

Thesis subject: Toward absolute sustainability integration and reflexivity into Power Electronic researchers' activities.

Laboratory of assignment: G-SCOP laboratory

Context and work environment

Structure description: the G-SCOP laboratory¹ is a multidisciplinary laboratory created to meet the scientific challenges imposed by the ongoing changes within the industrial world. The scope of the laboratory goes from the products conception to the production systems management and is based on strong skills in optimization. The creation of the G-SCOP laboratory is, in Grenoble, the culmination point of a long history of scientific breakthroughs and collaborations in the field of production systems, product design and operational research. In this multidisciplinary scheme, the PhD supervision will be ensured by the G-SCOP and the G2ELab. Both teams are collaborating together since 2018 to address circularity and environmental impact considerations into Power Electronics. The G2ELab has a strong expertise in design, model and manufacturing of power converters systems, considering the design evolutions to address for usage contexts and constrains including circularity scenarios, through modularity, and standardization. The PhD candidate will be part of the CoSys team² of the G-SCOP addressing sustainable circularity issues in Product-Process life cycles engineering design activities, and will strongly collaborate with the Power Electronic³ team at the G2ELab. Both laboratories are situated in Grenoble city center.

This PhD will be part of the CDP PowerAlps, led by the G2ELab, fostering interdisciplinary collaborations and building a research community in Power Electronics. The PowerAlps institute will embrace a broad common vision of Power Electronics challenging researchers through technological breakthroughs and absolute sustainability vision and practices. Power Electronics is a key enabling technology for controlling electrical energy and targeting 50% of electricity production from renewable sources in France by 2035. Targeting carbon neutrality by 2050 should at the same time, respect the other Planetary Boundaries⁴. The resulting social-ecological systems potential disruptions from technological changes, should be mindfully addressed to Power Electronics designers, engineers and researchers.

70% of electricity is already interfaced by power electronics⁵. Electrical Grid remains an application with a low penetration of Power Electronics, despite its capacity to interface between renewable production (PV, wind turbines, fuel cells and other unconventional sources) and the 50Hz constant frequency AC grid. It also provides bidirectional link with storage systems as batteries. Beside this "simple" but mandatory interface, many other applications are necessary for 'future' Grids targeted for 2035 for Power Electronic experts: DC transportation for underwater links, systems to control power transfer and prevent blackouts due to congestions (e.g., with electric vehicle superchargers), etc. The PowerAlps institute considers the opportunity to reduce the inertia of the grid (and stability), which is today mainly based on rotating generators.

This evolution toward electrical energy control is therefore shaping industrial and social activities related to Power Electronic systems, and must be planned to stay inside the Planetary boundaries. History of sciences and technics⁶ however showed that industrial and technological breakthroughs developments have not yet enabled to maintain our

¹ G-SCOP website: <https://g-scop.grenoble-inp.fr/en/laboratory>

² Cf. The Product-Process Design team past projects on: <https://g-scop.grenoble-inp.fr/en/research/product-process-design>

³ The Power Electronics research team of the G2ELab website: <https://g2elab.grenoble-inp.fr/en/research/ep>

⁴ Cf. The Stockholm Resilience Center for socio-ecological intertwined models addressing the planetary boundaries, currently stretched to a perilous degree, <https://www.stockholmresilience.org/research/planetary-boundaries.html>

⁵ <https://www.hitachienergy.com/news/perspectives/2021/08/power-electronics-revolutionizing-the-world-s-future-energy-systems>

⁶ Cf. Jean Batiste Fressoz, Dominique Bourg, Christophe Bonneuil, François Jarrige publications for instance.

societies under ecosystems resilience limit. Sustainability commitments in Power Electronic should then be addressed seriously to researchers developing such technologies.

Position's mission and main activities

Power electronic industry sectors and societies are currently making bold commitments to sustainability, both in terms of scope and intended time for achievements of these duties. This PhD research project focuses on the capacity of Power Electronics researchers in understanding the issues raised by sustainability, integrate them in their research activities to handle research that will support Ecodesigned Power Electronics based products and technologies.

The aim of this PhD is to develop and test the effect of a reflexive method adapted to the Power Electronics research domain to support the integration of an "absolute sustainability thinking", based on the researcher's capacity to (i) exercise introspection on their own activity in power electronic, and (ii) learning about their fundamental awareness and consciousness about socio-technical aspects of sustainability. This PhD will provide an operational format of this reflexive method to ease its dissemination across the Power Electronic communities, in academia and in industry.

This PhD project will focus on the capacity of power electronic researchers to integrate absolute sustainability in their own practices in a reflexive manner. An absolute sustainability perspective considers the planetary boundaries altogether as a limit to avoid to raise the risks to the Earth system stability. This research project will entail a systemic modelling of current practice, researchers' skills, medium to long-term visions, method implementation and potential absolute sustainability achievement in order to provide the baseline for gap analysis between the intention and the achievement of preventing life cycle engineering for absolute sustainability in power electronic research, to be fully integrated. A reflexive method will be proposed and tested on the power electronic researchers (including the PowerAlps CDP research project participants) to measure its capacity to reduce this gap. The objective for the case studies will be to test the reflexive method in different research team context (e.g.: technology and processes, design integration, Power systems), concerning different type of PE systems, envisaged at different scale, with different degree of maturity. Invariant factors to reduce the gap between the prior intention and the achievement in the ecodesign practice, that will be identified across the case studies will help to address to other contexts (private, public, sectors, etc.) such reflexivity.

The PhD project refers to the field of integrated life cycle engineering design in a socio-technical perspective considering the planetary boundary as the ultimate safe operating space to target for the future of the industries.

Main activities:

The PhD student will construct a scientific research method based on the DRM⁷, used in product design engineering: starting from the research clarification (Research Question, issues, and hypothesis based on the literature review), a descriptive stage (refined issues), a prescriptive stage (the proposed method-reflexive one), a descriptive II stage (interviews & observations during case studies), a prescriptive II stage (refined proposition), a validation method (based on the research-action type), and the conclusion of the contributions & limitation to address further research work.

The envisaged case studies of the reflexive method will be addressed to Power Electronic collaborators that would be interested in trying the method, or part of the method, in order to validate complementary functions. Interviews and observations will be handled by the PhD with the help of an intern student specialized in social sciences, to develop relevant questionnaires, to organize the interviews and the observations, as well as to manage and interpret data to provide some tangible results.

Tasks related to IT and dissemination:

Some basic IT developments to improve the online format of the reflexive method based on the framework that will be developed in the PhD will be handled by internship students in IT development & social media if required. This task will consist in (i) designing the interface between Power Electronics researchers and the reflexive method to enable its dissemination, and (ii) develop this interface on a basic online and open-source platform that will be accessible to research communities (IDEX – UGA platform, EcoCloud, GDR MACS, SAGIP, SMART, Club EEA, etc.) to capitalize on this research methodology and support further improvements.

Restriction or constraints related to the position

Desired profile

⁷ DRM method can be downloaded on: <https://link.springer.com/content/pdf/10.1007%2F978-1-84882-587-1.pdf>

Expected skills (priority): integrated life cycle engineering design, Power Electronics, Sustainability, Absolute Life Cycle Assessment, Eco-Design

- **Trade skills/ expertise:** Engineering Design, Life Cycle Engineering, Sustainable Circular Thinking, Ecodesign
- **Personal skills:** Curiosity, Engagement in Sustainability, Sustainable Values, Capacity to collaborate and stay open minded, Capacity to manage project, Communication skills, Pedagogic capacity, Self-determination, Scientific rigor; social sciences and anthropology interests.

Desired professional experience: beginner 2 to 5 years

Previous formation, diplomas: Engineering Degree, Master (Research) Degree in sustainability.

General information

Contact for the questions related to the position:

Maud, RIO, Maître de Conférence, Associated Professor, <https://pagesperso.g-scop.grenoble-inp.fr/maudrio/> ;

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Pierre, LEFRANC Maître de Conférence, Associated Professor, <https://g2elab.grenoble-inp.fr/fr/le-laboratoire/lefranc-pierre>;
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Informations projet de recherche

Description du sujet	IDEX – CDP - PowerAlps
Sujet de thèse	Toward absolute sustainability integration and reflexivity into Power Electronic researchers' activities.
Mots clés	Integrated design, Sustainability, Industrial Engineering, Power Electronics
Champ scientifiques	Engineering sciences, Environmental sciences, Electronics
Champs scientifiques secondaires	Research, Education sciences
Ecole doctorale	EEATS Grenoble
Directeur de thèse (NOM Prénom, mail)	LEFRANC Pierre, pierre.lefranc@univ-grenoble-alpes.fr
Co-encadrant (NOM Prénom, mail)	RIO Maud, maud.rio@g-scop.eu
Co-tutelle	NON
Co-financement	NON

Calendrier

Date début diffusion	01/09/2022
Date fin diffusion	15/10/2022
Date limite candidature	15/10/2022
Date pré-sélection (facultatif)	
Date début entretien	20/10/2022
Date résultats sélection	30/10/2022
Date début de contrat	1 ^{er} Janvier 2023

Dossier candidature

Documents à fournir	CV
	Motivation letter, argued to demonstrate the ability, the motivation, and the strengths to engage with the topic, manage the PhD project and succeed being a researcher.
	Recommendation letters from at least two referees.
	Articles, conference papers and other communications material achieved, related to research in the PhD topic.