Institute of Communication
and Computer Systems (ICCS)
of the National Technical
University of Athens (NTUA)

The Green ICT Tool: A Methodology-Driven Platform for Assessing ICT Energy Consumption

Vasiliki Tzelepi, Ilias Angelopoulos, Thodoris Theodoropoulos, Kostas Chatziioanou, Georgios Tsimiklis, Dr. Angelos Amditis

Contact email: vasiliki.tzelepi@iccs.gr

Institute of Communication & Computer Systems (ICCS), Athens, Greece

IARIA Conference, Valencia, Spain, 8-12 March 2026

Vasiliki Tzelepi

vasiliki.tzelepi@iccs.gr

Education:
2018 - 2020. MSc. **Environmental Science**
NTUA – Athens, Greece
2011 - 2017. MEng. **Chemical Engineering**
University of Patras – Greece

Professional Experience

- **Scientific Project Manager/Researcher** at Institute of Communication & Computer Systems (**ICCS**) of National Technical University of Athens (**NTUA**)
- Research associate at Chemical Process & Energy Resources Institute of Center for Research and Technology-Hellas (**CERTH**)

Publications

- Tzelepi, V. et al. Biomass Availability in Europe as an Alternative Fuel for Full Conversion of Lignite Power Plants: A Critical Review. **Energies** 2020, 13, 3390. https://doi.org/10.3390/en13133390
- Tzelepi, V. et al. Biomass Valorization Recommender Tool Development. **Energies** 2025, 18, 2545. https://doi.org/10.3390/en18102545

Conferences

- Tzelepi, V, et al. A conceptual framework of matchmaking system development for feedstock adaptation in industry, TRINEFLEX project, **ECOMONDO** conference, 2024, Rimini, Italy
- Tzelepi, V, et al. Development of Conceptual Framework for Biomass Valorization Recommender (poster), TRINEFLEX project, 32nd European Biomass Conference & Exhibition (**EUBCE**), 2024, Marseille, France
- Tzelepi, V, et al. Production of aviation and marine fuels by combining thermochemical, biological and thermocatalytic processes from biogenic waste, BioSFerA project, 7th Hellenic Solid Waste Management Association (**HSWMA**) conference, 2022, Athens, Greece

The Institute of Communication & Computer Systems (ICCS)

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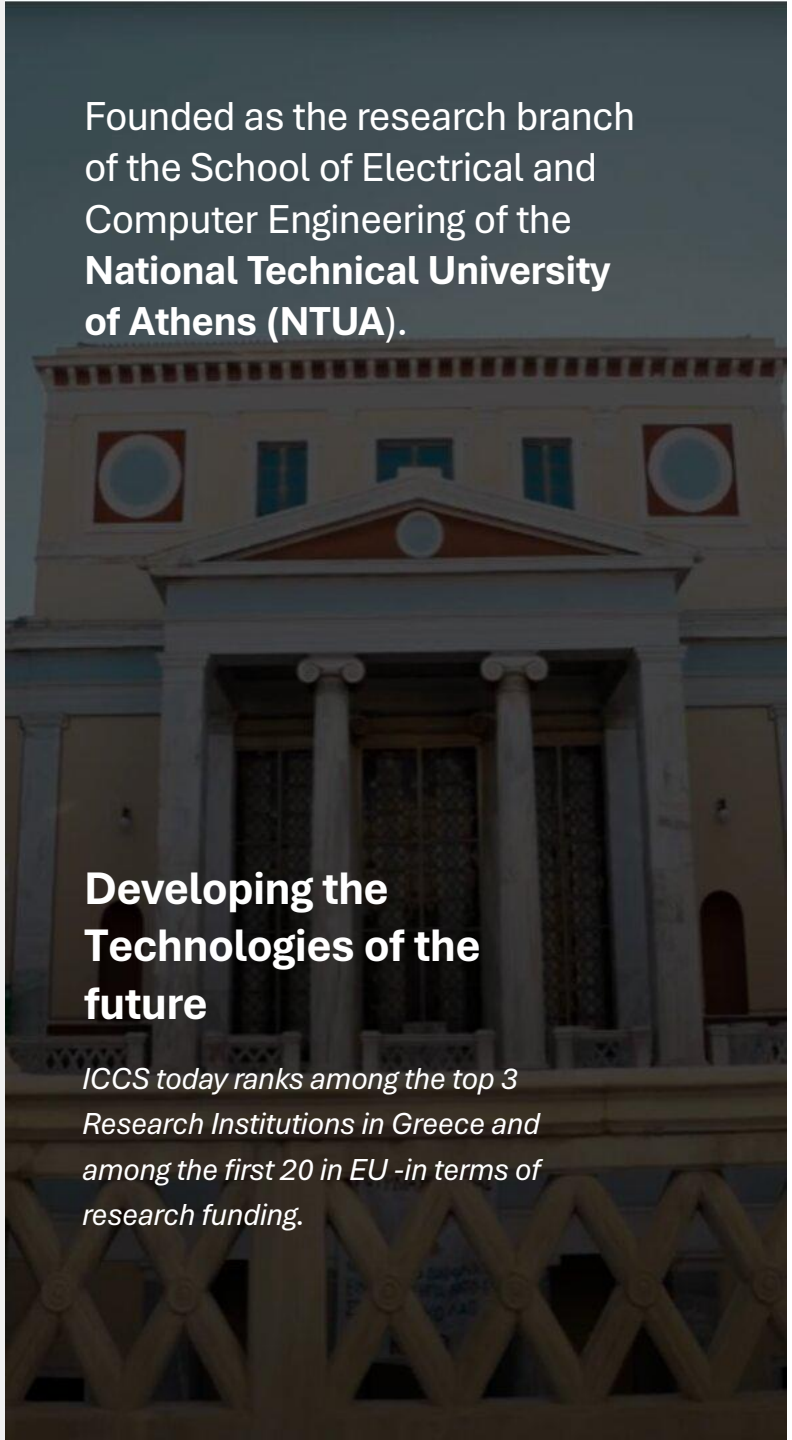

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ICCS today ranks among the top 3 Research Institutions in Greece and among the first 20 in EU -in terms of research funding.

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Clean Industrial & Energy Systems (CIES) division

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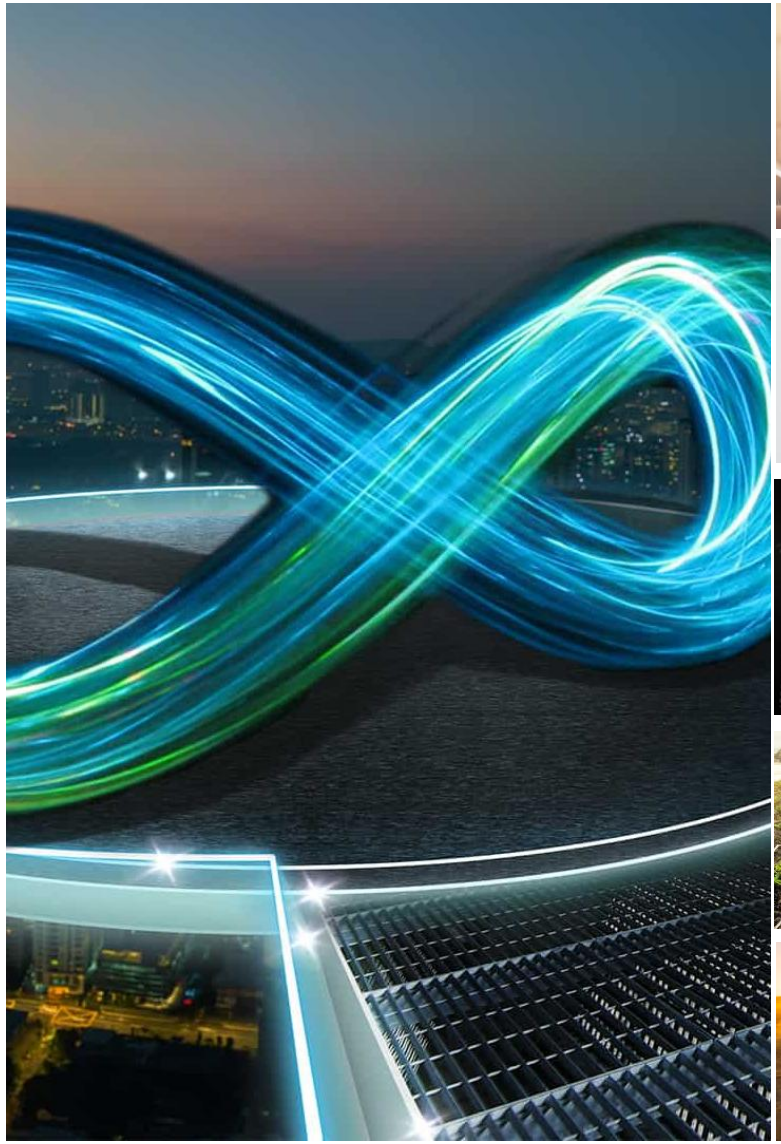
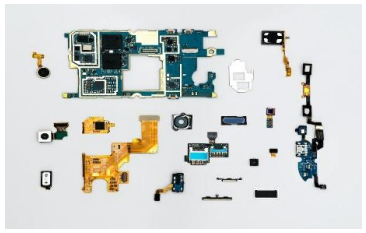
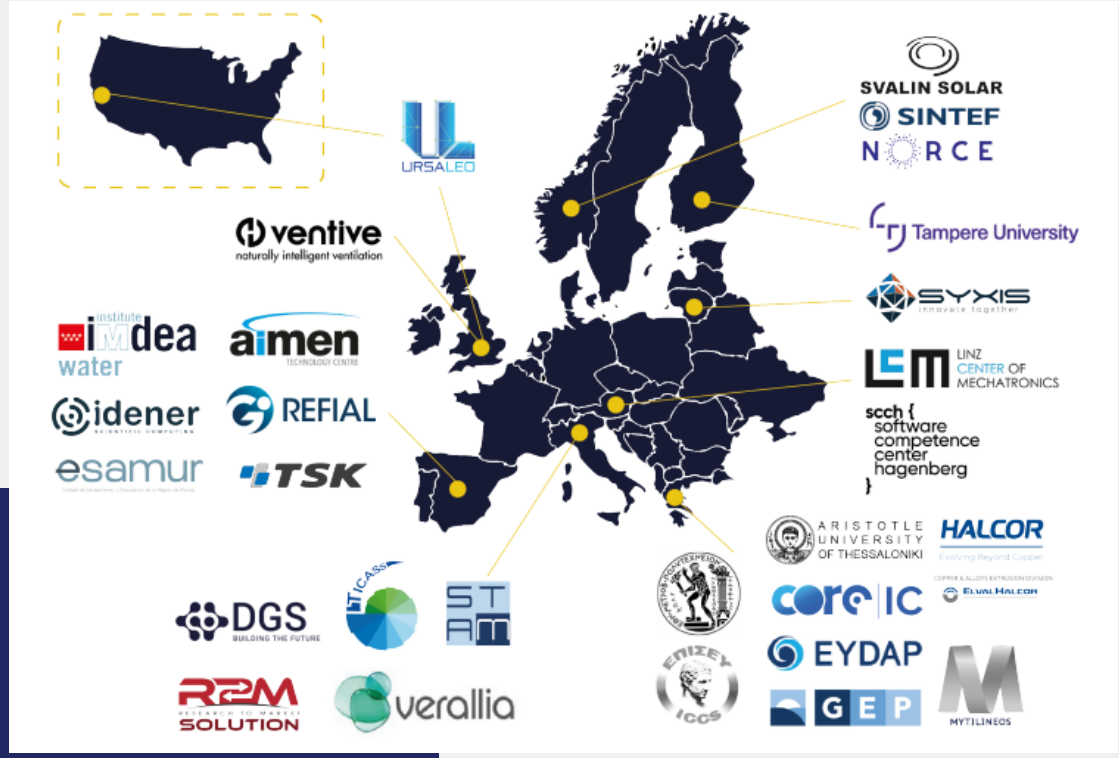




- FRAMEWORKS & DIGITAL TOOLS FOR CIRCULARITY & INDUSTRIAL OPTIMIZATION
- DATA MANAGEMENT SYSTEMS , DIGITAL PRODUCT PASSPORTS AND TRACING
- AI/ML MODELS FOR QUALITY & QUANTITY ASSESSMENT
- DSS AND RECOMMENDERS FOR BIOMASS AND ENERGY
- ENERGY OPTIMIZATION, BATTERY STORAGE AND GRID STABILITY

trineflex

TRINEFLEX project



Funding instrument and scheme
HORIZON Innovation Actions

Grant agreement ID:
101058174

Call for proposals:
HORIZON-CL4-2021-TWIN-TRANSITION-01

Topic:
HORIZON-CL4-2021-TWIN-TRANSITION-01-21

Start date
1 September 2022

End date
31 August 2026

Total cost: €19 262 988,75

EU contribution. €16 308 948,50

PROJECT COORDINATOR: AIMEN (Asociacion de Investigacion Metalurgica del Noroeste), Spain

PARTNERSHIP: 29 partners (companies and research bodies)

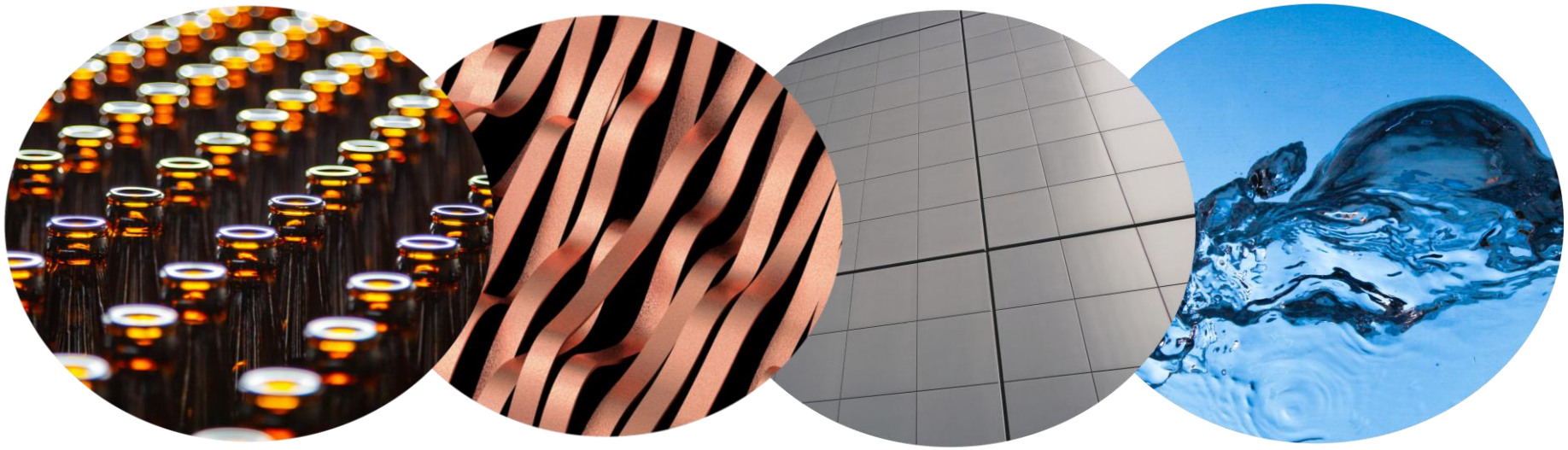
Project description

TRINEFLEX is a **toolkit for Energy Intensive Industries**: it will function as a service managing the digital aspects and the **flexibility and sustainability transition** of industrial processes.

Different innovative technologies will be implemented in synergy with the powerful digital solutions to **demonstrate flexibility measures towards energy neutrality.**

TRINEFLEX will be designed for **rapid replicability** and **high transferability** with the aim of increasing the industrial process energy flexibility and developing industrial symbiosis.

TRINEFLEX is implemented in **5 demonstration sites** from **4 sectors**:
Glass, Copper, Aluminium and **Water treatment.**



Project objectives

Transformation of energy intensive process industries implementing energy, process and feedstock flexibility

- Implement a **Digital Retrofitting** process in order to collect and exploit process data;
- Create a suitable environment for the **predictive assessment of alterations** in the operating conditions;
- Simulate the integration of new technologies utilising adaptable **Digital Twins**;
- Deploy a multi-agent system for decision support in order to **maximise energy, process and feedstock flexibility**;
- Alignment with the **ethical values of the EC** and the principles of the twin and just transition;
- Demonstrate flexible and sustainable operation in Energy Intensive Industries.

Development Process of Green ICT tool

Methodology

- Green ICT tool is used for the energy consumption calculation of ICT regarding the relative European standards for Green ICT.
- The methodology involves the classification of ICT components into distinct classes, namely **sensors**, **gateways**, **servers-platforms**, and **databases**, while these classes are further subdivided into sub-classes.
- The calculation of energy consumption places emphasis on particular components within each sub-class, encompassing **CPUs**, **RAM**, **GPUs**, **hard drives**, **network switches**, **cooling systems**, and **communication units.**

Table 1. European Standards for Green ICT

Code	Explanation	Date of Approval
ITU-T L.1001 ITU-T L.1002	External universal power adapter solutions for stationary and portable information and communication technology devices	2012-11-29 2016-10-14
ITU-T L.1006 ITU-T L.1007	Test suites for assessment of the External universal power adapter solutions for stationary and portable information and communication technology devices	2016-12-14
ITU-T L.1010	Green battery solutions for mobile phones and other hand-held information and communication technology devices	2014-02-13
ITU-T L.1015	Criteria for evaluation of the environmental impact of mobile phones	2019-05-22
ITU-T L.1020	Circular Economy: Guide for Operators and Suppliers on approaches to migrate towards circular ICT goods and networks	2018-01-13
ITU-T L.1300	Best practices for green data centres	2014-06-29
ITU-T L.Suppl.5	Life-cycle management of ICT goods	2014-12-19
ITU-T L.Suppl.20	Green public ICT procurement	2015-10-23
ITU-T L.Suppl.28	Circular Economy in Information and Communication Technology; definition of approaches, concepts and metrics	2016-10-14

Table 2. Example of Questionnaire's application

Question	Answer	Sub - Question	Choices	Consumption
Who is the manufacturer of your CPU?	Intel	Which group do you choose for your CPU based on the device model?	a. Low End CPU (Core i3) b. Mid End CPU (Core i5) c. High End CPU (Core i7) d. Top End CPU (Core i7-E) e. Highest End CPU (Core i9)	55 to 73W 73 to 95W 77 to 95W 130 to 150W 125 to 150W
	AMD	Which group do you choose for your CPU based on the device model?	a. 2, 4, 8, 12 and 16 Cores b. 24, 28 and 32 Cores c. 48, 56, 64, 84 and 96 Cores	65 to 280W 155 to 3220W 200 to 360W

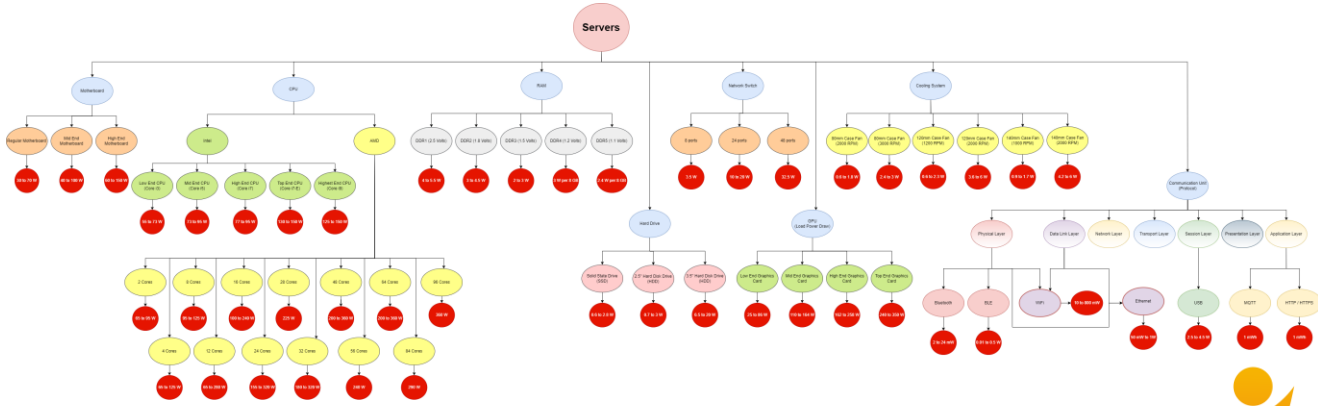


Figure 1. Energy consumption tree diagram for a Server's component

Development Process of Green ICT tool

Development

Develop prototypes and test concepts to refine ideas and ensure feasibility and functionality.

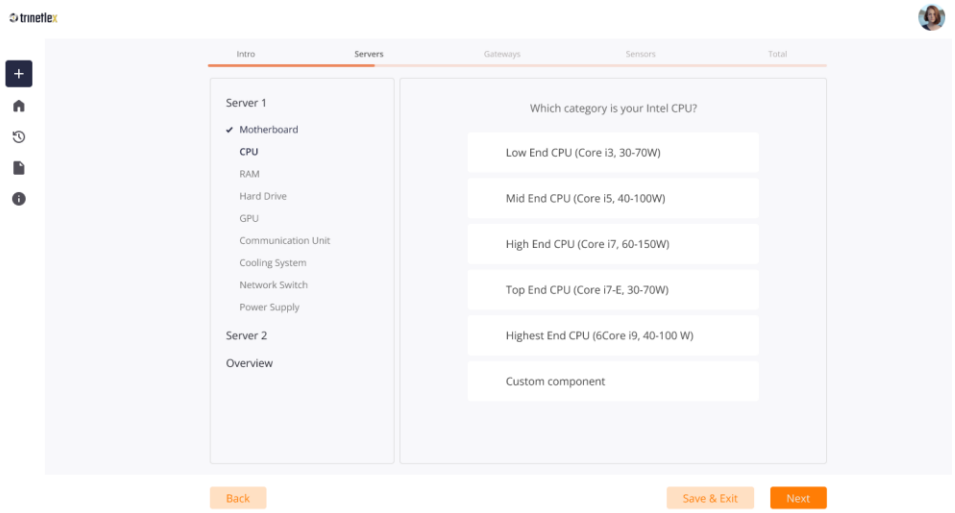


Figure 1. Mocap used for ICT components definition

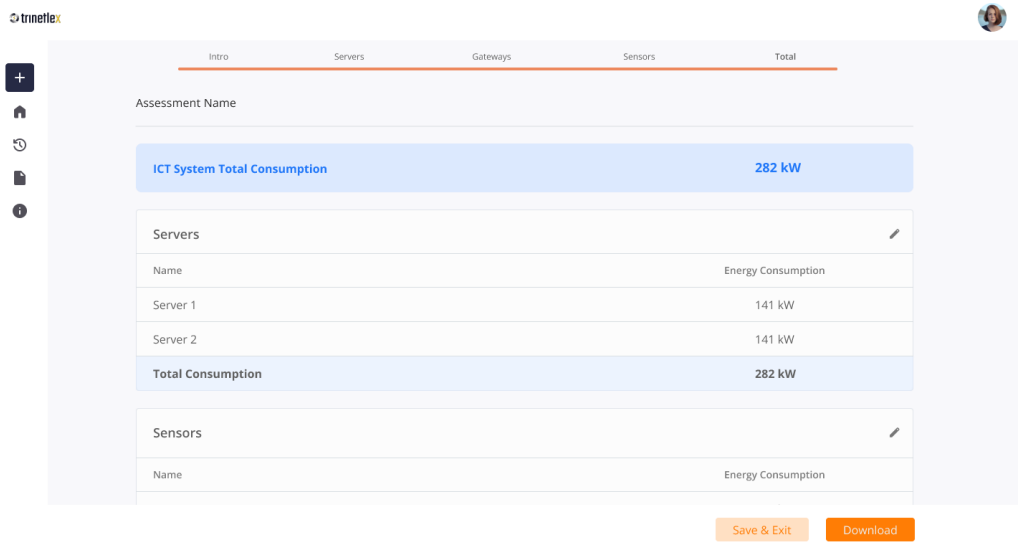
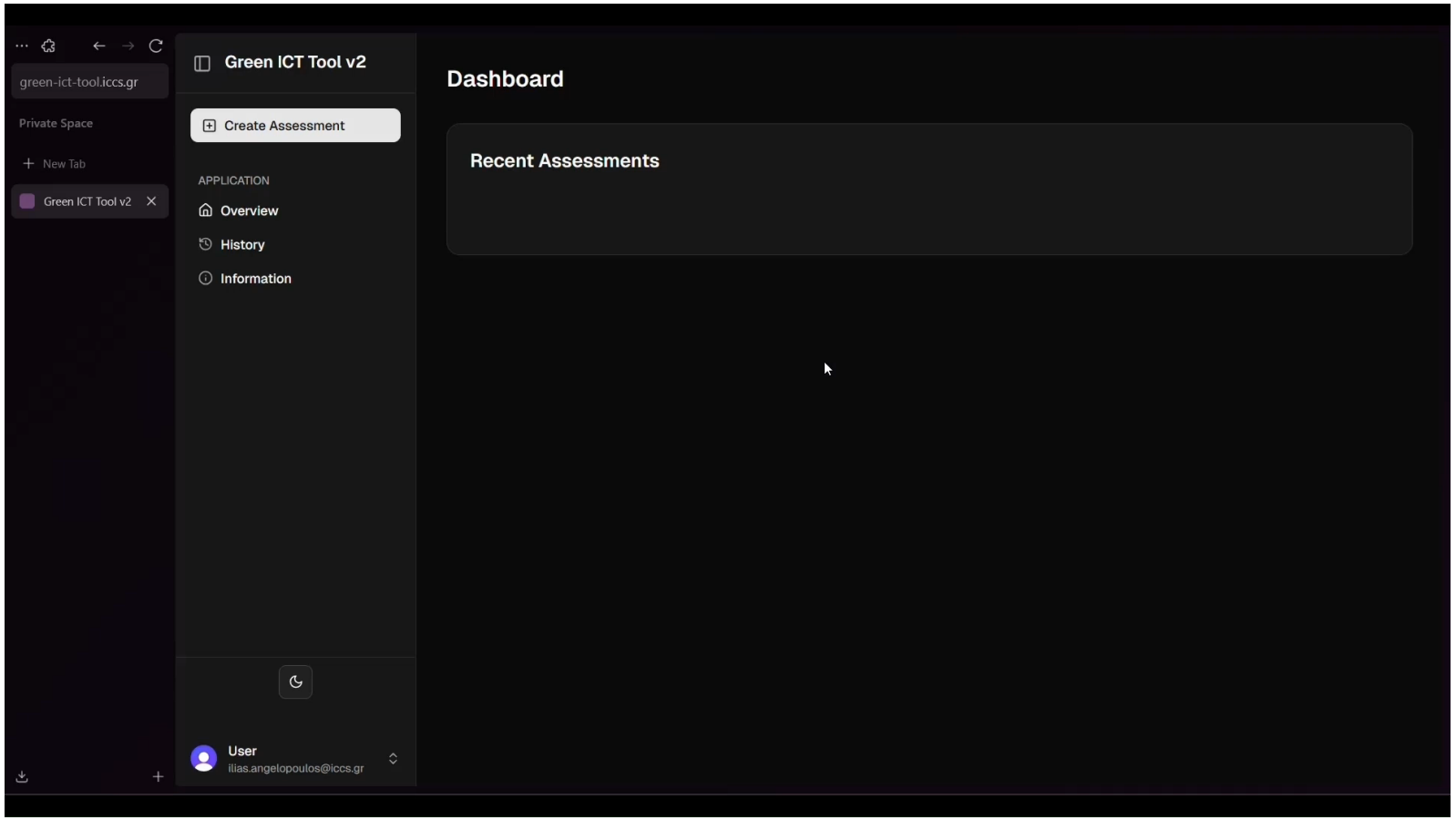


Figure 2. Mocap used for total energy consumption calculation

Steps

Development Process of Green ICT tool



Demonstration & Implementation

Assessment of ICT power consumption for TRINEFLEX infrastructure needs.

Summing up

Enables structured assessment of ICT components using:

- Predefined literature-based data
- Manufacturer technical specifications
- Manual input options

Calculate and visualizes:

- Energy consumption (W)
- Annual electricity use (kWh)
- Carbon emissions (CO_2eq)
- Comparative benchmarks (household/office equivalence)

Contributes to:

- Greener ICT system design
- EU Green Deal objectives
- Sustainable digital transformation
- Bring the gap between sustainable strategies and measurable technical data

Provides useful insights for:

- ICT designers
- Policy makers
- Industry stakeholders

References

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i-SENSE GROUP

Thank you

Vasiliki Tzelepi

Contact email: vasiliki.tzelepi@iccs.gr

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