After the RISEnergy Transnational Access, Users are required to submit a User Report. This should be done within 4 weeks after the Access is completed unless otherwise agreed. The User Report will be given to the User(s) by the WP2 leader. The report contains sections related to the work performed, the main results and observations that were achieved.

This document should be completed, signed, and sent by e-mail to risenergy@for.kit.edu.

Summary questionnaire for Users who have been granted Transnational Access (TA) under the RISEnergy project Horizon Europe TA scheme. More information on RISEnergy TA can be found in "General Rules" and in "Access Policy" which can be found on the RISEnergy webpage.

Please complete, sign, and send this form, together with the Cost claim by e-mail to risenergy@for.kit.edu with title: RISEnergy APPXXX - reports.

General information about the project	
Project title (as used in Application)	Optical enhancement of solar concentrators for biofuels processing
Project number (APPXXX) and acronym (max 15 characters)	APP194, OptSolBio
RISEnergy RI(s) accessed	CENER-SESES
Keywords (up to five, free text)	CSP; Solar furnace; Heliostat; Hydrothermal processing; Optical characterization; Simulation.
Arrival date (in town where RI is located)	Remote access
Departure date (from town where RI is located)	Remote access
Starting date of Access (first day at RI)	September 15th, 2025
Finishing date of Access (last day at RI)	December 20th, 2025
Number of days not using the RI (during the above period)	Not applicable
Reason for not using RI those days (describe)	Not applicable
Number of days using the RI	Not applicable
Number of Users granted Access (group size)	Not applicable
Comments	CENER-SESES consists of a simulation environment. The access to this research infrastructure does not require personnel travel.

User	
User group leader or sole applicant (user group member 1)	
First name	
Last name	
Affiliation / Employer	
Country of Employer	
E-mail	
User travelling to RI?	
Comments	
User group member 2	
First name	
Last name	
Affiliation / Employer	
Country of Employer	
E-mail	
User travelling to RI?	
Comments	
User group member 3	
First name	
Last name	
Affiliation / Employer	
Country of Employer	
E-mail	
User travelling to RI?	
Comments	
User group member 4	
First name	
Last name	
Affiliation / Employer	
Country of Employer	
E-mail	
User travelling to RI?	
Comments	

User group member 5	
First name	
Last name	
Affiliation / Employer	
Country of Employer	
E-mail	
User travelling to RI?	
Comments	
User group member 6	
First name	
Last name	
Affiliation / Employer	
Country of Employer	
E-mail	
User travelling to RI?	
Comments	
User group member 7	
First name	
Last name	
Affiliation / Employer	
Country of Employer	
E-mail	
User travelling to RI?	
Comments	
Please insert more fields if your groups had more than four members.	

Access Summary Report - work performed and initial results

Brief description of the objectives of your project (up to 200 words)

[Please describe short the main objectives of your project]

The present proposal addresses two aspects to improve and tailor the focusing of solar concentrators on solar reactors to produce biofuels: techniques for aligning mirror facets in large point-focus concentrators, and improved aiming methods for heliostat fields. In particular, the objectives of the access were to carry out simulations by using suitable customized Tonatiuh codes: simulations of null screens and modified Hartmann tests to align a faceted solar furnace; a parametric study of flux distributions of heliostats with

higher than typical concentration ratios; and evaluation of the yearly performance of concentrating heliostats in a field designed for hydrothermal processing of biomass for biofuel production.

Activities performed (up to 600 words)

[Please summarise the work carried you (steps taken, instrumentation used, techniques employed, data sources consulted etc.)]

Access began with a short training course on the Monte Carlo ray-tracing software Tonatiuh for participants in the project and other personnel associated with the user institution. The course consisted of two sessions: a first part introducing the main functions for Tonatiuh users, and a second part for developers, describing the steps and procedures for developing and implementing plugins for this software. The sessions took place online on September 15th and 18th, 2025, with 17 participants: 9 were UNAM's graduate and undergraduate students, and 8 were academic personnel.

Following this, discussion sessions were held between CENER personnel and the core participants from UNAM to identify desirable developments for the software tool to facilitate the analysis of these problems of interest. It was concluded that plugins for directly implementing convergent and divergent lenses, as well as diaphragms, would be of great help to simulate structured light projection for IER-UNAM's solar furnace, and in general, point focus systems. Another desirable improvement would be the ability to include point sources of light. However, this latter implementation appears to require significant changes to the software, and it was decided that such modification was beyond the scope of the project. Instead, a tentative approach to this kind of source from the other plugins to be developed was devised. Regarding heliostat simulations, after discussing the problems to be addressed, it was concluded that they could be carried out with the current Tonatiuh capabilities, though they require scripting due to the extensive computations involved.

The lens and diaphragm plugins were developed by CENER's personnel in accordance with UNAM's requirements. Then, the results obtained with these plugins were extensively tested against theory and against benchmark results from other optical software to ensure correctness. Cases considered included thick and thin lenses, in on-axis and off-axis configurations, as well as combinations of two lenses. As a result, a problem was detected and corrected in one of the plugins, and the final version passed all tests.

The next step was to implement Tonatiuh simulations for two optical tests to align the solar furnace based on structured light. The first simulated test projects a square-grid pattern of light onto the furnace using a commercial LED projector and observes the reflection on the furnace shutter. This involved simulating the projector's 3-lens set, light source, and diaphragms. This simulation primarily served as a further check of the developed software, since a previous simulation was available in the proprietary software. The comparison is satisfactory, indicating that the simulations are accurate within the method's intrinsic error. However, due to limitations recognized in this test previously, this option was not pursued further. A different test option was simulated using a screen with circular perforations and a diffuse LED light source, yielding promising results. Research is underway to design a null-screen test based on this configuration.

Finally, heliostat simulations were addressed. Tonatiuh's capabilities across different heliostat tracking modes were discussed, and it was clarified that, with the current trackers, no further software improvements are required.

The heliostat jointly operated by UNAM and UNISON in Hermosillo has two types of multi-facet concentrator heliostats: one with 25 square facets of 1.2 m x 1.2 m arranged in a 5x5 configuration. Each facet, in turn, has a deformation to concentrate radiation. The other type of heliostat consists of 12 rectangular facets measuring 2.6 m x 1.15 m, arranged horizontally in two columns of 5 facets each, with 2 facets located vertically in the central column. Simulations of both types of heliostats have been implemented on Tonatiuh to study the impact of the relative positions of the heliostats with respect to the tower on the distortion of the flux distribution caused by off-axis aberrations, and to determine the optimal aiming-point corrections needed to compensate for these aberrations. A script program to carry out the parametric study as a function of location, time of the year, and hour is being developed. Still, the simulation of a complete heliostat field for heating a solar reactor is pending, which will be addressed in the coming months.

Scientific results (up to 800 words)

[Summarise the (initial) outcomes of your study at the RI(s).]

The RIS-Energy access project duration (12 weeks) has been too short to obtain meaningful scientific results yet. However, the simulations implemented are already helping analyse possible alignment methods for the solar furnace and to design a parametric study for the heliostat field performance for highly focusing heliostats. It is expected that this work will yield novel results in the coming months, leading to presentations at an international congress and the submission of manuscripts to peer-reviewed journals during 2026.

Interpretation of the results (up to 400 words)

[Discuss the data obtained and describe the major scientific conclusions drawn.]

So far, comparing previous results obtained with a different software and with thick lens theory with those obtained with Tonatiuh, using the new plugins, has demonstrated that the tool is working properly. The implementation of simulations for solar furnace mirror tests has been simplified, allowing us to continue with the research activities.

Main achievements during the TA related work (up to 250 words)

[Describe the main achievements during your stay at the site(s), Outputs (results, publications, models, etc.), conclusions, next steps, potential impact]

Implementation of plugins to simplify the simulations of optical components in Tonatiuh.

Development of simulations for two different optical tests for IER-UNAM's solar furnace.

Development of simulations for two different concentrating heliostats at the heliostat field in Hermosillo.

Data Management

[Describe the further usage and storage of project data. State where the data will be kept and name a person responsible for the data. Define data]

Data generated, consisting mainly of the developed plugins, will be stored and made available to the public on the Tonatiuh web page kept by CENER.

Difficulties during the TA related work (up to 250 words)

[List problems and issues, you had, completing out your research project: Did you get access to all the necessary equipment, facilities, databases, etc.?
If not, please specify the problems that occurred and list equipment the was not working or accessible.]

There were no difficulties in accessing the facilities.

Intended publications

[Explain where and how you expect to publish the outcomes of your project work. Include also anything already published (What and where?)]

Results will be presented at SolarPACES 2026 and published in the congress proceedings.

It is expected that the results generated will allow the submission of two papers to peer-reviewed journals in the solar energy area, with potential titles:

- Solar furnace alignment by null-screens
- Optimal aiming of high concentration small size heliostat fields

Expected impact

[The impact the expected results will have on current and future research or practice, public safety, European standardization, competitiveness, integration and cohesion and on sustainable growth. any follow on proposals, projects, collaborations, commercialisation]

The project has helped improve the set of tools and human capacities available for IER-UNAM's group for the development of research projects related to CSP. In particular, they will be very useful as one of the tools for analysing heliostat designs and operations in the context of project proposals that IER-UNAM is preparing for a national Mexican call. The objective is to develop pilot solar tower plants for both power generation and thermochemical biomass processing. The RIS-Energy call has also helped to concretize UNAM's intentions for further collaboration with CENER, which is helping to develop those research proposals.

Conclusions / additional comments

[Provide any other comments you might have on your work]

In conclusion, the opportunity provided by the RIS-Energy call has been extremely valuable for improving IER-UNAM's simulation capabilities and for further collaboration with CENER. Due to the project's limited scope, meaningful scientific results have not yet

been achieved; however, novel contributions resulting directly from the project are expected in 2026.

Did you complete the European Commission User questionnaire https://ec.europa.eu/eusurvey/runner/RIsurveyUSERS?
☒ *Yes* ☐ *No*

Feedback – HSE, Ethics and Satisfaction					
Please rate on a scale from 1 (excellent) to 5 (poor). Feel free to provide additional comments					
Practical information on how to apply for Transnational Access and the overall application process	1 (excellent)	2	3 (neutral)	4	5 (poor)
	☒	☐	☐	☐	☐
Comment					
Information provided, once your project was accepted, on how to proceed	1 (excellent)	2	3 (neutral)	4	5 (poor)
	☐	☒	☐	☐	☐
Comment					

Support received at the site(s) regarding technical/scientific matters and logistics	Have you got sufficient support from the RI staff during the project? If not, please, specify the problems. ☒*Yes* ☐ *No*
Please specify any problems	
RI extension / upgrades required	In your opinion, is the RI needed to be upgraded? If yes, please give an explanation. ☐ *Yes* ☒ *No*
Please specify	
Problems with local regulations	Have you had any problems with regulations of the visited RI owner (HSE, lab working hours, etc.)? If yes, please, specify ☐ *Yes* ☒*No*
Please specify	
Health and safety issues	Did you encounter any health or safety issue during your research? Please provide details. ☐ *Yes* ☒ *No*
Please provide details	

Environment & Ethics	Did your research involve the use of elements that may cause harm to the environment, to animals or plants? Please provide details. ☐ *Yes* ☒ *No*
Please provide details	
Environment & Ethics	Did your research deal with endangered fauna and/or flora and/or protected areas? Please provide details. ☐ *Yes* ☒ *No*
Please provide details	
Environment & Ethics	Did your research involve the use of elements that may cause harm to humans, including research staff? Please provide details. ☐ *Yes* ☒ *No*
Please provide details	
Environment & Ethics – Dual use	Does your research have the potential for military applications? Please provide details. ☐ *Yes* ☒*No*
Please provide details	
Environment & Ethics – Misuse	Does your research have the potential for malevolent /criminal/terrorist abuse? Please provide details. ☐ *Yes* ☒*No*
Please provide details	
Environmental issues	Were any potentially dangerous substances (materials / gases etc.) released into the environment (atmosphere, water, or land)? Please provide details. ☐ *Yes* ☒ *No*
Please provide details	
Ethics issues	Are there any other ethics issues that should be taken into consideration? Please specify ☐ *Yes* ☒ *No*
Please provide details	
Overall impression of communication and interaction after finishing your TA and related work	1 (excellent) ☒ | 2 ☐ | 3 (neutral) ☐ | 4 ☐ | 5 (poor) ☐

Comment
Suggestions for facilities not included in RISEnergy which you would use for your research
[Please provide suggestions for specific type of facilities missing (RI gaps) or measurement / experiments you would like to perform which can not be done on current RISEnergy facilities.]
Suggestions how RISEnergy can improve future TA programme, how to make the TA more impactful and how to enable the achievement of high TRL levels
[Your suggestions]

Feedback – Pro-active Innovation Support

Awareness	Did you know about the pro-active innovation support of RISEnergy? ☐ Yes ☒ No
[Please specify how you learned about the pro-active innovation support]	
Personal experience	Have you taken advantage of or benefited from the pro-active innovation support? ☐ Yes ☒ No
[*Please provide details]*	
Information/service provided by the pro-active innovation support?	1 (excellent) ☐ | 2 ☐ | 3 (neutral) ☒ | 4 ☐ | 5 (poor) ☐
[*Please provide details]*	

I declare that the above provided information and especially that information on the number of days visited the RI is correct.

☒ *I have read the RISEnergy privacy policy for participation in the RISEnergy TA and consent to participation and the associated data processing.*

Your full name:

Your signature: