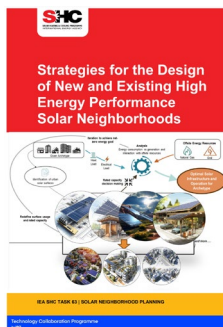
In this chapter, the results and deliverables for each subtask are first presented and discussed concerning their implications for solar neighbourhood planning in Switzerland (3.1). In the second section (3.2), the specific contributions of the Swiss partner are presented.

3.1 Global results of the Task 63¹

3.1.1 STA: Solar Planning Strategies and Concepts

A decision tool was developed to support the design of passive and active solar strategies at the level of existing or new neighbourhoods. This tool was tested with case studies corresponding to different archetypes. In addition, a comparative study of regulations and financial mechanisms related to urban and energy planning in Canada, Italy, Sweden, Norway, and Switzerland was conducted and published (see Section 7).

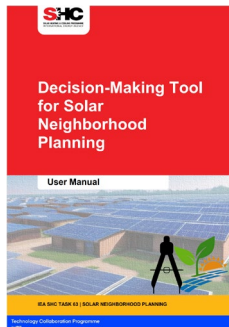
The deliverables from STA and the mains results are the following.



Report A1: Strategies for the Design of New and Existing High Energy Performance Solar Neighbourhoods

- Gives a comprehensive **overview of solar neighbourhoods**, including solar strategies, applications, standards, and regulations.
- Outlines the methodology and tools used to develop **archetype designs and analyses solar strategies** at both building and neighbourhood levels. Examples of archetypes applied to case studies around the world are presented.
- Provides a **decision-making tool** for solar strategies.

¹ The presentation of the results of Task 63 is based on the deliverables reports and their summaries presented by the Task (M. Wall) and Subtask Leaders (STA/C. Hachem-Vermette and K. Grewal, STB/S. Croce, STC/J. Kanters and M. Thebault, STD/G. Lobaccaro and M. Manni) during the Task 63 meeting in Oslo on 4th June 2024.



Report A2: Decision-Making Tool for Solar Neighbourhood Planning –User Manual

- Practical mean to implement the Solar neighbourhood strategies developed in A1.
- This **MS Excel tool** offers a structured approach to selecting sustainable solar strategies for neighbourhood development, catering to professionals such as architects, urban planners, energy planners, and policymakers -also in education.
- The tool considers various **passive and active solar strategies**, to enhance building performance and reduce energy consumption.
- The output of the tool provides **recommendations** for suitable solar strategies based on user inputs, helping users make informed decisions towards achieving their sustainability goals.

The Decision-Making Tool for Solar Neighbourhood Planning is available here: <https://task63.iea-shc.org/decision-making-tool>

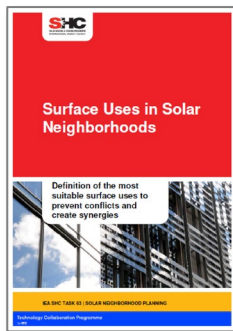
Implication for Switzerland:

- The A1 deliverable provides a systematic grid analysis of neighbourhood characteristics (metrics, building use and occupant profiles, energy demand, urban morphology, etc.), which is very useful to create a typology of neighbourhoods. This approach could be very interesting for the administrations of Swiss cities in order to address relevant energy transition strategies depending on the neighbourhood profiles that can be defined using the archetype matrix. The A1 report identifies relevant strategies for each type of neighbourhood.
- The Excel tool provides a practical means to prioritise solar energy actions for neighbourhood and buildings and could be used by Swiss urban and energy planners.
- An important aspect of the STA is to focus not only on active solar strategies, but also on passive strategies, in particular to improve access to daylight. This aspect is considered in the Swiss SIA standard 500, but it focuses mainly on lighting rooms with lamps, not particularly with natural light. Minergie provides a guideline on natural lighting, but Switzerland lacks a normative framework on this issue and, more globally, a strategic approach at the level of the neighbourhood, as pointed out in the STA.

3.1.2 STB: Economic Strategies and Stakeholder Engagement

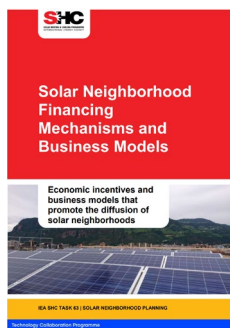
The STB focuses on strategies for increasing the use of passive and active solar energy considering three aspects: Urban surface uses and related benefits, Financing mechanisms and business models, Stakeholder engagement and behavioural design.

The deliverables from STB and the mains results are the following.



Report B1: Surface uses in solar neighbourhoods. Definition of the most suitable surface uses to prevent conflicts and create synergies.

- The aim to promote the **use of urban surfaces** in solar neighbourhoods by integrating the exploitation of solar energy with the enhancement of climate resilience and sustainability considering active solar energy systems, passive energy systems, green solutions (e.g. vegetation on rooftops mixed with solar panels), water solutions, urban agriculture, cool and innovative materials.
- Solar Neighbourhoods are urban areas planned to address not only the **production of renewable energy**, but also the **health and well-being** of their inhabitants.
- Urban surfaces can be a **key resource** for addressing issues related to urbanization and the associated effects of climate change (Urban climate management, Habitats & biodiversity preservation, Water management, Air quality amelioration, Renewable energy production, Fresh-water availability, Food provision).
- **Guidelines** on the main steps (see opposite) to be taken to consider surface uses during the design process, including methods and tools appropriate to the process, practical examples, and references to scientific literature.



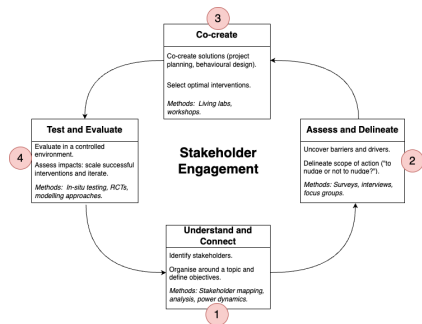
Report B2: Solar Neighbourhood Financing Mechanisms and Business Models.

- The aim is to understand **how to finance the transition and support the development of solar neighbourhoods**, moving from energy markets to added value services.
- The approach considers three aspects: (1) **Economics of solar neighbourhood development** (economic drivers in particular incentives, market potential for the solar projects development, investment profiles), (2) **Financing solar neighbourhoods** (categorisation of mechanisms: public / private - traditional / innovative, project financing timeline), (3) **Solar neighbourhood business models and case studies** (Develop-to-Own model, Develop-to-Release model, Develop-to-Host model).



Report B3: An Integrated Framework for Stakeholder and Citizen Engagement in Solar Neighbourhoods.

- The aim is to recommend appropriate activities for **stakeholder engagement/nudging strategies**, and to integrate lessons learned into urban planning practice.
- A series of **expert workshops** were held around three key themes: stakeholder typology analysis, behavioural design, integrating behavioural design and traditional stakeholder engagement approaches based on a systematic framework (see opposite).



- Collection of **case studies reporting stakeholder engagement actions** in solar neighbourhoods (Italy, Australia, Norway, France, Switzerland)

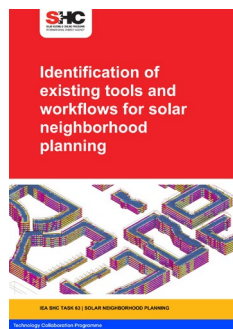
Implication for Switzerland:

- In Switzerland, cities and neighbourhoods, and in particular the use of urban surfaces, are still too often planned on a sectoral basis, with energy, greening, urban climate comfort, etc. being considered separately. Many conflicts often arise when the same surfaces are used for different purposes, for example on rooftops (energy production, vegetation, urban agriculture, cooling and ventilation technology, accessible terraces, etc.). Deliverable B1 therefore provides practical guidelines with examples and references that can help Swiss urban planners to develop a more holistic planning approach that reconciles different surface uses.
- Even if the development of community solar energy projects in Switzerland is well regulated by the federal laws on energy and electricity supply, through the grouping of self-consumers and soon of local electricity communities, deliverables B2 and B3 offer interesting insights to explore different financial mechanisms and business models, and a framework to identify and empower the stakeholders concerned (the framework has been tested in a case study in Geneva).

3.1.3 STC: Solar Planning Tools

STC dedicated efforts to developing digital urban solar modelling tools and refining the data workflow and management processes for these tools. In addition, relevant Key Performance Indicators (KPIs) have been developed based on an inventory of the most commonly used indicators to support decision making.

The deliverables from STC and the mains results are the following.



Report C1: Identification of existing tools and workflows for solar neighbourhood planning.

- **Inventory of common indicators** related to regulation on direct solar access, daylight and active solar strategy in European countries and also in China and Australia.
- **Workflows stories:** highlights how commercial and non-commercial players have worked with tools in the planning process for solar neighbourhoods. Set of examples of solar neighbourhood projects (passive and active) and the modelling tools used to support the projects design.
- **Benchmarking study:** Illustrating differences between commonly used tools by analysing their performances, and their workflows. The focus is on the vertical surfaces, and the benchmarking is carried out on a virtual neighbourhood. Tools benchmarked: CitySim (Energy in cities), Diva (Daylighting), EnviMet (Urban microclimate), Indalux (Daylighting), LadyBug-LB (Daylighting), Honeybee-HB (Daylighting), De Luminae (Daylighting), Solar Cadastre of Geneva (Solar Map), htrdr (MESO-star) (Physic model), SpaceMaker (BIM). The



benchmarking results show: as many different results as tools, small variations when direct sunlight, no single tool constantly over-or under-estimates hourly spatially-aggregated results.



Report C2: Opportunities for Improved Workflows and Development Needs of Solar Planning Tools.

- **Current use of the tools in the design process:** a framework is developed to determine which tool and type of modelling fit the best for each urban planning and building design process stage, also considering the data availability used by the tools, the KPIs, and the actors.
- **Mapping the solar potential:** Solar maps, maps showing the potential of installing active solar energy production on existing buildings, are often used as a first step to acquire information about this potential. Nevertheless, the rapid expansion and availability of such tools make them more and more attractive to support local stakeholders such as the authorities, the citizens, industries etc. Therefore, in this subtask, a benchmark of the most recent solar maps and cadastres was carried out, as well as a typology of the indicators used to communicate the solar potential (energy, technical, economic, environmental, other).
- **Opportunities & needs for the use of solar planning tools:** this last activity drew out some perspectives to improve the use of modelling tools and indicators like to reflect better on their added value in the solar projects, the need of simplification of methods, tools and metrics, better tool interoperability and interscalability, the use of tools to support solar readiness and solar rights.

Implication for Switzerland:

- The subtask first put into perspective the different regulations on solar energy and the related indicators and thresholds, such as the obligation or not to install solar panels on rooftops and what proportion (e.g. minimum 10 Wp/m² of floor area in Geneva). This overview can be a source of comparison and inspiration for the development of solar energy planning policies and regulations in Switzerland, and related indicators and legal thresholds.
- Most of the tools benchmarked in this subtask are widely used by professionals in Switzerland. But the framework proposed in C2 can help planners and engineers to use them better in line with planning and design, to guide them on the type of data to collect and the KPIs to communicate.
- In Switzerland, many solar cadastres and maps are available at national (Solardach.ch), cantonal and local levels. The benchmarking of solar cadastres around the world and the indicators can be a source of inspiration for Swiss solar cadastres to consider innovative and new ways of communicating solar potential.

3.1.4 STD: Case studies

STD provided a collection of 20 case studies that showcase both active and passive solar projects in different contexts.



D1: Case study collection on How to integrate active and passive solar strategies in New and Existing Solar Neighbourhoods?

- The **collection of the case studies** is presented through a Web platform (<https://task63.iea-shc.org/case-studies>) related to the Subtask D "Case studies" within the IEA SHC Task 63 "Solar Neighbourhood Planning" and the Subtask C "Case studies and action research" within the IEA SHC Task 51 "Solar Energy in Urban Planning".
- In the map all the analysed case studies are marked according to the different environments. For each case study a dedicated **brochure** (.pdf file) describing the case study in detail can be downloaded by the users.

Implication for Switzerland:

- This platform offers a very rich collection of examples of solar planning representative of different contexts (new and existing urban areas, passive and active strategies, integration of solar with other urban surface uses, etc.). If the presented cases are specific to local regulations and practices, they are also sources of inspiration for urban solar planning in Switzerland.

3.1.5 Key points

From the results presented previously, the key points and main findings of the Task 63 are the following:

- Development of enhanced solutions for architectural integration of solar systems, to enable greater flexibility in the design –to increase acceptance.
- Efficient use approach of urban surfaces –for solar energy production, green areas, local food production –to achieve healthy environments and sustainable cities not dependent on energy and food imports.
- Development of tools handling the neighbourhood scale, need to improve tool interoperability, development of Key Performance Indicators and target values for solar related indicators.
- Planning approach for "solar-ready" neighbourhoods and cities –Detailed Development Plans
- Need of legal reforms as to solar access protection to secure investments in renewable energy and sustainable developments. ("Right to Light" –and "Right to Shade")
- Need of improving planning approval processes where informed decisions can be made.
- Definition of business models for solar neighbourhoods to ensure long-term viability and include and elucidate added values (human health and well-being, resilience, energy security, biodiversity etc)
- Improvement of knowledge transfer, involving stakeholders and citizens in the planning and developments



3.2 Specific results and contributions from the Swiss partner

The Swiss partner (HEPIA) played an active role in each of the sub-tasks, either directly or through complementary projects (G2 Solaire, VALES, HELIOS):

- STA: Contribution to the elaboration of a decision-making tool for the implementation of solar strategies in existing and new buildings & neighbourhoods; contribution to the work on design archetypes and solar strategies, based on the case study of Carl Vogt in Geneva.
- STB: Contribution to the workflow process addressing multi-surface, multi-object uses in the urban environment according to a multi-criteria framework, providing case studies; feasibility studies on solar projects for 100 buildings owned by the members of the association 2050Today, with particular emphasis on financial mechanisms and stakeholder engagement.
- STC: Work on existing tools and workflows for solar district planning; development of a workflow (related to the G2 Solar project) to simulate the self-consumption of solar energy by buildings at an urban scale (Figure 8); work on typical framework processes to create robust KPIs for public display on web interfaces and data availability.
- STD: Contribution to the collection of case studies, with two Swiss case studies in Geneva, the first one related to the development of a new neighbourhood in PAV (Praille-Acacias-Vernets) and the solar simulation access on roofs and facades, the second one related to the development of a solar microgrid that distributes the energy from a central solar installation to 6 industrial owners in the industrial district of ZIBAY (Figure 9).

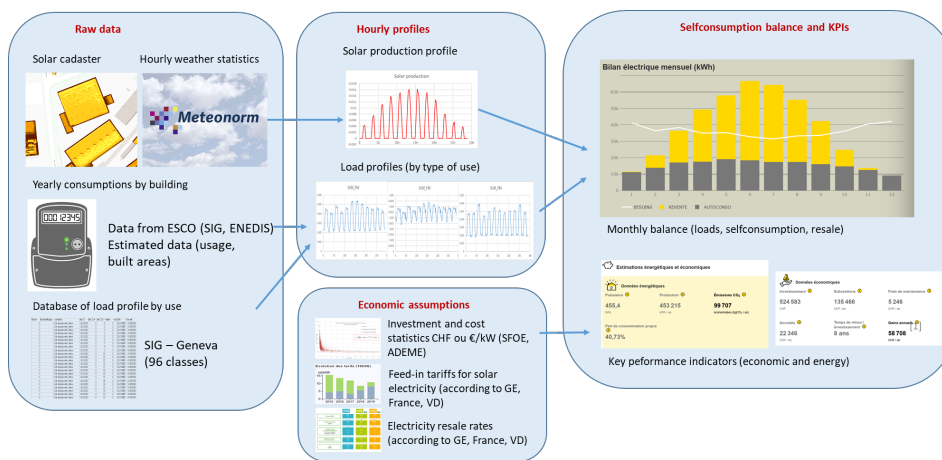


Figure 8. Process for self-consumption of Solar PV simulation applied for the solar cadastre of the Greater Geneva



Figure 9. case studies of PAV Grosselin (left) and ZIBAY (right)



4 Conclusions

The results of Task 63 provide a wealth of material in terms of methodologies, concepts, references, tools and practical examples that can support Swiss cities, urban planners and professionals in the planning of solar access to existing and new neighbourhoods.

The main findings useful for Switzerland can be summarized as follows.

The task highlighted the importance of the neighbourhood scale for solar energy planning, in order to create solar communities by grouping and sharing solar installations, as is done in Switzerland (grouping of own consumers). It also emphasized the different uses of solar energy (passive like daylight, passive heating and active for energy production) and how they can be implemented in neighbourhoods. This scale is also strategic to arbitrate between different uses of the surface (vegetation, solar energy) and to combine them.

The Task highlighted the large panel of legislations and regulations in terms of solar and building energy between the countries. Switzerland, and in particular cantons like Geneva, is very advanced in the use of solar energy for new buildings and renovations, promoting the phasing out of fossil fuels for heating. In fact, the installation of solar panels on the roofs of new and renovated buildings is mandatory, which is not the case in most other countries. However, it is behind for the creation of solar energy communities at the level of cities. But the recent vote on the law of June 9th will contribute to fill this gap through the local electric communities. Another aspect that is still missing in Switzerland is the regulation of the right to light or sun in the building environment, as is done in the UK or Sweden for example.

The Task enabled to make the state of the art and benchmark of numerous solar cadastres, maps and web applications developed at the cities, regions and countries. It dressed the list of the most common and recurrent Key Performance Indicators (KPI) of solar energy, as a reference for any further solar map development. The benchmark also emphasized the Geneva information system (SITG) offers a very complete open data frameworks used by international researchers for testing innovative urban environments model on climate, energy. The solar cadastre of the Greater allows the simulation in advance of the self-consumption of solar PV for each building of the region.

Finally, the Task has contributed to the creation of an international network of experts in urban solar energy planning that will continue to work and collaborate on innovative solutions for the energy transition and the achievement of zero carbon.

5 Outlook and next steps

In the next steps, the Swiss partner will continue to work with other international partners on joint publications to promote the work done in the Task. In particular, papers are being prepared for the conferences: 19th SDEWES Conference 2024 in Rome and EuroSun 2024 in Limassol.

Pending issues that need additional research concern, first of all, the economic optimization of solar installations in the built environment depending on variables such as investment costs, self-consumption, electricity prices (purchase and resale), discount rate. The University of Lund, the University of Savoie-Mont Blanc and HEPIA continue to collaborate on this issue, working on a comparative study of these variables in the European countries and the definition of the minimum irradiation threshold that allows a payback period of less than 10 years, for example. The work should also take into account the forecast of the evolution of the electricity purchase price and solar power resale price over the next 30 years.

Another issue is the *right to light* in the built environment. In fact, any new tall building can create additional shadows on the surrounding facades of existing buildings. The building ordinance of the Canton of Berne (art. 22 al. 3) requires to verify that new tall buildings (>30m) do not shade neighbouring



building facades for more than 2 hours on February 8 (representative day of winter) and March 21 (equinox). The Canton of Geneva uses this ordinance as jurisprudence for new building developments. Outside of this ordinance, there is a regulatory gap on this issue in Switzerland. In addition, new projects can also overshadow existing solar installations, but there is no regulation on this either. Therefore, based on the tools developed for urban solar modelling, HEPIA is working on the assessment of the shadowing of new building projects on the surrounding urban environment.

Finally, the tools for solar modelling and 3D building modelling will be further developed and refined in the HELIOS project in collaboration between HEPIA and NTNU.

6 National and international cooperation

20 institutions (academic and consultancy) from 10 countries actively participated in the task and contributed to the excellent results:

- Australia: Australian PV Institute (APVI)
- Canada: University of Calgary, Concordia University, University of Prince Edward Island, Toronto Metropolitan University
- China: China National Engineering Research Center for Human Settlements, China Agricultural University, Xi'an Jiaotong University
- Denmark: Dansk Energi Management, Solar City Denmark
- France: University of Savoie Mont-Blanc, University of Lyon (CETHIL)
- Italy: University of Padova, Eurac Research Institute for Renewable Energy
- Norway: Norwegian University of Science and Technology (NTNU), SINTEF and Multiconsult Norge AS
- Slovakia: University of Zilina
- Sweden: University of Lund, White Arkitekter AB
- Switzerland: HEPIA / HES-SO



Figure 10. Panel of the national experts during the meeting in the University of Padova 2023

The international cooperation was carried out through:

Meetings and workshops every 6 months with the national experts, physically (Chambery 2019, Calgary 2022, Trondheim and Padova 2023) and remotely during the Covid period.

- Joint works on the deliverables and reports.
- Collaboration on the scientific papers.
- Participation in public seminars (during the semester meetings) and in the Executive Committee meetings of the IEA SHC members.



7 Publications

Task 63 reports

The website <https://task63.iea-shc.org/publications> contains all the reports written by the international experts and published in the Task 63.

Here is the list of reports with the hyperlinks for free download:

[Technology Position Paper of the Task 63 \(Wall, 2024\)](#)

[A1: Strategies for the design of new and existing high energy performance solar neighborhoods \(Hachem-Vermette et al., 2022\)](#)

[A2: Decision-Making Tool for Solar Neighborhood Planning – User Manual \(Grewal and Hachem-Vermette, 2024\)](#)

[B1: Surface uses in solar neighborhoods. Definition of the most suitable surface uses to prevent conflicts and create synergies \(Croce et al., 2022\)](#)

[B2: Solar Neighborhood Financing Mechanisms and Business Models \(Wilczynski, 2024\)](#)

[B3: An Integrated Framework for Stakeholder and Citizen Engagement in Solar Neighborhoods \(Caballero, et al., 2024\)](#)

[C1: Identification of existing tools and workflows for solar neighborhood planning \(Kanters et al., 2022\)](#)

[C2: Opportunities for Improved Workflows and Development Needs of Solar Planning Tools \(Kanters et al., 2024\)](#)

[D: Case study collection \(Lobaccaro et al., 2024\)](#)

Journal papers

Martin Thebault, Vincent Clivillé, Lamia Berrah, Gilles [Desthieux](#). Multicriteria roof sorting for the integration of photovoltaic systems in urban environments. *Sustainable Cities and Society*, Elsevier, 2020, 60, pp.102259. <https://doi.org/10.1016/j.scs.2020.102259>

Stendardo, N.; [Desthieux](#), G.; Abdennadher, N.; Gallinelli, P. GPU-Enabled Shadow Casting for Solar Potential Estimation in Large Urban Areas. Application to the Solar Cadaster of Greater Geneva. *Appl. Sci.* 2020, 10, 5361. <https://doi.org/10.3390/app10155361>

Govehovitch, B.; Thebault, M.; Bouty, K.; Giroux-Julien, S.; Peyrol, É.; Guillot, V.; Ménézo, C.; [Desthieux](#), G. Numerical Validation of the Radiative Model for the Solar Cadaster Developed for Greater Geneva. *Appl. Sci.* 2021, 11, 8086. <https://doi.org/10.3390/app11178086>

Thebault M., [Desthieux G.](#), Castello R., Berrah L., 2022. Large-scale evaluation of the suitability of buildings for photovoltaic integration: Case study in Greater Geneva. *Applied Energy* 316 (2022), <https://doi.org/10.1016/j.apenergy.2022.119127>

Raybaud B., [Desthieux G.](#), 2022. Adapted strategy for large-scale assessment of solar potential on facades in urban areas focusing on the reflection component, *Solar Energy Advances*, Volume 2, 100030, <https://doi.org/10.1016/j.seja.2022.100030>

Manni M., Formolli M., Boccalatte A., Croce S., [Desthieux G.](#), Hachem-Vermette C., Kanters J., Ménézo C., Snow M., Thebault M., Wall M., Lobaccaro G., 2023. Ten questions concerning planning and design strategies for solar neighborhoods, *Building and Environment*, Volume 246, 110946, <https://doi.org/10.1016/j.buildenv.2023.110946> .

[Desthieux G](#) and [Thebault M](#) (2024) Solar governance for the transborder agglomeration of the Greater Geneva based on the solar cadaster development. *Front. Built Environ.* 10:1347056. <https://doi.org/10.3389/fbuil.2024.1347056>



Hachem Vermette C, Yadav S, Brozovsky J, Croce S, Desthieux G, Formolli M, Grewal KS, Kanters J, Lobaccaro G, Manni M and Wall M (2024), Towards the development of legislative framework for solar neighborhoods. *Front. Built Environ.* 10:1352844. <https://doi.org/10.3389/fbuil.2024.1352844>

Conference papers

Thebault, M., Berrah, L.A., Desthieux, G., Ménézo, C. 2019. Towards a Solar Cadastre For The Monitoring of Solar Energy Urban Deployment: The Case of Geneva. Solar World Congress, 04-07 Novembre 2019, Santiago, Chili, DOI:10.18086/swc.2019.51.04

Thebault, M., Bouty, K., Caliot, C., Compagnon, R., Desthieux, G., Formolli, M., Giroux - - Julien, S., Govehovitch, B., Guillot, V., Herman, E., Kanters, J., Kämpf, J., Lobaccaro, G., Ménézo, C., Peronato, G., Petersen, A.J., 2021. A Comparative Study Of Simulation Tools To Model The Solar Irradiation On Building Facades, Solar World Congress 2021, Virtual Congress, Proceedings - ISES Solar World Congress 2021 doi:10.18086/swc.2021.38.04

Desthieux G., Gressin A., Raybaud B., Ingensand J., 2023. Solar potential on facades at urban scale: an integrated approach combining solar and digital building modelling., *Journal of Physics: Conference Series* ; Proceedings of CISBAT2023, the built environment in transition, Volume 2600, 042004, <https://doi.org/10.1088/1742-6596/2600/4/042004>. (*Best Paper Award*)

Conferences, workshops, seminars

Desthieux G., *Neighborhood energy retrofit. The case of Cité Carl Vogt, Geneva*, in: COST PED-EU-NET 1st URBAN STAKEHOLDERS WORKSHOP “Sharing best practices and facilitating the science-policy dialogue “Sapienza” University of Rome, Rome, (IT) - 6 & 7 October 2021

Desthieux G., *Neighborhood energy retrofit. The case of Cité Carl Vogt, Geneva*, in: CAE Roadmap to Resilient Ultra-Low Energy Built Environment with Deep Integration of Renewables in 2050 – Low-Carbon and Positive Energy Resilient Communities Webinar – 12.10.2021. Webinar organized by the Canadian Academy of Engineering.

Desthieux G., *Research activities related to Solar Task 63*, in: SHC ExCo Meeting - OFEN, 01.06.2022, Rapperswil (Switzerland)

Desthieux G., *Solar modelling tools for energy urban planning. Application to the solar cadaster of the Greater Geneva*, in: Masterclass DATASUN thematic school (Solar Academy USMB) “”, Grand Bornand 16.11.2022.

Desthieux G., *How to boost major solar projects in building environment: the example of a village in Geneva*, Switzerland, in. IEA Task 63 public seminar, 23.09.2022, Calgary, Canada.

Desthieux G., *Adapted strategy for large-scale assessment of solar potential on facades in urban areas. Application to Geneva*, in: IEA Task 63 public seminar, 10.03.2023, Trondheim, Norway.

Desthieux G., *Multi-use PV solar installation project for the mental disability care center “Aigues Vertes” in Geneva*, Switzerland, in: IEA Task 63 public seminar, 29.09.2023, Padova, Italy.

Desthieux G., *Solar planning support based on the assessment of solar potential on roofs and facades in urban areas. Application to solar cadastre and case studies in Geneva*, in: Seminar Solenergi i stadsplanering / Solar Neighborhood Planning, 14.05.2024, University of Lund, Sweden.

Desthieux G., *Self-consumption of solar energy modelling: application to the solar cadaster of the Greater Geneva*, in: SHC ExCo Meeting: final dissemination event of Task 63, 04.06.2024, Oslo & online meeting, Norway.