



Schweizerische Eidgenossenschaft
Confédération suisse
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Federal Department of the Environment, Transport,
Energy and Communications DETEC

Swiss Federal Office of Energy SFOE
Energy Research and Cleantech

Report dated: 30.04.2026

Reporting period: 01.04.2025 - 31.03.2026

Annual Report Year 4 – Public Part

LANTERN



Source: ©SWEET Lantern 2025, Winterthur



Date: 30.04.2026

Location: Bern

Publisher:

Swiss Federal Office of Energy SFOE
Energy Research and Cleantech
CH-3003 Bern
www.bfe.admin.ch

SWEET Call: 1-2021

Annual report template: v3.1

Subsidy recipient:

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Executive summary

Lantern develops and tests practical ways to support Switzerland's energy transition in everyday life. The programme focuses on how people live, work, move, renovate buildings, cooperate around renewable energy, and make choices that influence energy use. Its overall aim is to help make the transition not only technically feasible, but also socially acceptable, fair, and effective over the long term.

To do this, Lantern combines research with experimentation in real-world settings. It works through living labs in different Swiss contexts, where researchers, public authorities, companies, citizens, and other partners jointly explore solutions, test them, and assess their relevance for wider implementation. This approach allows the programme to connect scientific evidence with practical decision-making.

During the first four years, Lantern has built a strong living lab ecosystem and a shared methodological basis across the consortium. In Year 4, an important step was the completion of the living lab set-up phase and the integration of the Geneva living lab, which strengthened the programme's capacity in urban transition, participation, and support for building renovation. The programme also improved its internal coherence through a mid-term realignment process, a stronger portfolio view of interventions, and common work on impact assessment.

Year 4 produced several important results. New tools were developed to support decisions in companies, municipalities, and neighbourhoods. These include a tool to assess the energy and carbon dioxide effects of different working models, a simulation tool for local energy communities, and refined methods to support the co-design of neighbourhood energy cooperation. The programme also generated new evidence from real-life interventions. In mobility, long-term analyses of the Winterthur car-free challenge showed lasting changes in travel behaviour. In buildings, low-tech and high-tech retrofit solutions were tested and assessed, including passive cooling approaches and innovative renovation systems. In tourism and leisure, participatory tools were further developed to support low-carbon planning and behaviour change.

These achievements matter because they go beyond producing academic knowledge. They help public authorities, companies, and local actors make better decisions, test new approaches, and prepare implementation pathways. In this way, Lantern contributes to Switzerland's Energy Strategy 2050 and climate goals by supporting energy sufficiency, better use of buildings and infrastructure, lower mobility-related emissions, stronger local use of renewable energy, and more socially robust transition strategies.



Zusammenfassung

Lantern entwickelt und testet praxisnahe Ansätze, um die Energiewende in der Schweiz im Alltag zu unterstützen. Das Projekt untersucht, wie Menschen wohnen, arbeiten, sich fortbewegen, Gebäude sanieren, bei erneuerbarer Energie zusammenarbeiten sowie Entscheidungen treffen, die den Energieverbrauch beeinflussen. Ziel ist es, die Energiewende nicht nur technisch umsetzbar, sondern auch sozial akzeptiert, fair und langfristig wirksam zu gestalten.

Um dies zu erreichen, verbindet Lantern Forschung mit Experimenten in realen Anwendungsumgebungen. Das Projekt arbeitet mit sogenannten Living Labs in unterschiedlichen Schweizer Kontexten. Dort erarbeiten Forschende, Behörden, Unternehmen, Bürgerinnen und Bürger sowie weitere Partner gemeinsam Lösungen, testen diese und prüfen ihr Potenzial für eine breitere Umsetzung. So werden wissenschaftliche Erkenntnisse direkt mit praktischen Entscheidungsprozessen verknüpft.

In den ersten vier Jahren hat Lantern ein starkes Living-Lab-Ökosystem sowie eine gemeinsame methodische Grundlage innerhalb des Konsortiums aufgebaut. Ein wichtiger Schritt im vierten Jahr war der Abschluss der Aufbauphase der Living Labs sowie die Integration des Living Labs in Genf, wodurch die Kompetenzen des Projekts in den Bereichen urbane Transformation, Partizipation und Begleitung von Gebäudesanierungen gestärkt wurden. Zudem verbesserte das Projekt seine interne Kohärenz durch eine Neuausrichtung zur Halbzeit, einen klareren Überblick über die verschiedenen Interventionen und eine gemeinsame Weiterentwicklung der Wirkungsanalyse.

Im vierten Jahr wurden mehrere wichtige Ergebnisse erzielt. Es wurden neue Instrumente entwickelt, um Entscheidungsprozesse in Unternehmen, Gemeinden und Quartieren zu unterstützen. Dazu gehören ein Instrument zur Bewertung der Energie- und Kohlendioxidauswirkungen verschiedener Arbeitsmodelle, ein Simulationswerkzeug für lokale Energiegemeinschaften sowie weiterentwickelte Methoden für die gemeinsame Gestaltung von Energiekooperationen auf Quartiersebene. Das Projekt lieferte zudem neue Erkenntnisse aus Interventionen unter realen Bedingungen. Im Bereich Mobilität zeigten Langzeitanalysen der autofreien Challenge in Winterthur dauerhafte Veränderungen im Mobilitätsverhalten. Im Gebäudebereich wurden Low-Tech- und High-Tech-Sanierungslösungen getestet und bewertet, darunter passive Kühlungsansätze und innovative Renovationssysteme. Im Bereich Tourismus und Freizeit wurden partizipative Werkzeuge weiterentwickelt, um klimafreundliche Planung und Verhaltensänderungen zu fördern.

Diese Ergebnisse sind bedeutsam, weil sie über die Generierung akademischen Wissens hinausgehen. Sie helfen Behörden, Unternehmen und lokalen Akteuren, fundiertere Entscheidungen zu treffen, neue Ansätze zu testen und Wege zur Umsetzung vorzubereiten. Auf diese Weise leistet Lantern einen Beitrag zur Energiestrategie 2050 und zu den Klimazielen der Schweiz, indem es Energiesuffizienz, eine bessere Nutzung von Gebäuden und Infrastrukturen, tiefere verkehrsbedingte Emissionen, eine stärkere lokale Nutzung erneuerbarer Energie sowie sozial tragfähigere Transformationsstrategien unterstützt.



Résumé

Lantern développe et teste des solutions concrètes pour soutenir la transition énergétique en Suisse dans la vie quotidienne. Le programme s'intéresse à la manière dont les personnes habitent, travaillent, se déplacent, rénovent les bâtiments, coopèrent autour des énergies renouvelables et prennent des décisions qui influencent la consommation d'énergie. Son objectif global est de rendre la transition non seulement techniquement possible, mais aussi socialement acceptable, équitable et efficace à long terme.

Pour cela, Lantern combine recherche et expérimentation dans des contextes réels. Le programme s'appuie sur des living labs implantés dans différents contextes suisses, où chercheurs, autorités publiques, entreprises, citoyennes et citoyens ainsi que d'autres partenaires conçoivent ensemble des solutions, les testent et évaluent leur potentiel de diffusion. Cette approche permet de relier les connaissances scientifiques à la prise de décision concrète.

Au cours des quatre premières années, Lantern a construit un solide écosystème de living labs et une base méthodologique commune à l'ensemble du consortium. En année 4, une étape importante a été l'achèvement de la phase de mise en place des living labs ainsi que l'intégration du living lab de Genève, ce qui a renforcé les capacités du programme en matière de transition urbaine, de participation et d'accompagnement des rénovations de bâtiments. Le programme a également amélioré sa cohérence interne grâce à un réalignement à mi-parcours, à une vision plus claire du portefeuille d'interventions et à un travail commun sur l'évaluation d'impact.

L'année 4 a produit plusieurs résultats importants. De nouveaux outils ont été développés pour appuyer les décisions dans les entreprises, les communes et les quartiers. Parmi eux figurent un outil d'évaluation des effets énergétiques et des émissions de dioxyde de carbone de différents modèles d'organisation du travail, un outil de simulation pour les communautés énergétiques locales, ainsi que des méthodes renforcées pour la co-conception de coopérations énergétiques de quartier. Le programme a aussi généré de nouvelles connaissances issues d'interventions en situation réelle. Dans le domaine de la mobilité, les analyses à long terme du défi sans voiture à Winterthour ont montré des changements durables dans les comportements de déplacement. Dans le domaine des bâtiments, des solutions de rénovation low-tech et high-tech ont été testées et évaluées, notamment des approches de refroidissement passif et des systèmes de rénovation innovants. Dans le domaine du tourisme et des loisirs, des outils participatifs ont été approfondis pour soutenir une planification sobre en carbone et des changements de comportement.

Ces avancées sont importantes car elles vont au-delà de la seule production de connaissances académiques. Elles aident les autorités publiques, les entreprises et les acteurs locaux à prendre de meilleures décisions, à tester de nouvelles approches et à préparer des trajectoires de mise en œuvre. De cette manière, Lantern contribue à la Stratégie énergétique 2050 et aux objectifs climatiques de la Suisse en soutenant la sobriété énergétique, une meilleure utilisation des bâtiments et des infrastructures, une réduction des émissions liées à la mobilité, un usage plus fort des énergies renouvelables locales et des stratégies de transition plus robustes sur le plan social.



Riassunto

Lantern sviluppa e sperimenta soluzioni pratiche per sostenere la transizione energetica in Svizzera nella vita quotidiana. Il programma si concentra su come le persone abitano, lavorano, si spostano, ristrutturano gli edifici, collaborano attorno alle energie rinnovabili e prendono decisioni che influenzano il consumo di energia. L'obiettivo generale è rendere la transizione non solo tecnicamente realizzabile, ma anche socialmente accettabile, equa ed efficace nel lungo periodo.

Per farlo, Lantern combina ricerca e sperimentazione in contesti reali. Il programma opera attraverso living lab in diversi contesti svizzeri, nei quali ricercatori, autorità pubbliche, imprese, cittadini e altri partner sviluppano insieme soluzioni, le testano e ne valutano la rilevanza per una più ampia applicazione. Questo approccio permette di mettere in connessione la conoscenza scientifica con i concreti processi decisionali.

Nei primi quattro anni, Lantern ha costruito un solido ecosistema di living lab e una base metodologica condivisa all'interno del consorzio. Nel quarto anno, un passo importante è stato il completamento della fase di avvio dei living lab e l'integrazione del living lab di Ginevra, che ha rafforzato la capacità del programma nei campi della transizione urbana, della partecipazione e del supporto alla ristrutturazione degli edifici. Il programma ha inoltre migliorato la propria coerenza interna grazie a un riallineamento di medio termine, a una visione più chiara dell'insieme di interventi e a un lavoro comune sulla valutazione dell'impatto.

Il quarto anno ha prodotto diversi risultati importanti. Sono stati sviluppati nuovi strumenti per sostenere le decisioni di imprese, comuni e quartieri. Tra questi vi sono uno strumento per valutare gli effetti energetici e le emissioni di CO₂ dei diversi modelli di lavoro, uno strumento di simulazione per le comunità energetiche locali e il miglioramento di metodi per supportare attività di co-progettazione in processi di cooperazione energetica a livello di quartiere. Il programma ha inoltre generato nuove evidenze da interventi in condizioni reali. Nel campo della mobilità, le analisi di lungo periodo della sfida senza auto di Winterthur hanno mostrato cambiamenti duraturi nei comportamenti. Nel campo degli edifici, sono state testate e valutate soluzioni di riqualificazione low-tech e high-tech, compresi approcci di raffrescamento passivo e sistemi innovativi di ristrutturazione. Nel turismo e nel tempo libero, strumenti partecipativi sono stati ulteriormente sviluppati per sostenere una pianificazione a basse emissioni e il cambiamento dei comportamenti.

Questi risultati sono importanti perché vanno oltre la sola produzione di conoscenza accademica. Aiutano autorità pubbliche, imprese e attori locali a prendere decisioni migliori, a sperimentare nuovi approcci e a preparare percorsi di attuazione. In questo modo, Lantern contribuisce alla Strategia energetica 2050 e agli obiettivi climatici della Svizzera supportando la sufficienza energetica, un uso più efficiente di edifici e infrastrutture, minori emissioni legate alla mobilità, un maggiore utilizzo locale delle energie rinnovabili e strategie di transizione più solide dal punto di vista sociale.

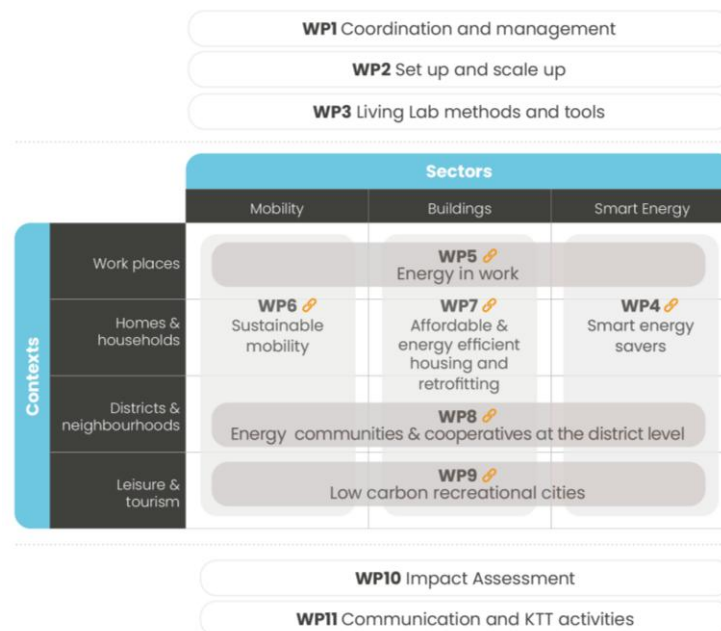


1 Work programme overview

Lantern (“Living Labs as Interfaces for the Energy Transition”) is an interdisciplinary and transdisciplinary consortium that develops and tests real-world interventions to accelerate Switzerland’s energy transition. Its overarching goal is to produce actionable, participatory solutions for decarbonisation by focusing on energy sufficiency, efficiency, and renewable integration in urban and regional contexts.

The consortium includes 17 academic partners and 6 Living Labs (in Lucerne, Lugano, Sion, Winterthur, NEST-EMPA, Geneva). The partnership spans engineering, social sciences, environmental sciences, policy, architecture, and urban planning, fostering collaboration across disciplines and sectors.

Work Packages Structure



The programme embeds co-creation with stakeholders through the Living Lab Integrative Process (LLIP), user-centred tools like Personas, and feedback loops that link empirical interventions with conceptual models. The work programme is structured around thematic research on smart energy users, energy and work, sustainable mobility, affordable and energy-efficient housing, neighbourhood energy cooperation, and low-carbon leisure and tourism, supported by transversal work on coordination, Living Lab set-up and scaling, methodology, integrated impact assessment, and communication.

In Year 4, this structure was further strengthened through the completion of the Living Lab set-up phase, the integration of the Geneva Living Lab, and a mid-term realignment process that clarified priorities, reinforced links between work packages, and improved the overall coherence of the intervention portfolio.



2 Progress of activities

During the reporting period, Lantern made substantial progress in moving from set-up and methodological development towards more operational experimentation, stronger cross-work package integration, and clearer implementation pathways. A major achievement was the consolidation of the programme as a coherent Living Lab-based research and innovation portfolio. This included the completion of the Living Lab set-up phase across the consortium, the operational strengthening of existing sites, and the integration of the Geneva Living Lab, which expanded the programme's capacities in urban transition, citizen engagement, and support for building renovation in occupied settings. These developments improved the programme's ability to test interventions in real-world contexts and to connect research more directly with local actors and implementation needs.

A second important development was the stronger alignment of activities across the consortium. During Year 4, the programme undertook a mid-term realignment process that clarified priorities for the second phase, strengthened links between work packages, and improved the articulation between activities, outputs, and expected outcomes. This effort was supported by synthesis tools, revised intervention mapping, shared discussions on impact pathways, and closer collaboration between thematic and transversal work packages. The Impact Day and other cross-consortium exchanges helped build a more shared understanding of what counts as impact, how interventions should be compared, and how local experiments can contribute to broader implementation and policy relevance.

Across the thematic activities, Year 4 saw important progress in the development of tools, methods, and empirical evidence. In the field of smart energy use, the programme generated statistically robust user profiles based on large-scale household surveys, advanced modelling of flexibility and thermal comfort, and tested the Gridly simulation tool with municipalities, distribution system operators, and academic partners to assess the feasibility of local electricity communities. In the field of energy and work, the Decision Support Tool for Working Model Impact was developed and refined together with practice partners, while case studies with companies and the SmartSpace pilot at the Zurich University of Applied Sciences advanced the programme's work on space use, occupancy, and energy demand in workplaces. These activities show that the programme increasingly provides decision-support tools that can be used by external actors in practical settings.

The programme also made significant progress in interventions related to mobility, buildings, and neighbourhood energy cooperation. In mobility, long-term analyses of the Winterthur car-free challenge were completed, showing persistent behavioural effects and providing a stronger basis for replication. In parallel, the Welcome Ride intervention in Lugano was fully designed with local stakeholders and launched at the end of the reporting period. In buildings, the programme generated quantified results from low-tech and high-tech retrofit solutions, including passive cooling prototypes, multisensory comfort interventions, and innovative renovation systems assessed in real settings. In neighbourhoods, work on energy cooperation continued through the QUBE living lab projects, the refinement of the Morphological Box, and the co-creation of a Community of Practice on sharing renewable energy in Sion. These activities demonstrate progress in turning research into applied experimentation with municipalities, housing actors, companies, and local communities.

In the area of low-carbon leisure and tourism, Year 4 marked a shift from development to implementation-oriented consolidation. The Treeps tool was finalised and tested through a randomised controlled trial design, while the Mountain Tourism Fresco was further developed, evaluated, and prepared for wider replication. These activities contributed to the programme's broader objective of



addressing energy demand not only in housing, mobility, and work, but also in tourism and recreational practices. At the same time, they reinforced the role of participatory methods and place-based experimentation in supporting sufficiency-oriented transitions.

Another significant area of progress concerns methodology, evaluation, and capacity building. The programme continued to strengthen its shared methodological foundation through annual interviews with work package leaders, support to intervention planning, co-design of tools, and exchanges with the sister consortium SWICE and the European Network of Living Labs. The Persona tool remained an important methodological asset and was further integrated into a broader toolkit for tailored sustainability interventions. Work also advanced on a standardised Living Lab evaluation methodology and on the integrated impact assessment framework, including closer alignment between work packages responsible for Living Lab development, methodology, and impact assessment. This progress is important because it helps ensure that evidence generated in different contexts can be compared, interpreted, and used more systematically over time.

Overall, the reporting period shows a programme that is becoming more mature, more integrated, and more implementation oriented. While challenges remain—notably in stakeholder engagement, scale-up conditions, resource constraints, and the consequences of the discontinued Pilot and Demonstration funding scheme—the consortium responded by adapting intervention strategies, relying more strongly on existing Living Lab infrastructures, and focusing on activities with stronger implementation and replication potential. As a result, Year 4 did not simply add more outputs; it improved the programme’s ability to connect research, experimentation, stakeholder needs, and future uptake pathways.



3 Highlights of outputs

During the reporting period, Lantern produced a set of outputs that illustrate the programme's main strengths: building a coherent Living Lab ecosystem, generating practical tools for external actors, producing evidence from real-life interventions, and increasing the policy relevance of its research. These highlights relate directly to the programme's core objectives: testing socially robust energy transition solutions in real contexts, supporting implementation through co-design, and generating transferable knowledge for wider uptake.

A first major highlight was the consolidation of the Living Lab infrastructure and the strengthening of programme coherence.

The completion of the Living Lab set-up phase across the consortium, together with the integration of the Geneva Living Lab, provided a stronger operational basis for real-world experimentation. This output is important because it gives the programme a more solid and comparable structure across sites, while expanding its capacity in urban transition, citizen engagement, and support for building renovation. The related outcomes are improved coordination, stronger methodological alignment, and better conditions for future implementation and scaling. This directly supports one of the programme's main research challenges: how to test energy transition solutions in different Swiss contexts while maintaining coherence across a diverse portfolio of interventions.

A second highlight was the development of practical decision-support tools for companies, municipalities, and energy actors.

In Year 4, Lantern advanced several tools that translate research into actionable support for decision-making. The Decision Support Tool for Working Model Impact was developed to assess how different working models influence energy use and carbon dioxide emissions in companies. At the same time, Gridly was tested further as a simulation tool for local electricity communities, and the Morphological Box was refined as a co-design and analytical tool for neighbourhood energy cooperation. These outputs are highly relevant because they move beyond diagnosis and offer concrete support for comparing scenarios, identifying suitable local solutions, and preparing implementation strategies. The resulting outcomes are already visible in stronger stakeholder engagement, more informed discussions with practice partners, and a clearer bridge between research and operational decision-making.

A third highlight was the production of quantified evidence from real-life interventions.

The programme generated important new evidence in mobility, buildings, and local energy cooperation. In mobility, long-term analyses of the Winterthur 31DAYS Challenge showed persistent behaviour change, including lower car use and car ownership, and confirmed the potential of such interventions for wider replication. In buildings, low-tech and high-tech retrofit solutions were tested and assessed in real settings, including evaporative cooling prototypes, multisensory comfort interventions, and innovative renovation systems with significant reductions in energy demand and environmental impacts. In workplace management, the SmartSpace intervention advanced the testing of a privacy-compliant occupancy sensor based on edge artificial intelligence to support more efficient use of space. These outputs matter because they provide measurable results under real conditions, rather than only conceptual or laboratory-based findings. The resulting outcomes include stronger



evidence for policy and practice, improved credibility of proposed solutions, and better understanding of the social conditions under which technical measures are accepted and effective.

A fourth highlight was the strengthening of programme-level integration and policy relevance.

Year 4 showed that Lantern increasingly produces results that are stronger when combined across work packages. One example is the joint contribution of work on smart energy users and neighbourhood energy cooperation to the Swiss Federal Office of Energy workshop on local electricity communities, where the programme was able to combine simulated potential, household flexibility profiles, and on-the-ground implementation challenges. Another example is the integration of behavioural profiles and personas into national energy system modelling in collaboration with SWICE. These outputs illustrate the added value of the consortium as a whole: not only generating disciplinary insights, but linking behavioural, technical, organisational, and governance dimensions. The related outcomes are greater policy relevance, stronger inter-work package coherence, and increased ability to produce knowledge that can inform implementation beyond the individual case studies.

A fifth highlight concerns communication and public-facing transfer activities.

Year 4 produced important public-facing outputs. These included the continued development of the programme website and digital resources, professional media articles, new webinar editions with SWICE, recorded podcast episodes linked to different thematic areas, and the submission of the Energy Bus initiative under the Swiss National Science Foundation Agora scheme. These outputs support visibility and accessibility of research results for broader audiences. Their main outcome at this stage is to prepare stronger public engagement and future stakeholder uptake, especially by making complex topics such as energy communities, working models, and Living Lab methods more understandable and usable for non-academic audiences.

Overall, the highlights of Year 4 show that Lantern is not only producing scientific knowledge but also strengthening the practical and institutional conditions needed to support Switzerland's Energy Strategy 2050. The programme is increasingly able to combine methodological innovation, applied tools, real-life evidence, and stakeholder-oriented outputs into a more coherent transition portfolio.



4 References - Selected complementary or more detailed information

Lantern consortium website – General overview of the programme, its objectives, partners, Living Labs, and thematic activities.

<https://sweet-lantern.ch>

ZHAW Toolkit for tailored sustainability interventions – Public access point for the toolkit that includes the Persona tool used in the programme.

<https://www.zhaw.ch/en/engineering/institutes-centres/ine/sustainable-energy-systems/team-energy-behaviour/toolkit>

Swiss National Science Foundation – Agora programme – Funding framework relevant to the Energy Bus public engagement initiative.

<https://www.snf.ch/en/JnT2xEAERCgO8qQc/funding/science-communication/agora>

ZHAW project page: Living Labs Interfaces for Energy Transition – Institutional project page summarising the ambition of the consortium.

<https://www.zhaw.ch/de/forschung/projekt/73726>

University of Bern overview page for Lantern – External institutional presentation of the consortium and its Living Lab approach.

https://www.cde.unibe.ch/research/projects/sweet_lantern_living_labs__interfaces_for_the_energy_transition/index_eng.html

Energy Living Lab Association – Updates on Lantern – News-style updates and examples of field-based collaboration.

<https://energylivinglab.com/updates-on-the-sweet-lantern/>