EnergyAlps

A LabEx on Electrical Energy, Systems and Society

A. Context

A.1.Background and motivation

In its road-map to stay below 1.5°C or even 2°C as prescribed by Paris Climate Agreement[1], IRENA (International Renewable Energy Agency) proposes a global energy transformation combining greater energy efficiency, the massive use of renewable energy and electrification[2]. All sectors are concerned, in particular the production of electrical energy, transportation, industry and buildings. In this context, from the generation side, renewable energy production will be a key ingredient of the electricity generation with a share possibly higher than 50% even if nuclear power plants are developed. On the other side of the value chain, namely consumption, it is foreseen an intensified electrification for decarbonizing energy consumption. It is worth noting that for the particular case of mobility, the EU is banning the sale of new thermal cars by 2035. With Ukraine crisis, UE also projects phasing out Europe's dependency on Russian fossil-fuel energy imports. RePowerUE promotes an acceleration of the clean energy transition and a deep change of UE's energy system[3]. In France, the multi-year energy road map for 2019-2028 specifies the targets to be achieved at the national level:

- reducing greenhouse gas emissions by 40% at 2030 horizon compared to 1990. This should be achieved in part by deep progress in sobriety practices of end-users (that also requires some infrastructures development, e.g. home thermal regulation, cycling paths) and by increasing energy efficiency.
- Increasing the share of electricity in the French energy consumption above 50% (instead of 25% now).

Clearly, reaching these objectives, given the complexity of the energy systems globally and the electrical system particularly, will require a significant research effort with a multi-disciplinary view from electrical technologies, components and systems, to human science while taking advantage of digitization.
In this perspective and beyond 2030, designing and developing new technologies and best trajectories for reaching the carbon neutrality by 2050, ensuring a resilient and clean energy system, and empowering communities for enhanced energy justice and equity will require a wide range of actions including public and private investments, intensification of research and innovation, revision of regulations. The purpose of EnergyAlps is precisely to intensify R&I efforts in Energy systems while strengthening the R&I Grenoble's ecosystem (see section A3). The electrification being essential to phase out fossil fuel energy, EnergyAlps will focus on Electrical energy and its role within the future energy mix.

A.2. Open challenges and key issues

Ramping up renewable-based electricity, transforming power infrastructures, enhancing energy efficiency, developing electromobility, making the energy system more flexible, more resilient, improving end-users' sobriety are **open and very actual challenges**. It is thus necessary to define research actions for:

- studying energy transition pathways, impacts of new uses, and consumer-centric systems,
- designing breakthrough hardware and/or software solutions for flexible and efficient energy conversion,
- modeling, planning and controlling energy systems allowing the stated targets to be reached,
- investigating and increasing resilience of complex energy systems and their end-users

There are many key technical and social research issues associated to these challenges for the whole scope of electrical energy, systems and societies. Some illustrations include the resilience and stability of electrical systems that need to be rethought with the integration of a massive share of renewable energy sources in particular those based on power electronic interfaces.

On one hand, the system inertia is indeed more and more reduced with potential significant impact on the overall system stability. This is exacerbated by the increasing sensitivity to weather conditions and climate

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[1] https://unfccc.int/process-and-meetings/the-paris-agreement/the-paris-agreement

[2] https://www.irena.org/Publications/2022/Mar/World-Energy-Transitions-Outlook-2022

[3] https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=COM%3A2022%3A230%3AFIN&qid=1653033742483

changes on existing grid components and devices. Hence, decentralized and distributed optimal strategies for efficient operations and planning able to cope with growing uncertainties, innovative sensors for enhanced observability, new protection schemes for handling high varying system conditions, are key issues to monitor, control, protect and restore future electrical systems. To enhance efficiency, electrical devices, including power electronics, must be rethought. Real time hard digitization should come along the development of innovative control and power technologies to reach the most agile system given the increasing complexity of these systems.
On the other hand, end-users will increasingly be equipped with on-site generation and storage, notably via the batteries in their cars. They will have different expectations in terms of the reliability of the electricity network and will also contribute differently than today to the financing of the public electrical grid (network access fees and charges). The modalities of territorial equity and the social contract of electricity supply (uniform access tariff based on consumption, high and systematic reliability, low temporal variation of prices, etc.) will necessarily have to evolve in directions that remain difficult to apprehend to date. In this context, much more than before, individual and collective consumers are key players of the energy transition. Public authorities and stakeholder groups engagement may have effects on regulation and on the operating of the energy system. Standards, regulations, economic, social and environmental issues have to be taken into account and anticipated.

Methodological issues include observation of uses, social survey, stochastic and dynamic models and tools for simulation and optimization of complex systems, hybrid data-physics methods, holistic approaches to design and manage sociotechnical systems and their components. The available methods generally ignore the uncertainties related to evolving systems and devices, faults or (sometimes extreme) external events, human behavior, unknown grid parameters, etc. In addition, the available design tools are mainly oriented towards engineers, and they are not easily accessible to managers, end-users and political or economic decision makers. Overall, some integrated multiscale approaches able to capture the properties of electrical energy systems at various scales (components, networks, governance …) are missing.

A.3. Grenoble's strength and highlight actions

Since late 19th century, Grenoble has developed a leading-edge ecosystem on energy. Hydroelectricity has driven the development of industry and research at the beginning of the 20th century. After the second World War, the establishment of the CEA has diversified and developed research and innovation activities in the fields of energy and microelectronics. In 1948, the Institute of Economic and Legal Studies of Energy was created and has initiated the dialogue between engineers and scientists in energy and researchers in social sciences. Technology transfers between research centers (UGA, CEA, INRIA) and industry companies (ATOS world grid, EDF, Schneider Electric …) and the creation of start-ups have always been at the heart of the Grenoble's ecosystem. The Carnot Institut "Energies du futur"[4] and the cluster for energy transition "Tenerrdis"[5] are pursuing this effort.

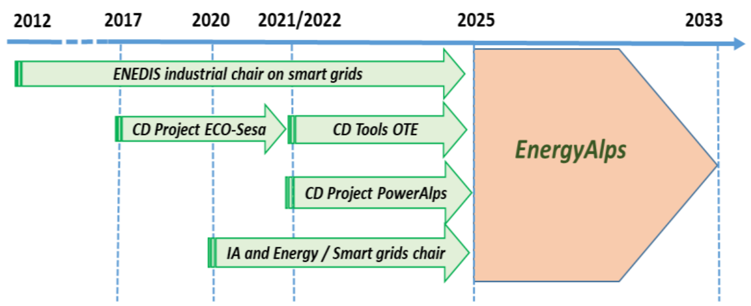

Figure 1. UGA's actions since 2012

Grenoble is now one of the major research hub in energy in France. According to CNRS[6], the three main research fields of Université Grenoble Alpes (UGA) in Energy are materials, systems (including electrical grids and buildings) and other related fields (including social sciences). In the fields of energy systems, power electronics, and social sciences, UGA has been recently involved in highlight impactful actions and has mobilized significant financial resources for breakthrough R&D programs on energy.

Figure 1 gives an overview of the actions supported by UGA for the last 10 years in the fields of electrical engineering and social sciences. It clearly shows that EnergyAlps represents both an opportunity to capitalize

[4] https://www.energiesdufutur.eu/
[5] https://www.tenerrdis.fr/en/
[6] https://www.celluleenergie.cnrs.fr/enquete-energie-du-cnrs/

on Grenoble's strengths and to continue to develop leading-edge scientific knowledge and technological innovations.

On the other hand, research on materials for energy at UGA has benefited from LabEx support between 2011 and 2024 to achieve a full academic visibility and this support will continue beyond 2024. Despite the undoubtedly strengths of Grenoble, similar support was missing for the whole scope of electrical energy, systems and social sciences and has motivated the creation of EnergyAlps

The highlight actions of UGA in the fields related to EnergyAlps are:

1. **UGA and CEA are copilots of the National Acceleration Strategy on Energy technologies (2022-2027, estimated funding for UGA and CEA = 5M€)[7]**

The National Acceleration Strategy on energy technologies aims at the intensification of Research, Innovation, Industrial and Education actions on Energy technologies. Three technologies are targeted: resilient and Flexible Networks, Photovoltaics and Floating wind turbines. A 50M€-research program (2022-2027) is included in the strategy. There are 4 programs leaders including Philippe Azais, CEA and Nicolas Retière, UGA. The program promotes collaborative actions between French research units in engineering, digital, environmental and social sciences. Five targeted projects are already supported. UGA and CEA LITEN lead one action on MVDC (Medium Voltage Direct Current) grids and are partners of another projects on hybrid IA modeling and distributed IA for multi-energy systems. UGA and CEA are also involved in other National Acceleration Strategies on both decarbonizing industry and electronics.

2. **UGA funded the Interdisciplinary program on energy in smart cities (EcoSESA – 2017-2021, 1.7M€) and the Observatory of Transition in Energy transition (OTE – 2022-2025, 280k€)[8]**

Funded by IDEX Grenoble Alpes, the Cross-Disciplinary Program *Eco-SESA Smart Energies in Districts* gathered 16 laboratories relative to Materials, Systems and Organization. It produces knowledge, concepts, tools and methods to re-think the planning, management and governance of urban energy systems, as well as the design of their components. On the whole, 30 junior researchers (PhD candidates or post-PHD) and 50 senior researchers generated 250 publications, many open source models, solvers and use cases, a webinar series on energy communities gathering 80 speakers and 300 auditors...[9] A continuation of Eco-SESA is the Observatoire de la transition énergétique (OTE). OTE aims to respond to the major challenges of energy sobriety, efficiency and decarbonization to move towards a low-carbon energy society. The main structural axis of the OTE is directly linked to a data platform, which will offer a transversal and mutual support for the collection of data and the dissemination of results for research and socio-economic actors. The overall approach covers the scientific cycle from observation, to scientific questioning, to the production of data and tools for socio-economic actors, in an iterative and recursive loop.

3. **UGA has recently launched PowerAlps, a cross-disciplinary project on power electronics (2022-2025, 1 M€)**

The Cross Disciplinary Program PowerAlps aims to federate research in power electronics, by combining scientific and technical challenges with an integrated eco-design approach and a focus on industrialization in a context of global competition. It brings together academic players from Grenoble and the CEA, in association with the Ampere laboratory (Lyon) (150 permanent staff total. The roadmap defined by PowerAlps will enable the public authorities to be informed of all the issues at stake in a technology that is essential and strategic for a country. The ambition of PowerAlps is to: i) develop technological breakthrough with high potentialities semiconductors, packaging, converter, control, …, ii) incorporate and eco-design approach robustness, efficiency, critical materials, circularity, …, iii) investigate industrialization aspects Global competition (China), France's strength, recommendations on regulations, …

4. **Grenoble INP/UGA leads industrial chair of Excellence on smart grids funded by ENEDIS (2012-2025, about 500k€/year)[10]**

The Smart Grids Chair began in 2012 to take over the joint innovation center between Grenoble INP-UGA, EDF and Schneider Electric (IDEA on future Electrical Distribution systems with about 12 M€ funding over 10 years) to bring answers to the scientific and technical challenges that the distribution networks face. The solutions

[7] https://hal.science/hal-03816585/document

[8] https://ote.univ-grenoble-alpes.fr/

[9] https://ecosesa.univ-grenoble-alpes.fr/eco-sesa/final-report-production-877096.kjsp?RH=248563962425208

[10] https://fondation-grenoble-inp.fr/en/nos-actions/chaire-smartgrids/

associate new methods for planning, controlling, operating and protecting networks, and ICTs (Information and Communication Technologies) for massive data management and the optimization of communication protocols. The Chair also includes an educational component to disseminate the results and to meet the distribution industry's new needs for qualified personnel. Since its creation, the Smartgrids Chair has supported 14 PhD theses (in addition to Post-docs, research engineers, and Masters) co-supervised by UGA researchers and ENEDIS engineers.

5. **UGA leads the research team on AI for Energy[11] funded by MIAI institute and industry partners (ENEDIS, ATOS) (2020 – 2025, 1.2M€)**

The purpose of the "AI and Energy / Smartgrids" chair within the Grenoble institute for IA (MIAI) is to address the scientific challenges linked to the integration of renewable energies and new uses in energy systems using artificial intelligence techniques. This area is part of the 3D energy transition: Decarbonation, Decentralization and Digitization. In this context, some data are generated in large numbers by the various sensors disseminated in the electrical system or at the end users (Linky smart meter) while other data are largely missing. This latter aspect complicates the complete observability of the electrical system that is necessary for a precise and efficient management and control especially as these systems concern critical infrastructures (vital systems). Traditional methods are limited and cannot handle the fast evolution of an evolving energy paradigm. Therefore, the contribution of artificial intelligence techniques to remove these obstacles is essential. However, the specificity is to couple data and physical models (hybrid models). Thus, the data gathered from these systems associated with Machine Learning processes should help improving various aspects of smartgrids including preventive maintenance models, real-time system diagnosis and control, stability of microgrids with a high rate of renewable energy systems …. Furthermore, the decision-making process in an uncertain context requires support tools for the network operator. These tools often require the coupling of deep and reinforcement learning techniques. This also makes it possible to integrate the expertise of the grid operator into these decision models.

A.4. Outstanding previous achievements

1. In smart grids

CEA and UGA have an outstanding record of accomplishment in scientific and technological developments for smart grids. In the recent years, several European Horizon 2020 projects were funded such as ERI-GRID on smart grid infrastructures[12]. More recently, UGA is strongly involved in CNRS@Create, a joint unit between CNRS and NRF (National Research Fundation) Singapore. It is the first CNRS subsidiary abroad. UGA co-leads the WP8 of the Descartes program about hybrid AI approaches for smart cities and critical urban systems and augmented hybrid engineering[13].

2. In power electronics

UGA is well known for his works on diamond based unipolar high-power devices. The major results recently achieved are the fabrication of a diamond Schottky diode demonstrating a state of the art Baliga's Power Figure Of Merit of 244 MW/cm. UGA leaded the european project on Green Electronics with Diamond Power Devices (GreenDiamond[14]) funded by Horizon2020 (14 partners, 2015-2020 - 4.4 M€). The project aimed to develop an electrical power converter incorporating diamond semiconductor components to reduce the energy losses associated with the conversion of direct current to alternating current. Although the development of a diamond-based power converter could not be achieved at the end of the project, 80% of its initial objectives were met. Furthermore, the consortium members identified the remaining bottlenecks. The R&D effort required to produce a functional prototype was also accurately estimated with a view to preparing the next stage of the research program. Ultimately, the innovations resulting from the GreenDiamond project should help to increase the efficiency of power converters by a factor of 4, resulting in a 75% reduction in energy losses compared to current converters based on the use of silicon. CEA is also a partner of TRANSFORM[15], a R&D project funded by the EU and national funding authorities aiming to build a complete and competitive supply

[11] https://miai.univ-grenoble-alpes.fr/research/chairs/environment-and-energy/artificial-intelligence-for-smart-grids-862258.kjsp

[12] https://erigrid.eu/

[13] https://descartes.cnrsatcreate.cnrs.fr/wp8-augmented-hybrid-engineering/

[14] https://www.greendiamond-project.eu/project-overview/

[15] https://sic-transform.eu/en/

chain in EUROPE for Power electronics (PE) based on SiC semiconductor technology (33 partners, 2021-2024 - 89.3 M€).

3. In numerical modeling

UGA is also worldwide recognized for its research in computational electromagnetics and the FLUX software[16], which was born at G2Elab and is now co-developed and commercialized by Altair Engineering. The finite element FLUX software helps in the design of electrical engineering devices and is used by nearly 700 companies worldwide. Recent research developments include the models for soft magnetic materials, including static and dynamic hysteresis phenomena. The work led to the development of a high-performance vector Preisach model in terms of computation time and convergence. Modeling of conductive strip windings and laminated magnetic circuits to determine the distribution of losses in electrical devices were also performed giving more accuracy for the determination of efficiency in the design phases.

4. In social sciences

Another set of outstanding previous achievements is related to the study of the users' behavior and actors' practices of energy systems[17]. At a territorial level, the introduction of the notion of socio-metabolic assemblage[18] in a volumetric transect representing infra- and superstructures of a district highlighted the embedded dimensions of energy and water ecosystem[19], their role to interconnect building actors[20], their interactions with soil, atmosphere and landscapes. GAEL, G-Scop and LIG researchers, within the framework of a national-funded project, have built a technical platform and equipped different houses with sensors in order to measure the evolution of the users' behavior according to the types of signals emitted by the energy supplier. These laboratories have also developed a first prototype of an interactive energy manager able to produce specific explanations to the occupants. Finally, OTE has created a panel of 1500 volunteer households to conduct surveys or field experiments in the field of energy transition with respect to privacy regulations.

A.5. Platforms and facilities

Grenoble has a long-lasting tradition of experimental works supported by platforms and facilities. EnergyAlps will benefit from some of them as listed below:

1. Interoperable smart grid facility

EnergyAlps will use an interoperable smart grid facility coupling PREDIS[21] and PRISMES[22] platforms, from UGA and CEA respectively. It is based on a hybrid-cloud supervisory, control and data acquisition architecture[23]. It includes the integration of a common information model in the framework of the smart grid IEC 61850 standard. This interoperable platform can serve as a fundamental infrastructure for research on real-time co-simulation, advanced multi-agents solutions, and PHIL (Power Hardware In the Loop) hybrid simulation. Moreover, a standardized library of DER (Distributed Energy Resources) models has been created following the CIM standard. This interoperability structure is capable of processing and exchanging information between energy systems, visualizing and controlling the available experimental tools remotely in real time.

2. Power electronics platforms and facilities

CEA will bring his facilities in electronic components development, with high quality cleanrooms able to process 100, 200 and 300 mm wafers sizes. These include various processes dedicated to wide band gap materials (material growth, wafer bonding, high-end lithography and many other techniques). Associated with the clean room, the nano-characterization platform is able to perform a wide range of characterizations such as scanning

[16] https://www.altair.com/flux/

[17] https://ecosesa.univ-grenoble-alpes.fr/ and https://ote.univ-grenoble-alpes.fr/

[18] G. Debizet, Assemblage socio-énergétique et transitions bas-carbone urbaines, ED SHPT , UGA, 2018.

[19] S. Laroche, N. Tixier, L'eau dans les paysages de l'énergie. Le cas de la presqu'île de Grenoble, Projets de paysage, n°20, 17 juin 2019.

[20] L. Morriet, Conception multi-acteur de systèmes énergétiques locaux bas-carbone : outils, modèles et analyses qualitatives, PhD dissertation, UGA, 2021.

[21] PREDIS is a 2000 m² platform dedicated to smart grids. It includes renewable energy sources, microgrids and a Power-Hardware-In-the-Loop real-time simulators of electrical energy systems.

[22] PRISME is a CEA facility with a multi microgrid platform, a PV system of hundred kW, solar mobility station, and a semi-virtual platform designed for dynamic testing of thermal systems.

[23]V. H. Nguyen, Q. T. Tran, Y. Besanger "SCADA as a Service approach for Interoperability of micro-grid platforms", Sustainable Energy, Grids and Networks, Elsevier, https://doi.org/10.1016/j.segan.2016.08.001

probe measurements (SSRM, AFM, SCM), TEM (holography, tomography, HRTEM) and Atom Probe Tomography. CEA also has expertise in electrical characterization of power devices (voltage up to 3kV, current up to tens of amperes, high frequency up to µs range).

3. Intensive computing and data facility

GRICAD Grenoble Alpes Research is a scientific computing and data shared infrastructure dedicated to the challenges of current scientific needs in intensive computing and data[24]. It is accessible to any UGA's researcher. It will host and disseminate data and algorithms and be used for computationally intensive tasks of EnergyAlps.

4. Observatory platform in Energy

OTE's observatory platform gathers the means of animation, administrative, legal and technical management whose first objective is to perpetuate the collection of data from panels of households or individuals, "living labs", or any type of research field. It also gathers the methods and procedures necessary for the production of new knowledge and original tools (transects, open-source code, open data, serious games for training, teaching materials ...) for researchers and socio-economic actors (citizens, collectives, communities, companies, regulators, state ...). The aim is to support scientific communities in their demonstration and proof process in a completely independent manner, without neglecting the ethical aspects, whether from an operational point of view or in terms of the fundamental questions raised.

5. Human and social sciences facilities

EnergyAlps will also benefit of the facilities developed at UGA for Humanities and Social Sciences. These facilities are dedicated to "real world" experimental research, tests and "field experiments". In their field-experiment version, they are mainly used for behavioral research: the subjects recruited are "real people" (and not students) and the tasks they have to perform are concrete (for example, in experimental economics, choosing and buying products, testing devices monitors, etc.).

B. Quality

B.1. Main themes

EnergyAlps will study **local and regional scales, focusing on distribution energy systems highly impacted by energy transformation**. The main focus will be put on **electrical systems** due to the increasing electrification of energy production and uses. Obviously, the interactions with other scales (e.g. with transmission systems) or energy carriers (e.g. heat or gas networks) could be investigated when necessary (e.g. to study multi-infrastructure resilience or increase flexibility). **The whole time range will be considered from decades for planning to microsecond for electromagnetic phenomena**.

B.2. Methodology

EnergyAlps will be dedicated to **low-TRL research**, meaning from the observation and modeling of basic principles to the experimental demonstration of the proof of concept. **A very differentiating element will be the focus on interdisciplinary works** between electrical engineering, social sciences, computer sciences and applied mathematics. EnergyAlps will develop new concepts, methods and technologies for electrical energy systems, incl. its power electronics components. Humanities and social sciences will be mobilized to study sustainable energy transition pathways, in terms of policy, economic behaviors, markets, territorial and societal issues. Computer sciences will bring innovative digital and data solutions to improve the safety, productivity, agility of the electrical system. Applied mathematics will be an essential element to design leading edge methodologies and tools for the analysis and the optimization of electrical systems and components.

The scientific and technological program of EnergyAlps is structured into four pillars, each one being associated to a work package: **planning, design and control of resilient systems (WP1), governance, empowerment and regulation (WP2), digitization of energy systems (WP3) and power electronics development (WP4)**. They will address ambitious questions about electrical-centered energy systems, their governance and regulation, their digitization and leading-edge developments in wide-band gap power electronics. Two cross-sectional work packages will develop methodological works: **multi-scale methods, tools for modeling, design and supervision (WP5)** and **data and observations (WP6).**

[24] https://gricad.univ-grenoble-alpes.fr/

EnergyAlps aims at **promoting interdisciplinary, collaborative actions** between its members to reach its research targets and more particularly the development of innovative methods to understand the complexity of evolving energy systems. These actions will be either **targeted projects or community management actions**. Research actions will be designed to complement existing R&D programs whether they are funded by European Union, National Agencies or non-academic partners. With the creation of EnergyAlps, we expect to enhance UGA's academic reputation in Energy domain at national and international level.

Research unit	Description
CREG (UGA)	CREG's research program is related to the study of globalization and governance issues through specific themes such as organizations and social Innovations.
CRJ (UGA)	Based on public economic law, local government law and electoral law in particular, the CRJ confronts the various legal instruments available to the territories of public action
GAEL (UGA, CNRS, INRAE)	GAEL is a laboratory in applied economics with a major research axis on energy where issues of household behavior and corporate strategies in electricity markets are studied.
LARHRA (UGA, CNRS)	The LARHRA is specialized in history, for the modern and contemporary periods, and in particular in economics and innovation.
PACTE (UGA, CNRS)	PACTE social science laboratory builds common languages and horizontal knowledge on the changes underway in society, and their political, territorial, sociological and ecological implications.
G2elab (UGA, CNRS)	G2elab covers a wide spectrum of expertise in the field of Electrical Engineering from long-term research up to collaborative research supported by a strong involvement in partnerships with large companies and SMEs.
CEA LETI (CEA)	CEA-Leti pioneers micro and nanotechnologies, tailoring differentiating applicative solutions that ensure competitiveness in a wide range of markets. The institute tackles critical challenges such as healthcare, energy, transport and ICTs. Its multidisciplinary teams deliver solid expertise for applications ranging from sensors to data processing and computing solutions.
CEA LITEN (CEA)	CEA-Liten is a major European research institute and a driving force behind the development of the sustainable energy technologies of the future. The institute is working in renewable energy, energy efficiency/storage and development of materials. CEA Liten helps its industrial partners achieve competitive advantage through the development of cutting-edge renewable energy, energy efficiency and novel material technology.
NEEL INSTITUTE (UGA, CNRS)	Largest French research unit in Physics, Institut NEEL is a fundamental research laboratory in condensed matter physics, with a strong interdisciplinary component at the interfaces with chemistry, engineering and biology. Institut Néel possesses technological expertise of the highest level that is strongly intertwined with research projects. Wide bandgap semiconductor group (WBGS) of Institut Néel has a strong expertise in power electronics based on ultra-wide band gap semiconductors (diamond, oxides and nitrides)
GIPSAlab (UGA, CNRS)	Gipsa-lab is a multidisciplinary research unit developing both basic and applied researches in Automatic Control, Signal and Images processing, Speech and Cognition. The research unit develops projects in the strategic areas of energy, environment, communication, intelligent systems, Life and Health and language engineering.
G-SCOP (UGA, CNRS)	G-SCOP (CNRS UMR5272) is a Laboratory hosting researchers focusing on applications of discrete mathematics that have been working on energy from the origin of the lab in 2007. Main topics developed are dealing with environmental impact assessment but also optimization of electrical grid settings and configurations, the management of building systems involving optimization based multi-scale control, usage prediction, self-learning algorithms of usage,...
INRIA	Inria has a world-recognized expertise in artificial intelligence, optimization and computer systems. Inria leads research projects on energy-efficient computing and electrical networks, as illustrated by the recent bilateral partnership ("Défi Inria") with EDF that aims at develop forecasting methods, and stochastic optimization algorithms in order to better integrate renewable energy to the grid.
LIG (UGA, CNRS)	LIG is focused on the foundations and development of computer sciences, including Intelligent Systems for Bridging Data, Knowledge and Humans ; Interactive and Cognitive Systems ; Distributed Systems, Parallel Computing and Networks.
LJK (UGA, CNRS)	LJK is a department gathering researchers in applied mathematics in a broad sense. Its expertise ranges from partial differential equations, numerical simulation (including high performance computing), to optimization and statistics.

Table 1. List of involved research units

B.3. Consortium

Because **EnergyAlps wants to bring original solutions and knowledge by confronting different visions and scientific approaches**, the research units involved in EnergyAlps are working in different domains (Humanities and social sciences, Engineering and materials, Computer sciences and applied mathematics. They are either joint units between UGA (Grenoble's University) and CNRS (French National Center for Academic Research) or affiliated to CEA (French Alternative Energies and Atomic commissions) or INRIA (National Institute for Research on Computer sciences). These four institutions are key players in research and innovation in Energy. The research units and their field of expertise are described in Table 1. The complete list of investigators is given in Appendix.

B.4. Local, national and international positioning

The positioning of EnergyAlps is very original by **its promotion of interdisciplinary low-TRL research**, its transversal view on the whole value chain of electrical energy and the inclusion of interactions with other energy carriers. EnergyAlps is compared in Table 2 with same kind of actions (medium-size, academic research programs). In France, similar programs are less focused on technologies. In Europe, they are not interdisciplinary and/or develop pre-competitive researches, less focused on low-TRL topics. In the US, the research centers mobilize important resources but are very focused on some specific technologies.

France	The transition Institute 1.5	Starting initiative with a weak technological focus
France	Energy4Climate	Focused on climate and environment issues
Belgium	EnergyVille	Covers the energy value chain but no multidisciplinary approach
Germany	E.ON Energy research center	Industrial chair with a large budget
UK	PNDC Strathclyde	Targets precompetitive research
US	CEPES	Focused on power electronics
US	PSERC	Focused on power system engineering.

Table 2. EnergyAlps positioning

At local level, EnergyAlps will foster joint projects on specific topics at the interface between UGA's others LabEx and institutes. Examples include prediction of renewable resources and impact of mid-term climate variations at regional scales with the LabEx dedicated to Earth sciences, mechanical design of new turbines with the LabEx in mechanics, joint studies on the Internet of Things for Energy with the LabEx on ICTs, territorial innovation with the Labex dedicated to transitions in social systems. Some collaborative actions could be supported with the UGA's Institute on artificial intelligence[25]. With regards to existing cross disciplinary projects within UGA, Power Alps and OTE are closely linked to EnergyAlps, respectively on power electronics and energy transition observation. Given the time shifting, they will be integrated in EnergyAlps after their termination (see Figure 1).

B.5. WP description

The work packages are now described, giving their main objectives, methodology and expected results. The interactions between the work packages are given in a supplementary section.

WP1: Planning, design and control of resilient energy systems

The structural evolution of smart energy networks is characterized by a logic of decentralization and interconnection, an increasing digitization of the infrastructure, and a stronger interaction with end-users[26]. WP1 deals with the major technological transformations related with the massive use of renewable energy productions, their integration into the grid, the massive storage required as a result, the development of electric mobility and smart charging, the intelligent electrification of energy uses, the coupling with multi energy carriers. Three main sub-axes will be studied such as the planning of the energy system, the design of each component, and the multi-scale control.

To plan the infrastructures, we will develop prospective scenarios of production, demand and flexibility of the electrical system, at various time steps and geographical scales. We will take advantage of multi-energy synergies (electricity, heat, cold, natural gas and hydrogen) in order to increase the mutualization of resources, both temporally and spatially, while controlling the complexity of the system in a parsimonious way. We will

[25] https://miai.univ-grenoble-alpes.fr

[26] M. Masera, E. F. Bompard, F. Profumo and N. Hadjsaid, "Smart (Electricity) Grids for Smart Cities: Assessing Roles and Societal Impacts," in Proceedings of the IEEE, vol. 106, no. 4, pp. 613-625, April 2018

develop new architectures of electrical networks, in particular with the presumed mutations towards direct current or hybrid networks[27], or even new topologies (meshed networks ...). Finally, we will analyze the resilience of these critical infrastructures to extreme events such as cyberattacks or natural disasters[28].

The electrical components needed for the energy system will be specified and designed to achieve global objectives of efficiency, durability and robustnesss (small generators for dispersed power plants, high performance electric vehicle motors, power interfaces with storage units or other energy infrastructures). We will also provide solutions to the significant increase in the number of sensors required, coupled with intelligent protection devices, to make this complex system more resilient. We will design components that are efficient and economical in the use of materials, which must be abundant and recyclable[29]. The design will include anticipative aging models to increase the life span and robustness of the overall system.

We will propose technologies for energy control and management, for large and micro grids, which can be hybrid AC / DC, which ensures production-demand balancing and guarantees availability and reliability. We will rely on numerical and mathematical tools, stochastic approaches to uncertainty management[30]. We will develop the Digital Twin Instance coupling the physical model to real-time data, integrated in distributed architectures allowing also close decision-making[31]. In particular, we will develop new techniques for data capture, processing and transmission. We will develop local congestion forecasting, stability analysis and real-time control of network. On longer time scales, we will propose automatic multi-criteria decision support for diagnosis / prognosis, in interaction with operators, by integrating an explanatory approach.

WP2: Governance, empowerment and regulation

Public policies and stakeholders' strategies have a structuring impact on the energy transformation through the choice of technologies, the forms of organization, or the involvement of actors and citizen/consumers[32][33]. An in-depth understanding of new instruments and models for action is essential to identify opportunities for innovation and collective action in connection to policy development implementation. Moreover, the aspiration to (re)locate energy production, to revise involvement of actors and ownerships require thinking about short-circuit circularities between production sites and consumption places. Several themes will be investigated:

- The intermittency of renewable energies and the weak flexibility of nuclear electricity production shift the focus to the network and consumption flexibilities and to storage and energy conversion. The analysis of technological choices and the network operators' business models require new technical-economic modeling (e.g. based on game theory, dynamic programming, and multi-agent system). The emergence of flexibility activation mechanisms on the demand side allows alongside storage and back-up power plants, facilitating supply/demand balances at the national, decentralized or end-user levels.
- Moving to renewable energies require change of practices of end-users, transformation or deployment of new distribution infrastructures at different scales. Self-consumption, energy communities and some emergent business intermediation could redefine the relation between production and consumption and, therefore, bustle the energy market. In order to understand the sociotechnical transformations, we need to characterize the factors of the supply and the use of energies according to specific configurations.
- The adaptation of social groups and individuals to climate change and the ambitious mitigation targets are profoundly disrupting social values: issues of sovereignty and justice are pushing actors to act and

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[27] H.Farias De Barros, B. Raison, M.-C. Alvarez Herault, Q. T. Tran, "A Comparative Study of Optimal Planning of Distribution Systems: AC/DC Architecture vs. Conventional Strategies", Accepted for CIRED conference 2023 ; 12-15 June, Roma, Italy

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[29] Mallard, Kathleen & Garbuio, Lauric & Debusschere, Vincent. (2020). Towards sustainable business model and sustainable design of a hydro generator system dedicated to isolated communities. Procedia CIRP. 90. 251-255. 10.1016/j.procir.2020.02.004.

[30] B. Iooss, B. Sudret, S. Lo Piano and C. Prieur, Special Issue on Sensitivity Analysis of Model Outputs. Reliability Engineering and System Safety, 10477, 2022

[31] S R Kumar, A Easwaran, B Delinchant, R Rigo-Mariani, "Behavioural cloning based RL agents for district energy management" BuildSys '22: Proceedings of the 9th ACM International Conference on Systems for Energy-Efficient Buildings, Cities, and Transportation. November 2022 Pages 466–470

[32] D. Møller Sneum, "Barriers to flexibility in the district energy-electricity system interface – A taxonomy," Renew. Sustain. Energy Rev., vol. 145, no. February 2020, 2021, doi: 10.1016/j.rser.2021.111007.

[33] Gilles Debizet, Marta Pappalardo, Frédéric Wurtz, Local Energy Communities: Emergence, Places, Organizations, Decision Tools, Taylor & Francis, 2022.

reexamine the regulation and governance of the electricity sector. The analysis of controversies, the management of which is an essential condition of its societal acceptability and for which the multidisciplinary study in terms of public policy design is decisive. The energy transition requires a renewal of participatory policies: involving citizens in technical and social innovations, energy communities, new forms of energy governance. At a national level, the public/private relationships, especially in France where the legal dimensions are very impactful, are also addressed through the analysis of the evolution of the legal frameworks.

- The digitization of energy systems offers various modalities and governances of energy management. The abundance of data questions the use of indicators, the privacy of their access and their sharing between distribution system operators, market suppliers, local authorities and, if applicable, the energy communities. A broader reflection, an understanding of complex and polycentric norms is required with regard to the plurality of issues and of actors involved.
- Based on renewable energy and, sometime, on storage, mini-grid solutions are progressing not only in southern countries and non-electrified areas but also in buildings connected to the public grid. Therefore, the integration of these forthcoming technologies have to be studied both to understand the social transformations they induce/require in the places and with the network where they are implemented and to draw trajectories for their deployment in France and all over the world.
- At the industrial level, the development of new energy technologies (e.g. power electronics-based devices) needs a detailed and in-depth analysis. They represent a dramatic change in industry organization, but also an opportunity according to the fact that the whole sector has to change, leading to a new deal where the international competition might be reinitialized.

Beyond the production of new knowledge, tools and/or analysis methods, WP2 aims at feeding the other WPs with a transversal look on social transformation and public actions. It also intends in giving opportunities to valorize their research with the actors in charge of regulation and of development of systems compliant to those changes. By associating legal sciences (which define the set of possibilities but which is also evolving), sociology (which studies the "manufacture" of collective, public and private actions), geography (which studies the spatial (re)configurations) and economics (which analyzes the strategic behaviors of actors), the consortium of WP2 seeks to determine in synergy the innovative public policies of the systemic energy transition.

WP3: Digitization of energy systems

The development of a digital infrastructure yields opportunities, but also challenge on how to deploy and use such a technology. Four main challenges must be addressed: how to acquire data via low-power sensor networks, how to deploy secure and robust control architectures via autonomic and self-adaptive computing systems, how to make use of information for better prediction and control, and how to makes the information accessible to operators and end users:

- Sensor networks are needed to monitor the distributed energy suppliers or users in order to send them control signals. Grenoble is renowned for his expertise on low-power sensor networks (e.g. LoRaWan). We will focus on the issues of scaling up such networks: robustness/reliability, optimization of data transmission and energy consumption for balancing with available power. We aim at redesigning current mesh networks protocols (PLC G3 or Zigbee) to overcome their limitations.
- Security and self-adaptivity are essential for electrical systems. The main challenges are (1) the cybersecurity, and (2) the reaction to face intrusions by migrating software components across edge/fog/cloud. Thanks to our expertise in autonomic computing, we want to develop software architecture for autonomic management, coordination of multiple feedback loops. Two outcomes of this part will be the development of an experimental workbench on real industrial device and an open source distributed IDS specialized in intrusion-detection for smart-grid architectures.
- The energy transition implies a strong evolution of management tools, both at the level of network operators, public authorities and communities in their decision-making role. We want to develop innovative decision aiding tools for stakeholders: (1) prediction tools, and (2) indicators to better qualify the issues of energy regulations, governance and ownership. Regarding prediction, we propose new models of individuals, households or communities to better simulate and anticipate energy consumption, including reactions of end-users to nudges to increase flexibility. Instead of top-down models, we will develop a bottom-up multi-agent approach to represents emerging individual behaviors in a realistic way.

Additionally, we want to take advantages of the datasets provided by the WP6, and tools from explainable AI, to build meaningful indicators in a co-operative manner to better manage changes in regulations, consumption and practices.

- Monitoring end-users will allow an integration of more renewable energy but also yields challenges, such as the detection of data privacy risks with solutions to reduce them, and the support of inhabitants in adapting their behavior. Time-varying energy availability implies an evolution of the users' behavior, supported by home energy management systems. Because of the lack of understanding, energy managers might act in competition and contradiction with inhabitants. We plan to design interactive and cooperative approaches that do not aim at "doing instead" but to "do with" the inhabitants: The objective is to empower end users such that they better understand the consequences of their actions. Interactive and cooperative systems will be developed for informing, explaining, asking, suggesting and learning both on human and decision aiding sides.

WP4: Power electronics development

Power Electronics is a "key enabling technology" which becomes mandatory for all future improvement in any application of electrical power, combining high efficiency and high controllability. Silicon is a well-established semiconductor material that has addressed the requirements of energy conversion for more than 50 years. However, it is widely recognized that a real step-improvement in Power Electronics is obtained by employing devices based on wide bandgap semiconductor (WBG) materials. Power electronic devices based on WBG will result in substantial improvements in the performance of power electronics systems by offering higher blocking voltages, improved efficiency and reliability, as well as reduced thermal requirements thus leading to realization of more efficient green electronic systems. Ultra wide band gap semiconductors (UWBG), as diamond and Ga_2O_3, are considered to be the ultimate semiconductors for applications in high power electronics due to their exceptional properties[34].

In this context, WP4 addresses two main challenges: the rising of the power output of systems (either through higher voltage or higher current) and the increase of the modularity of the systems (either during design or during working phase) in order to improve the resilience, to adjust the power output with always optimal efficiency, increase durability, reparability and recycling process, and finally help in reaching a sustainable power electronics.

UWBG will require also new packaging concepts, new system and drivers design able to work at very high temperature (200°C and above). This power increase can also be addressed by parallelization of devices, which will also require the development of driving and monitoring concepts able to cope with multiple devices, including compensation of performance drifts with system conditions, time or aging.

Modular Power Electronics can be of critical importance. One axis will be to ease the design of new power converter, working with already validated and standardized elementary power blocks, including an eco-design approach, by an optimal use of critical material and knowing the exact environmental impact of each blocks (in opposition to a full custom design approach, starting always from the beginning). The second axis is the modularity in working conditions, in order to optimize the conversion yield on a large power range, to deal with failure of a part of the system and more generally to adapt the system to different working conditions.

WP4 will couple its multiscale approach from material to systems with an eco-design methodology that will take into account at all stage the sustainability of the proposed developments. This global vision, from material to system is the only way for achieving the necessary breakthroughs in digital energy management services offered by Power Electronics. The goal is to facilitate the dialogue between the system-level, defining the mission profile of the devices, and the materials, which are the elementary bricks of the power converters:

- At material and device scales, WP4 will first focus on the synthesis, characterization and fabrication of components of the most promising UWBG, namely diamond and Ga2O3, for new applications in power electronics. It will include the on-chip integration of sensors, drivers, protection, but also the innovation in packaging, especially for UWBG, where higher working temperatures than today (more than 200°C) are expected.

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[34] N. Donato, N. Rouger, J. Pernot, G. Longobardi, and F. Udrea, Diamond Power Devices: State of the Art, Modelling, Figures of Merit and Future Perspective, J. Phys. D: Appl. Phys. 53, 093001 (2019)

- At converter and systems scales, WP4 will mainly address design methodologies based on mission profiles and a standardization approach, integrating LCA (Life Cost Analysis) constraints. One of the goal is to defined what could be a standardized elementary Power Cell, its level of complexity, which function are integrated and how to characterize and model this cell. In addition, a methodology for designing different types of converter will be defined, using at beginning already existing devices (such as SiC) but also adapted to the development of future devices (Ga_2O_3, diamond). An additional task will be to define which architecture based on the modular Power Cell can be useful to have reconfigurable Power Converter, typically adapted to multiple level of power (current and/or voltage). Some indicators for eco-design will be also defined during the design process to monitor LCA costs and how to mitigate them.

WP5 Multi-scale methods and tools for modelling, design and supervision

The main objective of this WP is to develop general and innovative techniques for the modeling, the analysis, the design and the supervision of electrical systems featuring a multi-scale dimension, with the ultimate ambition that these can be used for emulating "digital twins"[35], covering a wide range of scales (from the microscopic scale for the material laws to the continental scale for electrical networks!), integrating uncertainties and extreme uncertain events, with re-calibration capabilities from externally measured or simulated data and which can be integrated into efficient optimization loops and planning, designing or operating interactions. In other terms, we aim to devise a faithful digital copy of a real electrical system, evolving over time with it and allowing real time access to quantities impervious to the measurements which can be realized within a time scale compatible with the needs of decision support. In collaboration with the other work packages, WP5 will clarify the objectives, problems and families of case studies for which a digital twin would meet a scientific challenge that can be resolved otherwise. Priority attention will be given to disruptive methods and sociotechnical solutions with high long-term impact. This axis lends itself to a literature review and cross-cutting activities involving all WPs and a "livre blanc" type formalization on digital twins for the transition of energy systems.

At each scale, we will improve the performance of the state of the art by enhancing models for an accurate description of the phenomena of interest, within a reasonable computational time. To achieve this, it will be necessary to make progress on the modeling of materials, to propose discretization techniques that go beyond the quasi-static hypothesis traditionally used by the electrical engineering community for the modeling of new power electronics devices with increasing frequencies, and to develop disrupting techniques for the analysis of electrical systems (graph and complex systems theories that could link geometrical features of the electrical networks with their properties, e.g. stability). A second aspect of our work on modeling issues will be devoted to coupling strategies for complex problems, involving different physical phenomena, human process and scales. A reflection will be carried out by taking into account the rapidly growing parallel capabilities of the current and future computer architectures. For system-scale models, it will be necessary to investigate the connections between scales with, for example, hierarchical techniques, homogenization methods or model order reduction techniques with nonlinearities as the main bottleneck. It will also be necessary to consolidate classical couplings with other physics (mechanics, thermic) and social issues (elasticity of demand, parametrization of strategic behavior) but also to investigate new interfaces (meteorological and climatic models, quantitative geography, game theory in economics).

Concerning design and optimization, parametric, shape or topological optimization approaches will be investigated at the component level (such as electric engines). At the global system level, coupling approaches and the consideration of uncertainties must be integrated in the design phase and especially in the control phase. In this last context, computational efficiency is a key point. More generally, a line of work will focus on a better mathematical formalization of optimization problems and on the development of algorithms adapted to the cooperation between actors from different fields, ranging from physical and technical sciences to the human, economic and social sciences.

Obviously WP5 will enrich the modeling and optimization methods by assimilating data, which can be obtained directly from measurements made by sensors disseminated in the system or by simulations. This raises the need for hybrid physics / data approaches. The research problems will concern the location, the type and the quality

[35] Chinesta, Francisco, et al. "Virtual, digital and hybrid twins: a new paradigm in data-based engineering and engineered data." Archives of computational methods in engineering 27.1 (2020): 105-134.

of measurements, the relevant parameterization of the models for the recalibration and the contribution of artificial intelligence approaches.

The developed numerical tools will be integrated in robust, efficient and scalable digital platforms that will be available to designers and managers.

<table>
<tr><th></th><th>WP1 provides</th><th>WP2 provides</th><th>WP3 provides</th><th>WP4 provides</th><th>WP5 provides</th><th>WP6 provides</th></tr>
<tr><td>To WP1</td><td>N/A</td><td>Major issues, controversies and disruptions for markets, social involvement, public policies, actors …</td><td>Low-energy IT solutions with distributed architecture, sensors placement, hybrid machine learning algorithms</td><td>Impact of the systems specifications on the design of power converters</td><td>Methodology and tools for multi-scale modeling, uncertainty propagation, optimization, digital twin support …</td><td rowspan="5">Data bases, data treatment algorithms, real time forecasting services, dissemination platform</td></tr>
<tr><td>To WP2</td><td>Design for electrical energy systems and needs for stakeholders, public policies and regulations</td><td>N/A</td><td>AI opportunities for new methods and questions, privacy issues, needs for the evolution of regulations, governance and ownership</td><td>New socio-technical issues in the HSS research agenda</td><td>Decision support tool for the governance and supervision</td></tr>
<tr><td>To WP3</td><td>Needs for digital technologies and software</td><td>Privacy regulations, governance schemes</td><td>N/A</td><td>Needs for distributed control architecture</td><td>Needs for innovative communication protocols</td></tr>
<tr><td>To WP4</td><td>Requirements for power electronics bricks of smart grids</td><td>Research inputs on international challenges and needs for industrialization</td><td>Sensor placements for multi converters systems</td><td>N/A</td><td>Numerical methods for converters analysis and design</td></tr>
<tr><td>To WP5</td><td>Modeling and optimization issues not solved by today tools and methods</td><td>Modeling input, esp. on stakeholders roles, behaviors, markets dynamics, regulation</td><td>Expertise in integration digital elements, protocols in digital twin</td><td>Specifications and datasheet for high frequency modeling</td><td>N/A</td></tr>
<tr><td>To WP6</td><td colspan="5">Open Data sets, survey results and software</td><td>N/A</td></tr>
</table>

Table 3. Relationships between work packages

WP6: Data and observations

This methodological WP will use the Observatory of Transition in Energy (OTE) platform for collection and share of data. OTE platform responds to several operational and methodological challenges, such as the recruitment of energy actors, legal and administrative questions concerning the availability and privacy of data (agreement to make data available, informed consent for data covered by the RGPD), and technical solutions for collecting and storing sensitive data while producing and making new data available for research. OTE platform provides support and protocols to collect data of an interdisciplinary nature, ranging from measurements provided by physical sensors and energy meters, to data on behaviors and practices from the social or economic sciences. It preserves private interests and producing new anonymized and/or aggregated data capable of being of interest to research, but also to socio-economic actors.

In EnergyAlps, WP6 will focus on the scaling up of the abundant research observations and the quality of the data resulting from cross-disciplinary studies. New observation methods and tools will be developed to complement current observations and forecasting tools with innovative devices measurements that allow data to be collected over long periods and repeatedly (longitudinal cohorts, user panels, interviews databank, geographic information systems, smart meters, sensors, etc.). A work on the collected data (preparing, cleaning, aggregating, merging, transforming, missing values …) will be performed involving all the research teams producing or using data.
On the other hand, EnergyAlps will develop enhanced tools for the capitalization and sharing of data not only within EnergyAlps but for any researcher worldwide. Indeed, there is a major scientific need for reliable, relevant and robust analyses, which can only be met if we implement an ambitious system of data collection and sharing on the socio-technical system. It is also a matter of complying with the obligations of open science, dissemination and reproducibility of research that are increasingly required.

Beyond the legal and technical issues, the management of data sharing and reuse between/by researchers in a cross-disciplinary domain is a challenge. Heterogeneity of practices and positions according to disciplines, lack of experience of researchers in this area, call for an iterative, both collegial and specific, development of procedures. In this WP, the procedures will be developed with the research teams involved in the other work packages, producing or using data.

B.6. Relationships between work packages

Work packages are not pure stand-alone packages but aim at tackling intertwined issues. The main relationships between them are shown in Table 3. WP1 and WP2 are about sociotechnical energy systems while WP3 and WP4 are about key enabling technologies. WP1 and WP2 will interact with each other and address specifications to the technological work packages WP 3 and WP4. WP3 and WP4 will return constraints and opportunities to the socio-technical analyses of energy systems. The methodological work packages WP5 and WP6 will bring observations, data, advanced numerical methodologies and tools necessary to perform the works. The scientific animation of EnergyAlps will ensure the integration of each WP within EnergyAlps framework.

C. Impact

C.1. Contributions to major scientific, technological and societal issues

EnergyAlps is a cross-disciplinary joint-research initiative that gathers research teams in electrical engineering, social sciences, computer sciences, applied mathematics and material sciences. The main expected impact is the production of leading edge knowledge and innovative concepts and functionalities that could be used by scientists, engineers, private and public stakeholders to understand and design the energy system transformation. **Major technological advances are expected** about power devices, electrical and digital architectures, management and design strategies to ensure a safe, resilient and sustainable operation of the future energy systems. More importantly, **the technological choices will be challenged by social sciences**. Beyond technology, EnergyAlps will contribute to the definition of public policies, social organization forms that will foster the transformation of the energy system and empower users for a sustainable energy transition. A high-impact contribution will be to define and deliver in an open science framework new concepts, methods and tools to assess, analyze, model at various scales the energy systems.

C.2. Dissemination and communication of the research results

EnergyAlps executive board will develop a *Dissemination Plan* at the very beginning of the project. This Plan will define a common dissemination policy, the objectives of the dissemination actions. It will identify the targeted audiences and the communication channels, and will define a schedule for implementation of the actions. Its aim will be to maximize the awareness on the project and the impact of its results on different target communities ranging from larger audience, end-users of the considered technologies (i.e. DSOs, aggregators, manufacturers, etc.) to researchers, policy makers among others. The dissemination tasks will be performed throughout the project according to this Plan. Impact indicators will be defined in the Dissemination Plan to monitor the impacts of the dissemination activities. Some of these indicators are given in Table 4. Example of indicators. The actions that aim at disseminating information will include:

Academic production

- Publication of the scientific results in high impact scientific journals.
- Presentation of the main achievements at international Conferences, such as CIGRE, CIRED, IAEE, IEEE, PSCC, Power Tech Conferences, STRN, either as technical papers or thorough dedicated panel sessions.

Transfer to industries and organizations

- Organizing a yearly general open conference on the outputs and achievements of EnergyAlps
- Participation of the Consortium members in various international Advisory Groups, Task Forces or expert groups that are organized within CIGRE, CIRED, etc.
- Development of a LinkedIn group dedicated to the project. It might host a discussion forum about energy transformations and advanced concepts related to them
- Publishing 4 to 5 white papers targeting socio-economic actors and policy makers
- Organizing open webinars targeting international audience

Open science actions towards society

- Development of a web page with a detailed description of EnergyAlps
- Free access to uploaded deliverables, data and source codes used and produced within the program through the website.This will allow external and interested parties to follow obtained results The open digital platform used for the dissemination will be developped in WP6.
- Publications targeting broader audience to highlight the challenges of the energy systems transformation and the ambitious and cross-disciplinary work done in EnergyAlps to answer them
- Participation of the project members to local or national outreach events such as: Fête de la science, seminars organized by the French association of electrical engineering and electronics SEE[36] or the French ministry of Sustainable Development and Energy, etc.

C.3. Strenghtening national and international positioning and collaborations of UGA

As previously noted, UGA is already a major research center in Energy. **EnergyAlps intends to reinforce this leading place by the promotion of cross-disciplinary and breakthrough research fed by theoretical and experimental works**.

- Dissemination and communication actions will help UGA to gain visibility as an important actor of energy transformation studies.
- Some proposals will be prepared within EnergyAlps for national and/or European calls. They will involve other academic and industrial actors from France and/or Europe.
- Researchers from other institutions will be invited for giving talks in the frame of the seminars organized by EnergyAlps.
- UGA is member of UNITE!, a European University network[37]. One of the four focus area of UNITE! is sustainable energy. EnergyAlps will contribute to the development of UNITE! by welcoming UNITE! partners ‘students and proposing joint research and innovation actions.

C.4. Strengthening facilities within UGA

Grenoble has a long-lasted tradition of experimental works conducted through labs or larger scale platforms of CEA and UGA. EnergyAlps will strengthen these experimental works. Some models developed for the digital twin will enrich the model library of the real-time test benches. Ultra-wide band gap test platforms will be further developed to characterize devices performances. An important contribution of EnergyAlps will be the strengthening of open science facilities within UGA. The dissemination of open source datasets, data analytics tools and software for energy transition studies will be done through the open digital platform of WP6. Finally, in Grenoble, experimental facilities are usually shared between Research and Education. Strengthening facilities will then benefit to Education and the links between Research and Teaching activities.

C.5. Contribution to Education within UGA

EnergyAlps researchers are already strongly involved in numerous education actions within UGA. Most of the researchers teach in License and Master curricula in electrical engineering, social sciences and computer sciences. They also teach in *GREEN* and *STEEN*, two graduate schools dedicated to energy and society transitions. These graduate schools aim at attracting high caliber young engineers and scientists. With the UGA *Design Factory*, they offer cross-disciplinary curricula in engineering and social sciences.

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[36] https://see.asso.fr/

[37] https://www.unite-university.eu/

EnergyAlps researchers will contribute to these curricula by providing courses, uses cases, internships inspired by their research activity[38]. Dedicated courses will result from the interdisciplinary research works of EnergyAlps, in order to show the complexity of the socio-technical transformations of energy systems. This is a crucial point to demonstrate to young graduated students and scientists that the social and technical energy challenges that they would face when they join industry or public organizations would be substantial and rewarding.

Another education impact will be PhD courses offered online by EnergyAlps researchers in Unite! doctoral school. The multidisciplinary vision of technological challenges offered by EnergyAlps (for instance ecodesign in Power Electronics) will boost attractiveness of « conventional » sciences for students.

Domain	WPs	Type	Metrics
Program management	All WPs	Research activity and structuration	Researchers involved into the projects Recruited PhDs and postdocs Master students involved in EnergyAlps Invited researchers
Outcomes	All WPs	Outcome indicators	High level publications International conferences Keynote speeches Prizes (best paper awards …) Open tools, codes, databases or benchmarks issued from the program
Impacts	All WPs	Impact indicators	KPIs for monitoring the contribution of EnergyAlps actions towards Net Zero Emission Public research funding issued from the program results Patents Created startups Cooperation agreements issued from the program results Academics or companies using at least one result of the project Number of contributions in press and media, conferences, views of videos and downloads of documents targeting non-academic people Number of connections to the website Attendance to seminars/webinars involving EnergyAlps members
Impacts	WP1/6/3	Technical and environmental KPIs	Hosting capacity of distributed energy resources, renewable energy sources, electric vehicles and other active loads Increased system flexibility (amount of generation or load that can be shifted temporarily) Improved power quality (voltage variations, harmonic distortion) Increased system resilience (ability to resist and/or absorb and/or recover after a critical event) Increased asset lifetime
Impacts	WP2/5/3	Economic, Social, Legal KPIs	Participations in public debates or national commissions on the regulation, the policy or the prospective of energy systems

Table 4. Example of indicators

C.6. Exploitation of results and intellectual property

EnergyAlps will produce useful and innovative results that are deserved to be exploited during and beyond the duration of EnergyAlps. Although the project aims low TRL research, the technologies emerging from the works could lead to securing patents and, accordingly, seek protection of the generated intellectual property (IP). The body of specialized lawyers of UGA will assist the securing of patents and the granting of licenses, including common licenses that could be appropriate for open science. EnergyAlps executive board will ensure that all researchers are aware of the essential character of IP protection, even in an open framework, for the success of the projects and the impact of EnergyAlps.

UGA is the coordinator of *ExTASE*, 1 of the 17 national consortia selected by the French government in January 2023 to accelerate the technology transfer from public research actors and industry. The 17 consortia will receive 275 M€. *ExTASE* aims at enabling the development of a French industry in the domain of energy

[38] https://www.univ-grenoble-alpes.fr/education/graduate-school/

technologies. Obviously, the coordination of *ExTASE* by UGA will facilitate the transfer of the most promising results of EnergyAlps towards *ExTASE* for the development of innovations.

C.7. Leveraging for additional funding.

The scientific community involved in EnergyAlps is well connected with the socio-economic landscape and stakeholders. They are also well experienced in obtaining external funding from various funding agencies at regional, national and European levels. As the research field of EnergyAlps covers a large spectrum of issues and topics and the projected internal funding for this project is expected to ensure funding for only a very reduced numbers of topics, **EnergyAlps will explore all possibilities for additional funding from external sources (national or EU calls for Cofund or collaborative projects, bilateral project with non-academic partners such as companies or communities…).** For this purpose, EnergyAlps will take advantage of the experience of the involved researchers on this issue. Hence, this external funding will be used for supporting additional actions that are not funded through the initial budget but connected to the core challenge of EnergyAlps with high added value in terms of coping with specific key scientific challenges. An example is that the priority projects within EnergyAlps will be oriented toward more systemic and cross-disciplinary topics while the external funding may concern specific topic or technology.

C.8. Key performance indicators

The outcomes and impacts will be monitor by a set of indicators that will be defined by the executive board in the Dissemination plan. Examples of indicators are given in Table 4. They could measure program advancement, technical, economic, social, environmental, legal impacts.

D. Implementation

The governance scheme follows the guidelines imposed by UGA. The executive board will be chaired by EnergyAlps main coordinator and include WP leaders. The members of the board of directors are the heads of the research units involved in EnergyAlps. The supervisory board will include representatives of UGA, CNRS, CEA and INRIA. The scientific advisory board will be composed of renowned scientists in the field of Energy, systems and societies.

D.1. Organization of the research activity according to the stated objectives

The research activity of EnergyAlps will be handled mainly by the following resources:

- PhD theses, post-docs, and seed funding for preparing new research topics through internships and short-term engineering projects.
- Permanent research staffs

EnergyAlps budget dedicated to research activity concerns mainly funding the first type of resources, ie, PhD theses, post-docs, short-term engineering projects, and internships. The distribution of this budget for these resources is expected to be organized as follow (see Table 5):

- PhD theses organization:
    - Phase 1: progressive ramp up for PhDs with 2 PhD theses on year 1, 3 on year 2 and 4 on year 3.
    - Phase 2: Cruise regime for years 3-6 with 4-5 PhDs at the same time combining ending of ongoing PhDs and launching new PhDs
    - Phase 3: Soft landing towards the end of the current funding while projecting for self-sustainability as the topic of EnergyAlps is considered and known as a long-term challenge (energy).
- Post-docs organization: Post-docs are intended to last for one or two years. They will be dedicated primarily for developing specific solutions, deepening identified scientific issue, reinforcing a targeted research action, contributing for opening and structuring new research subjects for new PhDs, etc. With respect to the considered phases described above, these post-docs will contribute as follow:
    - Phase 1: 2 Post-docs for the 1st year, then 1 post-doc per year from year 2 to year 3.
    - Phase 2: Cruise regime for years 3-6 with 1 PhDs per year combing ending of ongoing post-docs and starting new post-docs depending on the research needs.
    - Phase 3: This phase is a soft landing one for PhD but will consist on increasing the number of post-docs for valorizing and deepening some identified PhD achievements as well as preparing for the sustainability operation of EnergyAlps beyond the funding period.
- Seed funding. This part is mainly dedicated to exploring and preparing new topics for potential PhDs. It will consist of an average of 6 master internships per year.

- Permanent research staffs: For this type of resource, we will consider:
    - Permanent staff already paid by the university (UGA and Grenoble INP) and research organizations (CNRS, CEA, INRIA, INRA) for financial or IP issues, web designs… For this resource, EnergyAlps budget is not considered.
    - Project manager for the duration of EnergyAlps needed for such large research projects with significant number of research resources as well as for ensuring a proper progress of the research activity. He/she will tackle the defined objectives while ensuring the overall coherency of EnergyAlps given the variety of laboratories and disciplines involved in EnergyAlps and interacting with the related stakeholders. A specific budget line will be dedicated for funding this resource.
- Fee levy for the fixed administrative cost of UGA
- Scientific animation (see next section for description)

Resources (k€)	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	*Avg*
PhD (with support fees)	86.7	130	173.3	173.3	216.7	216.7	130	43.3	*146*
Post-doc	110	55	55	55	55	55	110	55	*69*
Seed fund	20	32	32	24	24	16	0	0	*19*
Project management	42	42	42	42	42	42	42	42	*42*
Animation/com/misc	20	20	20	20	20	20	20	20	*20*
Fee levy (8%)	17,9	22,5	30,3	25,1	28,3	28,0	24,2	12,8	*24*
TOTAL	242	303	410	339	382	378	326	173	*320*
Nb of launched PhD	2	1	1	2	2	1	0	0	
Total nb of PhD	2	3	4	4	5	5	3	1	
Nb of post-doc	2	1	1	1	1	1	2	1	

Table 5. Budget distribution per year

D.2. Scientific animation

EnergyAlps involves different scientific communities and laboratories working in the area of electrical energy mixing various disciplines ranging from electrical engineering to human and social sciences passing through digitization, IT and applied mathematics. In addition, for these various communities, and given the inherent characteristic of the scientific challenges linked to the evolution of the energy sector, **there is considerable need for ensuring a continuous scientific and collective animation to bridge all these communities and stakeholders.**

This animation will consist of various actions among which we can list:

- EnergyAlps community management
    - Fostering cross fertilization among the communities through targeted meetings and scientific exchange allowing efficient bridging between engineering and human/social sciences
    - Animation of the local information system (Intranet, newsletter for internal and external public, …)
    - Broadcasting to EnergyAlps community relevant information and events related to EnergyAlps topic
    - Together with WP6, implementing a strategy for collecting key results, progress highlights and capitalizing produced tools
    - Organizing and structuring meetings and yearly conference of EnergyAlps
- Impact and dissemination management
    - Monitoring EnergyAlps impact indicators
    - Preparing proposals for national or European calls
    - Organizing the dissemination actions (see Implementation part above)
    - Animation of communication channels: Webpage, professional social media, videos, interviews, …

The project manager will follow these actions under the supervision of the executive board, with a budget of 20k€ per year.

D.3. Budget allocation and priorities

In this section, we will describe the strategy and process of allocating the budget in particular for different PhDs and Post-docs, internships and short-term project.

Due to the limited overall budget allocated by UGA, yearly priorities will be defined by a "Strategic Orientation Committee - SOC". This SOC will be composed of the "EnergyAlps executive board", key scientists within the involved institutions provided by the Board of Directors, and stakeholders. The SOC will meet once a year in conjunction with the yearly conference or separately. The yearly priorities will target topics that are not already funded at the time of their definition. **Priorities for years 1 and 2 will be: multiscale approaches to enhance resilience and technologies for energy savings**.

In this context, the purpose is to make the process of selecting proposals simple, transparent, smooth and efficient given the limited budget. The first selection processing will be handled by the executive board of EnergyAlps and the final arbitrage, considering budget constraints, will be handled by the board of Directors. The submission period will be used by EnergyAlps Executive Board for supporting the researchers in the process of structuring their research project proposal. The submission document will be short, describing the main objectives, the proposed methodology, the expected outputs and the participants. The selection process will be based on known criteria that will be considered every year in relation with the yearly priorities. Scientific quality and implementation (objectives, methodology, expected results, involved teams, planning, risk analysis) and impact for EnergyAlps (development of community synergies, potential for academic and non-academic collaborations or innovations, UGA's visibility enhancement…) will be two decisive criteria.

EnergyAlps field of research is also linked with national stimulus packages in particular the acceleration strategy for research namely PEPR (Program and Priority Research Equipment) TASE (Advanced Technologies for Energy Systems). From the timing perspective, the PEPR TASE has already started in particular for targeted topics. EnergyAlps is expected to start at earliest by late 2024. As such, the topics that will be considered in EnergyAlps will be positioned in complementarity with the actions undertaken by the PEPR taking into consideration the duration of EnergyAlps that is longer than the one of PEPR. On the domain of energy, the main expected partnership is with EDF and should start in 2023 for a duration of 5 years. This project will finance PhD or postdocs on the development of optimization algorithms for energy system. It does not concurrence EnergyAlps as it does not involve the same partners and will finish much earlier than EnergyAlps.

D.4. Risk management

The objective of this section is to avoid deviations from the Project Work Plan and develop mitigation strategies and contingency plans. The identified risk will be managed at different level: project level, Work Package levels, Executive Board level and Board of Directors Level.

Roles and responsibilities:

- Each project leader identifies risks, develop mitigation strategies and contingency plans for his/her tasks and monitors risks. He/she reports risks to the work package leader.
- Work package leaders consolidate risks; develop mitigation strategies and contingency plans on work package level. They report to the Executive Board.
- The Executive Board is responsible of risk management of the whole project. It consolidates risks, develops mitigation strategies and contingency plans, monitors the risks and reports risk status. If required, it informs the Board of Directors.

Methodological framework:

Risk will be allocated to following types: Technical, Operational, External factors (see Table 6). All risks will be assessed using the three-point scale: low risk, medium risk, high risk. The project risk plan provides a set of forms to specify risks and document status of risk.

Category	Risk	Scale	Mitigation action
Technical	The first results may be divergent from what was forecasted	low	The operational organization of the project supports the early detection of any such risk, the reallocation of resources within the project activities
Technical	The work is more complex than initially forecasted and requires more resources to be finalized.	medium	Early detection of any such risk in order to revise the objectives or the methodology adopted.
Operationnal	Stakeholders cannot be involved as required	low	The consortium will enlarge stakeholder involvement if necessary.
Operationnal	Slip in the work plan of the Scientific and technical preparatory evaluations having a significant impact on the seminars and conferences and consequently on the overall successful delivery of the project.	low	A realistic project management structure and means for resolving conflicts as well as procedures for addressing inadequate performance in any one partner organization will be established.
Operationnal	Withdrawal of key persons in partners	medium	All partners have qualified staff to replace personnel All project works will be well documented – also in case tasks must be reassigned. If necessary tasks can be partially reallocated to another partner within the consortium with similar competences
Operationnal	Withdrawal of one of the consortium partners	low	Some redundancy in the competences of the different partners. Tasks can be reallocated to another partner
External	Low interest, lack of awareness of the stakeholders (industry, research centers, public bodies, …) regarding the added value of EnergyAlps	low	Awareness plan, including active dissemination, will be fostered.
External	Difficulties for getting sensitive information from the stakeholders contacted and questioned	high	Anticipation: having a protocol for getting and exploiting sensitive information which does not affect the interests of the stakeholders and capitalizing on OTE experience.

Table 6. Examples of identified risks

D.5. Engagement in assessing carbon trajectory over the duration of the project

EnergyAlps deals with energy challenges in particular on the energy contribution for the transition toward the Net Zero Emission (NZE). Indeed, energy consumption in various sectors such transportation, industry, and building are responsible of about 70% of global CO2 emissions. In addition, there is a worldwide consensus that in order to reach the NZE by 2050, there is a need to increase the share electricity in the final energy consumption to 50-60% having in mind that today this share is about 20-25%.

As such, all the research actions that will be carried out within EnergyAlps, described in the different WPs, are organized to contribute towards this objective. Besides the fact that EnergyAlps is dealing specifically with electrical energy, it is also mixing power engineering, digitization and socio-economic issues for empowering the end user customer while tackling institutional and organization issues.

In this perspective, the consortium will issue specific KPIs for monitoring the contribution of EnergyAlps actions towards NZE. Two categories of actions will be specifically considered:

- Research actions:
  - All the WP will systematically assess the KPI while integrating the contribution of the research carried toward carbon emission reduction. This will be considered both during the process of project selection and result evaluation
  - Ability of the research outputs to propose solutions for switching carbon-based usages to carbon-free usages including the use of electricity energy carrier.
- Organization actions
  - For the whole duration of EnergyAlps, the sustainable development and societal responsibility process will be adopted. This will be applied for meetings organization, conference participation, for example by fostering the use of soft transportation means when possible, and all actions showing the lowest impact on carbon emissions.

E. ANNEXES

CV of the project leaders

Prof. Nouredine Hadjsaid

58 years old, married, 2 children

Full Professor at Grenoble InP, the Institute of Engineering of Univ. Grenoble Alpes

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21 avenue des martyrs CS 90624
38031 Grenoble Cedex – France
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Career

2000 - Present:	Full professor at Grenoble InP - the Institute of Engineering of the Univ. Grenoble Alpes /ENSE3/G2Elab
Jan – Jul 2007:	Invited/visiting Professor at Virginia Tech (USA)
1999 – 2000:	Invited/visiting Professor at Virginia Tech (USA)
1993 – 2000:	Associate Professor, Grenoble Institute of Technology
1991 – 1993:	Assistant Professor, Grenoble Institute of Technology

National Responsibilities

2015 – Present:	**President** of the scientific Council of SmartGrids France, the French industrial branch of SmartGrids including all “Energy” and “ICT” industrials as well academia, research centers, energy regulator (CRE) and government bodies.
2018 – Present	**Director** of G2Elab (Grenoble Electrical Engineering Laboratory), 300 researchers, Engineers and administrative staff
2013 – Present:	**Director** of Industrial chair of excellence for ENEDIS (French Distribution System Operator) on SmartGrids
2010 – 2018:	**Chairman** of the research program “power grids and storage” at the French National Research Alliance on Energy (ANCRE)
2014 – 2018:	**Deputy Director** G2Elab
2006 – 2018:	**Animator** of cleantech technologies cluster in Rhone-Alpes – France
2001 – 2013:	**General Director** IDEA – GIE (common research & innovation center on SmartGrids between EDF – French utility-, Schneider Electric – manufacturer – and G2Elab

International Responsibilities

2022 – Present	**Vice President IEEE Power & Energy Society** New Initiatives and Outreach
2018 - 2021	**Treasurer IEEE PES** (Power and Energy Society) – Elected by IEEE PES members worldwide.
2019 – Present	**Chair** of Singapore industrial branch SPECS Technical Committee (TC) on Smartgrids and Power Electronics, Singapore
2012 – 2018:	**Chair** of IEEE ETCC (Emerging Technologies Coordination Committee).
2013 – 2014:	**French coordinator** for the German – French Forum on Energy for the Ministry of Research, Innovation and Higher Education
2009 – 2012:	**French representative** at the International Energy Agency (IEA) – ENARD implementing agreement
2010 – 2012:	**Chairman** of RA1 of the European Commission Strategic Research Agenda 2035 for SmartGrids (EU SmartGrids Technological Platform)
2007 – 2010:	**Past-President** of CRIS International Institute (International Institute for Critical Infrastructures) in charge with European commission relationship
2004 – 2007:	**President** of CRIS International Institute
2002 – 2004:	**President Elect** of CRIS International Institute
1999 – 2002:	**General Secretary** of CRIS International Institute

International expertise

2003 – 2022:	International Expert for Research Grants Council of Hong Kong (assessment of research projects)
2016 – 2018	International Expert for the Wallonie (Belgium) Research Agency DGO6 (assessment of research projects)
2012 – 2016	EU Stakeholder Advisory Board of EU project “GRID4EU”
2012:	International Expert for research assessment of KTH – Sweden (assessment of the university scientific performances)
2008 – 2010:	International Expert for the Hercule – Foundation – Belgium and Catholic University of Leuven – Belgium (assessment of research projects)
2009:	International Expert for the Swedish Energy Agency – Assessment of EKC2 scientific performances)
2006 – 2009:	EU Stakeholder Advisory Board of EU project “IRRIIS“
2006 – 2007:	EU Stakeholder Advisory Board of EU project “CI2RCO”
2001 – 2004:	EU Stakeholder Advisory Board of EU project “AMSD”
2001 – 2004:	Scientific EU expert for the EU project “EXaMINE »

Scientific Production and Publications

PhD Advising:	**52** PhD theses completed and defended and 5 ongoing PhDs
Journal Papers:	**90** journal papers (IEEE Transactions, IEE, Elsevier, …)
Conference papers:	**204** (IEEE, CIRED, ISGT, PowerTech, PSCC, …)
Books:	**10** books (7 in French and 3 in English)
Book chapters:	**15** chapters (3 in French and 10 in English)
Review Editorial:	**7** editorials in IEEE, Energy regulator, European Commission and REE mainly on SmartGrids
Patents and Licenses:	**5** patents and **1** industrial License
International invitations:	**67** invited keynotes speeches and presentations at international conferences and workshops
National invitations:	**30** invited keynotes speeches and presentations at national conferences and workshops
Dissemination conf.:	**48** invited presentations for general public dissemination, Energy regulator, TV, press, etc.

2022 Citation Index (Harzing : Publish or Perish – Google Scholar):

- **H_index=44** (41 in 2021, 39 in 2020)
- **G_Index=85** (80 in 2021, 75 in 2020)
- **Citations : 5882** (5163 in 2021, 4598 in 2020)

Industrial Partnership and Projects

Industrial contracts:	**30 industrial** contracts (about 10 M€) with major power industry (EDF, ENEDIS, RTE, Schneider Electric, Alstom (GE), Nexans, Atos WG, …)
IDEA Contracts	**11,5** M€ from 2011 to 2013 as a General Director
EU contracts:	**9 EU projects** awarded (competitive bid EU wide) with major industry partners from European Union (total budget of 40 M€)

ENEDIS Industrial Chair of Excellence: about **0.5 M€** every year since 2013

National projects:	**11 national projects** awarded (competitive bid nationwide) with consortia grouping industry and academia (total budget of 70 M€)

Scientific and Editorial Responsibilities - International Conferences

2018 – Present:	Member of the steering committee of IEEE PowerTech
2014 – 2019:	Associate Editor IET Generation, Transmission & Distribution
2015 – 2018:	Book collection Director ISTE
2013 – 2016:	Member of ANR CPS (Comité de Pilotage Scientifique), défi 2

2016:	General Chairman of IEEE Conference-Forum SG4SC 2016 (SmartGrids for SmartCities)
2013	General Chair of IEEE PowerTech'2013 conference, Grenoble – France
2006	General Chair of CRIS international Workshop, Magdeburg - Germany
2002 – 2018:	Member of the international scientific committee of more than 30 international conferences (USA, China, EU, …)

Personal Awards and Distinctions

2021	Service appreciation award IEEE
2019:	SEE Emeritus elevated member
2016:	IEEE Outstanding Achievement award IEEE/ SG4SC 2016
2015:	President of the Jury for the French-ERDF - RTE contest for innovative Start ups on SmartGrids
2014 :	GSGF (Global SmartGrid Fenderation) International Jury for SmartGrids demo projects (the only EU representative)
2013:	IEEE Outstanding Achievement award IEEE/PowerTech'2013
2007:	Distinction EU implication project CRISP
2006:	CRIS Award recognition
2000 :	2 0% best Professors at Virginia Tech (USA)
1999:	Best PSC paper
1997 :	Best IEEE paper

Education

1998:	*Habilitation à Diriger des Recherches* (HDR) Diploma (Hability to direct research)
1992 :	PhD at National Polytechnic Institute of Grenoble (INPG) – France, Electrical Engineering Laboratory of Grenoble (LEG) with Honors
1988:	Master at National Polytechnic Institute of Grenoble (INPG) – France, Electrical Engineering Laboratory of Grenoble (LEG)
1987:	Engineering Degree, Major, at University of Tizi Ouzou- Algeria

Field of Expertise

SmartGrids, Power energy technologies, Distributed Generation, Electrical Systems, Regulation & Deregulation of the power industry (markets and Engineering coupling), Critical Infrastructures (Energy and Information/communication interaction)

Prof. Daniel Llerena
57 years old, married, 3 children

Full Professor at Univ. Grenoble Alpes
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38058 Grenoble CEDEX 9 – France
Tel : +33 476 742 963

Diploma and qualifications

- Since 2013: Professor (Full), ***second higher aggregation competition***.
- February 2001: ***Habilitation for supervising researches,*** Dynamics of industrial organizations, UGA.
- January 1996: ***PhD in Economics,*** Internalization of the Environment and Learning in Organizations, University of Strasbourg.
- September 1990: ***Master of Industrial Management and Innovation***, University of Strasbourg.

Synthesis of the scientific results

Publications: 20 publications in international peer-reviews, 28 communications in international conferences and 13 in national conferences, 11 chapters of book, 3 books coordination, CV Hal: https://cv.archives-ouvertes.fr/daniel-llerena .
Contracts: Scientific coordination of 13 research contracts, participation to 8 research contracts.
Supervising: 8 PhD supervised

Management/Animation of Research

- Since 2020, Deputy Director of the ***GAEL*** (UMR 5313)
- Since 2020, Co-animator of the Thematic program *GREEN* of the GraduateSchool@UGA
- From 2017 to 2021, scientific animator of ***one research front in the Eco-Sesa projet*** (see https://ecosesa.univ-grenoble-alpes.fr/eco-sesa-project/organization/).
- From 2010 to 2020, Director of the ***Federative Research Structure on Innovation, Knowledge and Society*** (FR 3391 CNRS) which brings together 18 laboratories in order to develop multidisciplinary research on the industrial, societal and environmental challenges of innovation in the three main areas of Sustainable Energy Development, the Information Society and Health.
- From 2003 to 2006, Director of the ***Institute of Production and Industrial Organizations*** bringing together 10 laboratories in Engineering Sciences and in Human and Social Sciences in order to support interdisciplinary research in the field of industrial organizations and the evolution of production systems.

Administrative and collective responsibilities:

- Elected member of the G.A.E.L. Laboratory Council, 2016 - 2020.
- Member of the Scientific Council of Grenoble-INP, 2012 - 2015.
- Elected member of the Scientific Council of the Pierre Mendes France University Grenoble, 2007 - 2012.
- Elected member of the Board of the Faculty of Economics, since 2000.
- Chairman of the Department of Economics at the Pierre Mendes France University, Grenoble, from 2013 - 2015. Vice-President of the Department from 2009 - 2013.
- Elected member of the Commission of Specialists in Economics of the University Pierre Mendes France of Grenoble, 2000 - 2007.
- Referees: *Energy Economics, International Journal of Environmental Technology and Management, Management International, Journal of Evolutionary Economics, Economie et Prévisions, Economie Appliquée.*

International Partnership and experience

- Responsible for the Franco-Brazilian cooperation program FIPE (USP) / Faculty of Economics Grenoble, "Master in Economic and Statistical Studies", 2011 - 2015.
- Participation in the European TEMPUS-MEDA program "Organization of a Master in Economics" (OMAR project), with the Universities of Savoie, Salamanca and Mohammed V University of Agdal-Rabat, 2003 - 2006.
- Scientific leader (with N. El Aoufi, Mohammed V University, Rabat) of the Integrated Action of the Ministry of Foreign Affairs "Which industrial organization for a quality production?", Convention MA/01/29, 2001 - 2004.

Extracts from the scientific production:

- Nudges and peak pricing: A common pool resource energy conservation experiment (with P. Buckley), Journal of Behavioral and Experimental Economics, in press, 2022.
- Objective Evaluation of Subjective Metrics for Interactive Decision-Making Tasks by Non-experts (with G. Calvary, J. Coutaz, Y. Laurillau and V. B. Nguyen), Human-Computer Interaction – INTERACT, 2021, pp.384-403.
- Potential substitutes for critical materials in white LEDs: technological challenges and consumer issues (with P. Gaffuri, E.Appert, S. Robin, E. Stolyarova, M. Salaün, and V.Consonni), Renewable & Sustainable Energy Reviews, 2021, 143.
- Elicitation of Willingness to Pay for Upgradeable Products with Calibrated Auction-Conjoint Method (with V. Lobasenko), Journal of Environmental Planning and Management, 2017, 60 (11), pp.2036-2055.
- Changing partner in a cheap talk game: experimental evidence (with A. Garapin and O. Bonroy), International Journal of Economic Theory, 2017, Vol. 13, n°2, pp.197-216.
- Consumers' preferences for upgradeable products: an elicitation of willingness to pay for sustainable and innovative products (with C. Michaud, I. Joly, and V. Lobasenko), International Journal of Sustainable Development, 2017, 20 (1-2), pp.8-32.
- Willingness to pay for environmental attributes of non-food products: a real choice experiment (with C. Michaud and I. Joly), European Review of Agricultural Economics, 2013, Vol. 40 (2), 313-329.
- Willingness To Pay for remanufactured products: an experimental analysis (with C. Michaud), Business Strategy and Environment, 2011, Vol. 20 (6), 408-420.

Field of Expertise

Environmental and Energy Economics, Innovation and Consumption Behavior, with experimental economics methodology

Examples of research projects

- Scientific leader of the **EXPESIGNO** program (GAEL, G-SCOP, G2ELab, LIG), Experimentation of household responsiveness to signals from energy system operators, Pack Ambition Recherche of the Auvergne Rhône-Alpes Region, 2017 – 2022: test new types of feedbacks and information that focus on the non-monetary consequences of households' consumption, i.e. their impact on health and air quality, but also on the impact on climate change or on the probability of power outages in their neighborhood.

- Scientific leader of the Working Package ***Emerging behaviors from individual to communities*** of the Cross Disciplinary Program Eco-SESA (16 laboratories of the Grenoble site), Financing Investissement d'Avenir IDEX, 2016 - 2021 : analysis of individual and collective behaviors, as well as their necessary evolution in a community logic as implied by the eco-neighborhoods, on the basis of field and laboratory experiments, associating behavioral economics, sociology and engineering sciences (in particular those of the I.H.M.).

- Scientific leader of the Working Package HSS Specification of the **Equipex Amiqual4Home** (INRIA Grenoble, UJF, Grenoble-INP, SFR Innovacs, Schneider Electric Group), Investissement d'Avenir funding 2012 - 2019: to develop and implement a platform for experimenting and observing the deployment of new ambient intelligence technologies in the home.

English summary

In its road-map to stay below 1.5°C or even 2°C as prescribed by Paris Climate Agreement, IRENA (International Renewable Energy Agency) proposes a global energy transformation combining greater energy efficiency, the massive use of renewable energy and electrification. In France, the multi-year energy road map for 2019-2028 specifies the targets to be achieved at the national level:

- Reducing greenhouse gas emissions by 40% at 2030 horizon compared to 1990. This should be achieved in part by deep progress in sobriety practices of end-users (that also requires some infrastructures development, e.g. home thermal regulation, cycling paths) and by increasing energy efficiency.
- Increasing the share of electricity in the French energy consumption above 50% (instead of 25% now).

Reaching these objectives, given the complexity of the energy systems globally and the electrical system particularly, will require a significant research effort with a multi-disciplinary view from electrical technologies, components and systems, to human science while taking advantage of digitization. The purpose of EnergyAlps is precisely to intensify R&I efforts in Energy systems while strengthening the R&I Grenoble's ecosystem. Ramping up renewable-based electricity, enhancing energy efficiency, making the energy system more flexible and more resilient, improving end-users' sobriety are open and very actual challenges that are addressed in EnergyAlps. It is therefore necessary to define research actions for:

- studying energy transition pathways, impacts of new uses, and consumer-centric systems,
- designing breakthrough hardware and/or software solutions for flexible and efficient energy conversion,
- modeling, planning and controlling energy systems allowing the stated targets to be reached,
- investigating and increasing resilience of complex energy systems and their end-users

The scientific and technological program of EnergyAlps is structured into four pillars: electrical engineering, humanities and social sciences, power electronics and digitization. These pillars address ambitious questions about planning, design, control of electrical-centered energy systems, their governance and regulation, their digitization and leading-edge developments in wide-band gap power electronics. Each pillar is associated to one work package. The Electrical engineering and Humanities and social Sciences work packages will interact with each other while addressing specifications to the technological work packages dedicated to digitization and power electronics that will return constraints and opportunities to the socio-technical analyses of energy systems. Two cross-sectional work packages will develop and bring to the four pillars observations, data, advanced numerical methodologies and tools necessary to perform their works.

The main expected impact of EnergyAlps is the production of leading edge knowledge and innovative concepts and functionalities that could be used by scientists, engineers, private and public stakeholders to understand and design the energy system transformation. Major technological advances are expected about power devices, electrical and digital architectures, management and design strategies to ensure a safe, resilient and sustainable operation of the future energy systems. The technological choices will also be challenged by social sciences. Indeed, beyond technology, EnergyAlps will contribute to the definition of public policies, social organization forms that will foster the transformation of the energy system and empower users for a sustainable energy transition. A high-impact contribution will be to define and deliver in an open science framework new concepts, methods and tools to assess, analyze, model at various scales the energy systems.

Résumé

Dans sa feuille de route pour rester en-deçà de 1,5°C voire 2°C comme le prescrit l'Accord de Paris sur le climat, l'IRENA (Agence internationale pour les énergies renouvelables) propose une transformation énergétique globale combinant une plus grande efficacité énergétique, le recours massif aux énergies renouvelables et l'électrification. En France, la feuille de route pluriannuelle de l'énergie 2019-2028 précise les objectifs à atteindre au niveau national :

- Réduire de 40% les émissions de gaz à effet de serre à l'horizon 2030 par rapport à 1990. Cet objectif devrait être atteint en partie par d'importants progrès dans les pratiques de sobriété des utilisateurs finaux (nécessitant le développement de certaines infrastructures, comme par exemple la régulation thermique des habitations ou les pistes cyclables) et par l'augmentation de l'efficacité énergétique.
- Augmenter la part de l'électricité dans la consommation énergétique française au-delà de 50% (contre 25% actuellement).

Compte tenu de la complexité des systèmes énergétiques dans leur ensemble, et du système électrique en particulier, ces objectifs nécessiteront un effort de recherche important avec une vision pluridisciplinaire allant des technologies, composants et systèmes électriques aux sciences humaines et sociales, tout en tirant parti de la numérisation. L'objectif d'EnergyAlps est précisément d'intensifier les efforts de R&I dans les systèmes énergétiques tout en renforçant l'écosystème grenoblois. Augmenter la production d'électricité d'origine renouvelable, améliorer l'efficacité énergétique, rendre le système énergétique plus flexible et plus résilient, améliorer la sobriété des utilisateurs finaux représentent des défis ouverts et très actuels qui sont abordés dans Energyalps. Il s'agit de définir des actions de recherche pour :

- étudier les trajectoires de la transition énergétique, les impacts des nouveaux usages et les systèmes énergétiques centrés consommateur,
- concevoir des solutions matérielles et/ou logicielles de rupture pour une conversion énergétique souple et efficace,
- developer des outils de modélisation, de planification et de contrôle des systèmes énergétiques afin d'atteindre les objectifs fixés,
- étudier et accroître la résilience des systèmes énergétiques complexes, ainsi que leurs acteurs.

Le programme scientifique et technologique d'EnergyAlps s'articule autour de quatre piliers scientifiques : le génie électrique, les sciences humaines et sociales, l'électronique de puissance et la numérisation. Ces piliers abordent des questions ambitieuses sur la planification, la conception, le contrôle des systèmes énergétiques centrés sur l'électricité, leur gouvernance et leur régulation, leur numérisation et les développements de pointe dans l'électronique de puissance à large bande. Chaque pilier est associé à un work-package. Les work-package en génie électrique et en sciences humaines et sociales interagiront étroitement, tout en adressant des spécifications aux work-package technologiques dédiés à la numérisation et à l'électronique de puissance qui, à leur tour, renverront les contraintes et les opportunités aux analyses socio-techniques des systèmes énergétiques. Par ailleurs, deux work-package transversaux développeront et apporteront aux quatre piliers les observations, les données, les méthodologies numériques et les outils nécessaires à la réalisation de leurs travaux.

Le principal impact attendu d'EnergyAlps est la production de connaissances originales, de concepts et de fonctionnalités innovants qui pourront être utilisés par les scientifiques, les ingénieurs, les acteurs privés et publics pour comprendre et concevoir la transformation du système énergétique. Des avancées technologiques majeures sont attendues en ce qui concerne les dispositifs de production, les architectures électriques et numériques, les stratégies de conception et de gestion, afin de garantir un fonctionnement sûr, résilient et durable des futurs systèmes énergétiques. Les choix technologiques seront également questionnés par les sciences sociales. Ainsi, au-delà de la technologie, EnergyAlps contribuera à la définition de politiques publiques et de formes d'organisation sociale qui favoriseront la transformation du système énergétique et donneront aux utilisateurs les moyens d'une transition énergétique durable. Une contribution à fort impact consistera à définir et à fournir, dans un cadre scientifique ouvert, de nouveaux concepts, méthodes et outils pour évaluer, analyser et modéliser à différentes échelles les systèmes énergétiques.

List of the researchers of EnergyAlps

Summary by affiliation

Affiliation	Number of researchers	Average participation rate
UGA incl. Grenoble INP-UGA and Sciences Po-UGA	106	77 %
CNRS	31	68 %
CEA	14	100 %
INRIA	2	35 %

A balanced participation of the three main institutions working in the field of Energy.

Summary by UGA's research department

Research department	Number of researchers	Average participation rate
Physics Engineering and Materials (PEM) incl. CEA	77	97 %
Social sciences (PSS)	33	82 %
Mathematics, Information and Communication Sciences (MSTIC) incl. INRIA	43	36%

EnergyAlps is the core LabEx of the researchers specialized in Engineering and Social sciences. ICTs researchers' participation is lesser but necessary for the digitization of energy systems. These researchers are also involved in the LabEx on ICTs, Persyval.

LABEX2025_EnergyAlps

Family name	Name	Title	Affiliation	%	Research unit	Research department
ALAMIR	Mazen	DR	CNRS	20,0	GIPSA-lab	MSTIC
BESANÇON	Gildas	PU	Grenoble INP-UGA	30,0	GIPSA-lab	MSTIC
BRATCU	Antoneta	MCF	Grenoble INP-UGA	80,0	GIPSA-lab	MSTIC
FIACCHINI	Mirko	CR	CNRS	10,0	GIPSA-lab	MSTIC
GEORGES	Didier	PU	Grenoble INP-UGA	10,0	GIPSA-lab	MSTIC
HABLY	Ahmad	MCF	Grenoble INP-UGA	50,0	GIPSA-lab	MSTIC
IOANA	Cornel	MCF	Grenoble INP-UGA	80,0	GIPSA-lab	MSTIC
MARTINEZ	John	PU	Grenoble INP-UGA	20,0	GIPSA-lab	MSTIC
MESLEM	Nacim	MCF	Grenoble INP-UGA	50,0	GIPSA-lab	MSTIC
CANUDA DE WITT	Carlos	DR	CNRS	40,0	GIPSA-Lab-INRIA	MSTIC
FRASCA	Paolo	DR	CNRS	30,0	GIPSA-Lab-INRIA	MSTIC
Amayri	Manar	MCF	Grenoble INP-UGA	100,0	G-SCOP	MSTIC
Catusse	Nicolas	MCF	Grenoble INP-UGA	10,0	G-SCOP	MSTIC
Espinouse	Marie-Laure	PU	UGA	20,0	G-SCOP	MSTIC
Gascard	Eric	MCF	Grenoble INP-UGA	10,0	G-SCOP	MSTIC
Jacomino	Mireille	PU	Grenoble INP-UGA	100,0	G-SCOP	MSTIC
Margaux	Nattaf	MCF	Grenoble INP-UGA	10,0	G-SCOP	MSTIC
Muhlenthaler	Moritz	MCF	Grenoble INP-UGA	10,0	G-SCOP	MSTIC
Penz	Bernard	PU	Grenoble INP-UGA	20,0	G-SCOP	MSTIC
Ploix	Stéphane	PU	Grenoble INP-UGA	100,0	G-SCOP	MSTIC
Dufossé	Fanny	CR	CNRS	50,0	INRIA	MSTIC
Gaillard	Pierre	CR	inria	20,0	Inria	MSTIC
Gast	Nicolas	CR	CNRS	40,0	INRIA	MSTIC
GAUJAL	Bruno	DR	inria	50,0	INRIA	MSTIC
Rutten	Eric	CR	CNRS	20,0	INRIA	MSTIC
Bobineau	Christophe	MCF	Grenoble INP-UGA	50,0	LIG	MSTIC

Dugdale	Julie	PU	UGA	50,0	LIG	MSTIC
Heusse	Martin	PU	Grenoble INP-UGA	50,0	LIG	MSTIC
Laurillau	Yann	MCF	UGA	50,0	LIG	MSTIC
Reignier	Patrick	PU	Grenoble INP-UGA	50,0	LIG	MSTIC
Ziebellin	Danielle	PU	UGA	50,0	LIG	MSTIC
Mocanu	Stéphane	MCF	Grenoble INP-UGA	20,0	LIG-INRIA	MSTIC
Bidegaray-Fesquet	Brigitte	CR	CNRS	25,0	LJK	MSTIC
Dapogny	Charles	CR	CNRS	20,0	LJK	MSTIC
Hildebrand	Roland	CR	CNRS	20,0	LJK	MSTIC
Iutzeler	Franck	MCF	UGA	20,0	LJK	MSTIC
Jourdana	Clément	MCF	UGA	20,0	LJK	MSTIC
Juditsky	Anatoli	PU	UGA	50,0	LJK	MSTIC
Malick	Jérôme	DR	CNRS	20,0	LJK	MSTIC
Meignen	Sylvain	MCF	Grenoble INP-UGA	20,0	LJK	MSTIC
Oudet	Edouard	PU	UGA	20,0	LJK	MSTIC
Picard	Christophe	MCF	Grenoble INP-UGA	20,0	LJK	MSTIC
Prieur	Clémentine	PU	UGA	20,0	LJK	MSTIC
AITKEN	Frédéric	CR	CNRS	100,0	G2elab	PEM
ALVAREZ	Marie-Cécile	MCF	Grenoble INP-UGA	100,0	G2elab	PEM
ASFOUR	Aktham	MCF	UGA	100,0	G2elab	PEM
AVENAS	Yvan	MCF	Grenoble INP-UGA	100,0	G2elab	PEM
BACHA	Seddik	PU	UGA	100,0	G2elab	PEM
BADEL	Arnaud	CR	CNRS	100,0	G2elab	PEM
BENECH	Philippe	PU	UGA	100,0	G2elab	PEM
BESANGER	Yvon	PU	Grenoble INP-UGA	100,0	G2elab	PEM
BONIFACI	Nelly	CR	CNRS	100,0	G2elab	PEM
BUIRE	Jérôme	MCF	Grenoble INP-UGA	100,0	G2elab	PEM
CAIRE	Raphael	MCF	Grenoble INP-UGA	100,0	G2elab	PEM
CAUFFET	Gilles	MCF	UGA	100,0	G2elab	PEM
CHADEBEC	Olivier	DR	CNRS	100,0	G2elab	PEM
CHAZAL	Hervé	MCF	Grenoble INP-UGA	100,0	G2elab	PEM
CHILLET	Christian	CR	CNRS	100,0	G2elab	PEM
CLAVEL	Edith	PU	UGA	100,0	G2elab	PEM
CREBIER	J.-Christophe	DR	CNRS	100,0	G2elab	PEM
CUGAT	Orphée	DR	CNRS	100,0	G2elab	PEM
DEBUSSCHERE	Vincent	MCF	Grenoble INP-UGA	100,0	G2elab	PEM
DELAMARE	Jérôme	PU	Grenoble INP-UGA	100,0	G2elab	PEM
DELINCHANT	Benoît	PU	Grenoble INP-UGA	100,0	G2elab	PEM
DUCHAMP	Jean-Marc	MCF	UGA	100,0	G2elab	PEM
FASSENET	Marylin	MCF	UGA	100,0	G2elab	PEM
FREY	David	MCF	UGA	100,0	G2elab	PEM
GALLOT-LAVALLEE	Olivier	MCF	UGA	100,0	G2elab	PEM
GALOPIN	Nicolas	MCF	UGA	100,0	G2elab	PEM
GARBUIO	Lauric	MCF	Grenoble INP-UGA	100,0	G2elab	PEM
GEOFFROY	Olivier	MCF	UGA	100,0	G2elab	PEM
GERBAUD	Laurent	PU	Grenoble INP-UGA	100,0	G2elab	PEM
GIMENO MONGE	Leticia	MCF	UGA	100,0	G2elab	PEM
GUICHON	Jean-Michel	MCF	UGA	100,0	G2elab	PEM
HADJ-SAID	Nouredine	PU	Grenoble INP-UGA	100,0	G2elab	PEM
HANNA	Rachelle	MCF	Grenoble INP-UGA	100,0	G2elab	PEM
JEANNIN	Pierre-Olivier	MCF	UGA	100,0	G2elab	PEM
LEBOUC	Afef	DR	CNRS	100,0	G2elab	PEM
LEFRANC	Pierre	MCF	Grenoble INP-UGA	100,0	G2elab	PEM
LEMBEYE	Yves	PU	UGA	100,0	G2elab	PEM
LESAINT	Olivier	DR	CNRS	100,0	G2elab	PEM

MARECHAL	Yves	PU	Grenoble INP-UGA	100,0	G2elab	PEM
MEUNIER	Gérard	Emeritat	CNRS	100,0	G2elab	PEM
NDAGIJIMANA	Fabien	PU	UGA	100,0	G2elab	PEM
NIYONZIMA	Innocent	MCF	UGA	100,0	G2elab	PEM
RAIN	Pascal	PU	UGA	100,0	G2elab	PEM
RAISON	Bertrand	PU	UGA	100,0	G2elab	PEM
RAMDANE	Brahim	MCF	Grenoble INP-UGA	100,0	G2elab	PEM
REBOUD	Jean-Luc	PU	UGA	100,0	G2elab	PEM
RETIERE	Nicolas	PU	UGA	100,0	G2elab	PEM
RIGO-MARIANI	Rémy	CR	CNRS	100,0	G2elab	PEM
RIU	Delphine	PU	Grenoble INP-UGA	100,0	G2elab	PEM
ROUDET	James	PU	UGA	100,0	G2elab	PEM
SCHAEFFER	Christian	PU	Grenoble INP-UGA	100,0	G2elab	PEM
SCHANEN	Jean-Luc	PU	Grenoble INP-UGA	100,0	G2elab	PEM
SYLVESTRE	Alain	PU	UGA	100,0	G2elab	PEM
TIXADOR	Pascal	PU	Grenoble INP-UGA	100,0	G2elab	PEM
WURTZ	Frédéric	DR	CNRS	100,0	G2elab	PEM
Rio	Maud	MCF	UGA	100,0	G-SCOP	PEM
Zwolinski	Peggy	PU	Grenoble INP-UGA	30,0	G-SCOP	PEM
Godignon	Phillipe	Chercheur	CEA	100,0	Leti	PEM
Gwoziecki	Romain	Chercheur	CEA	100,0	Leti	PEM
Plissonnier	Marc	Chercheur	CEA	100,0	Leti	PEM
BIER	Anthony	Chercheur	CEA	100,0	Liten	PEM
BUI VAN	Anh-Linh	Chercheur	CEA	100,0	Liten	PEM
BUTTIN	Herve	Chercheur	CEA	100,0	Liten	PEM
DELHOMMAIS	Mylène	Chercheure	CEA	100,0	Liten	PEM
DO	Thai Phuong	Chercheur	CEA	100,0	Liten	PEM
GUILLEMIN	Sylvain	Chercheur	CEA	100,0	Liten	PEM
Martin	Jérémy	Chercheur	CEA	100,0	Liten	PEM
PICHENOT	Gregoire	Chercheur	CEA	100,0	Liten	PEM
Soupremanien	Ulrich	Chercheur	CEA	100,0	Liten	PEM
Tran	Quoc Tuan	PU	CEA	100,0	Liten	PEM
Vallée	Mathieu	Chercheur	CEA	100,0	Liten	PEM
BUSTARRET	Etienne	DR	CNRS	50,0	NEEL	PEM
EON	David	MCF	UGA	100,0	NEEL	PEM
FERRANDIS	Philippe	MCF	UGA	80,0	NEEL	PEM
GHEERAERT	Etienne	PU	UGA	80,0	NEEL	PEM
JACOPIN	Gwénolé	CR	CNRS	20,0	NEEL	PEM
PERNOT	Julien	PU	UGA	80,0	NEEL	PEM
BERTHAUD	Pierre	MCF	UGA	100,0	CREG	PSS
GUILHOT	Laëtitia	MCF	UGA	100,0	CREG	PSS
JACQUIER-ROUX	Virginie	MCF	UGA	100,0	CREG	PSS
ROCCA	Michel	PU	UGA	100,0	CREG	PSS
Bernard	Sébastien	PU	UGA	100,0	CRJ	PSS
Cohet	Frédérique	MCF	UGA	100,0	CRJ	PSS
Favreau	Amélie	MCF	UGA	50,0	CRJ	PSS
Lavorel	Sabine	MCF	UGA	50,0	CRJ	PSS
Videlin	J.-Christophe	PU	UGA	50,0	CRJ	PSS
CLASTRES	Cédric	PU	UGA	100,0	GAEL	PSS
FABBRI	Giorgio	CR	CNRS	100,0	GAEL	PSS
FADHUILE	Adélaïse	MCF	UGA	100,0	GAEL	PSS
GUERDJIKOVA	Ani	PU	UGA	100,0	GAEL	PSS
IONESCU-RIFFAUD	Oana	MCF	UGA	100,0	GAEL	PSS
KHALFALLAH	Haikel	MCF	UGA	100,0	GAEL	PSS
LLERENA	Daniel	PU	UGA	100,0	GAEL	PSS
MATHY	Sandrine	DR	CNRS	100,0	GAEL	PSS

RISCH	Anna	MCF	UGA	100,0	GAEL	PSS
ROBIN	Stéphane	CR	CNRS	100,0	GAEL	PSS
ROSSIAUD	Sylvain	MCF	UGA	100,0	GAEL	PSS
ROUSSILLON	Béatrice	MCF	UGA	100,0	GAEL	PSS
SEMIRAT	Stephan		UGA	100,0	GAEL	PSS
Artis	Amélie	MCF	Sc. Po Grenoble-UGA	30,0	PACTE	PSS
Becot	Renaud	MCF	Sc. Po Grenoble-UGA	50,0	PACTE	PSS
Chardonnel	Sonia	CR	CNRS	50,0	PACTE	PSS
Debizet	Gilles	MCF	UGA	90,0	PACTE	PSS
Diaconu	Adriana	MCF	UGA	20,0	PACTE	PSS
La Branche	Stéphane			100,0	PACTE	PSS
Labussière	Olivier	CR	CNRS	100,0	PACTE	PSS
Moulaert	Thibaut	MCF	UGA	20,0	PACTE	PSS
Reverdy	Thomas	PU	Grenoble INP-UGA	50,0	PACTE	PSS
Tabaka	Kamila	MCF	UGA	50,0	PACTE	PSS
Trompette	Pascale	DR	CNRS	90,0	PACTE	PSS
DALMASSO	Anne	PU	UGA	100,0	LARHRA	SHS