



Proposal for a contribution from Université de Lorraine to the mid-term review consultation of the Horizon Europe program

In order to meet societal challenges within the framework of the European Green Deal, université de Lorraine (UL) has set up an organization as interdisciplinary research, innovation and education centers. This holistic approach, which strengthens the links between research, innovation and skills, places its action firmly within the framework of the green deal with science with and for society.

UL contributes to meeting the challenges of European green deal policies and has established itself in certain areas which deserve more support and reinforcement if Europe wants to achieve the objectives of a carbon-neutral economy by 2050. It is also about contributing to the strategic autonomy of Europe: energy, raw material, circular economy, sustainable use of the natural resources, sustainable agriculture, recovery of the biodiversity, while embarking at an early stage the citizens and the society to achieve a just transition.

Université de Lorraine therefore presents shortly its strength and possibility to contribute to European objectives of the Green deal and make some concrete proposals to achieve faster the objective of net-zero emission target, to contribute to the implementation of a circular economy, to contribute to the SDG 12 objectives through its participation to the European university Eureka-Pro.

UL wants to contribute actively to societal challenges included in the European Green Deal, including in term of value chain and strategic autonomy, which requires a clear orientation of the strategic programming of Horizon Europe.

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1. Reinforcing the potential of the territories to achieve energy transition and decarbonisation**What do we do**

Université de Lorraine is carrying out inclusive research approach to the territory and its opportunities for the energy transition and decarbonisation, by focusing on the complex interactions between technologies, and society. It includes resources for the energy transition (primary/secondary resources, use of the subsoil for energy storage, bioresources for energy), technology and processes for low-carbon energy carriers, carbon engineering (emission mitigation strategies, carbon recycling), and all kind of energy transformation: thermochemical, mechanical, electrical, electrochemical, biological, that can be combined and optimized together at a territorial scale.

R&I policies (clusters 4 and 5, partnerships such as Clean hydrogen partnership, Clean energy transition partnership, CBE JU).

What Europe wants

In terms of decarbonization, Europe issued a number of text dealing with energy policy, agriculture, hydrogen with targeted objectives¹.

What we propose/ need at the European level

- **Energy transition in agriculture:** UL aims to address agricultural practices transformation towards self-sufficiency in energy and fertilisers which shall include methanisation (biogas production and fertilisation) and methanation to use the excess CO₂ by adding hydrogen produced by energy sources. UL aims to contribute to carbon neutrality by implementing researches to ensure the most effective storage of carbon in the soils or by the addition of biochar to agricultural soils. *EU should reinforce research policies on sustainable agriculture to go towards its energy autonomy and even to become a net-energy producer while achieving negative emissions;*
- **Hydrogen:** UL plays an important role in the research for detection and exploitation of natural hydrogen, underground hydrogen storage, hydrogen pipeline transport (corrosion, risks) the uses of hydrogen, e.g. the development of low cost, clean and efficient local (urban) mobility solution. *A reinforcement of these solution-oriented topics (e.g. in the Clean Hydrogen Partnership) will be able to boost the territorial contribution for contributing to achieve net-zero emissions;*
- **Decentralized smart energy systems as local energy hubs:** these systems will integrate renewable energy sources such as solar PV, wind energy or systems based on biomethane, with the cogeneration of electricity and heat, where hydrogen can play a role in long-term storage or be used for methanation (optimal design, management of multi-source multi-carrier energy systems). The R&I policies about local multi-sources, multi-carriers smart energy systems must be reinforced. These systems are also relevant in the design of off-grid systems, for the African continent, as an example;
- **Biomass resources and their processes** (wood, wastes- from agri-silvi-culture or human consumption like plastic, algal biomass) to convert them into energy carriers (methane, syngas, hydrogen), using several routes, such as gasification, methanisation, bio-methanation, and catalytic conversion while taking the opportunity to generate negative

¹ https://energy.ec.europa.eu/topics/research-and-technology_en

emissions. *R&I policies should be focused on biomass processing using several complementary processes and routes (with a diversification of the entrants – including plastic wastes as a carbon source) to achieved at least two services: energy production, material production, and negative emissions;*

- **Technological solutions through CCUS technologies and geosystems**

The CO2 capture and storage value chain have to be improved to reach a competitive cost by 2030. *One of the main route that is investigated in UL to reuse the captured CO2 is the production of useful added-value materials from natural minerals, mine tailings or waste. R&I policies should focus on generation of by-products of mineralisation such as hydrogen or metals as an additional lever to accelerate the economic development of CO2 mineralisation;*

Regarding CO2 storage, the monitoring of storage sites has an essential role in the prevention of potential risks and to provide confidence the CO2 storage stakeholders including society. EU R&I policies should provide the levers to accelerate the development of reliable sensors and data analysis metrologies that will serve to ensure confidence by society in the storage facilities;

- **Tacking societal impacts, contributions of society to decarbonisation and to changes in uses and practices.** UL is convinced that society and its organisation (politics, economy, communication, collective and individual behaviour) play a major role in the transformations necessary for deep decarbonisation and the transition to clean energy. Several R&I aspects are promoted, with dedicated topics in the research programming of cluster 2, 4, 5 and 6):

- *Developing a common methodology to properly evaluate the effects of decarbonisation at different spatial and geographical scales,*
- *The declination of the Green Deal, in terms of spatial or geographical scales,*
- *Energy choices in the light of democracy,*
- *Financing the transition and decarbonisation, which raises the question of the role of governments and authorities in financing and encouraging private actions in favour of the energy transition and the climate (taxation, monetary policy, green bonds, ...),*
- *Identifying the impacts on equity and social justice, financial stability, health, and resources (e.g. water, minerals),*
- *The law and public regulations makes it possible the implementation of social innovations, and have to be adapted to pay for and compensate for these several eco-systemic services of the land use,*
- *An accent should be laid on methodological approaches such as the human and planet-centric design of products, services and systems.*

2. Strengthen the sustainability of the material value chain for the energy and the digital transitions
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What do we do

The digital and the energy transitions rely on the development of technologies which are composed of complex materials designed by combining advantageously different classes of materials (metals, polymers, glasses, etc. but also steel and concrete for construction) under appropriate operating conditions. The supply of the raw materials as well as their processing, their sustainable transformation into materials and the recycling of produced items are the keys for the development of the digital and energy transitions.

What Europe wants

Developing a circular economy (Green deal), restoring sovereignty in the materials supply chain.

What do we propose

There are still several challenges to face up to develop a sustainable and safe material value chain for the energy and the digital transition:

- Integration of industry in the territory to ensure the supply of raw and recycled materials. This topic does not limit to the primary resources (opportunity to open new mines) but can be extended to recycling with a special focus on the geopolitics of the circular economy with a special focus on the secondary resources. Even if the population is favourable to the development of the recycling industry, the corresponding activities may be responsible for the development of heavy industry that can worry the population. *A special attention has to be paid in the R&I politics to the reuse or the substitution of critical and strategic materials that are essential in fields of catalysis, electronics, transition energy (renewable energy storage) or structural component ;*
- Development of cheap, sustainable and flexible processes for the production of materials requested from the digital and energy transitions. *These processes must be enough flexible to adapt to the change in the composition of the raw materials, the exploitation of new non-conventional resources (geothermal brines, seawater, etc.) and the fast evolution of the technologies to recycle;*
- *Take into account the environmental impact of the extraction/processing of materials very early in the design or in the conception, possibly with the help of AI, of new materials for the energy and the digital transition from raw to functional materials. The substitution of critical raw materials by other ones to reduce the environmental impact in spite of a decrease of the performance of the material could advantageously reduce the supply risk of raw materials;*
- *Develop new education programs to ensure that our industries can rely on high-qualified engineers and researchers for an efficient development of the energy and the digital transitions by providing both a holistic view of the energy transition by strengthening interdisciplinary skills and high-level skills in material science, engineering science to tackle innovation. This can be highly incentive in Horizon Europe projects, as well as real synergies with Erasmus projects;*
- *Develop new models for the circular economy;*
- *Make the circular economy more efficient by mastering each step of the value chain, by mastering the interface between the different steps of the value chain while having a holistic view of the circular economy.*
Design efficient models of the circular economy to assess different scenarios by taking into account the economic, technological and environmental constraints.

3. A necessary holistic and creative approach to be strengthen at the European level for the contribution of zero emission manufacturing, strategic autonomy and competitiveness.

What do we do

Since 2021, an ambitious strategic axis in research and innovation of the Université de Lorraine is part of the **Made in Europe Partnership** with the major objective in the field of manufacturing to

contribute to the “**twin ecological and digital transition**”² in order to offer companies tools and practices that will enable them to transform themselves in depth.

The UL strategic axis is therefore built on **multidisciplinary works** carried out by laboratories of digital sciences, sustainability sciences, human sciences, health sciences, organization sciences ... conferring a **real originality in holistic vision** to the proposed contributions with the ultimate goal of placing the company in an ecosystem with strong internal dynamics more conducive to adaptation and contribute to reinforce European manufacturing. The manufacturing European policy must be linked with an ecosystem approach as it is experimented by UL with industrial manufacturing companies such as Continental, Renault, Sew-Usocome, Stellantis.

- **UL is firmly convinced that the expected transformations** are based on the need to reduce complexity, to prioritize and integrate the different levels of decision making in the manufacturing enterprise, to innovative paradigms built on the principles of dynamic problem solving (real time), adaptability, autonomy, intelligence and agility in the face of a changing environment;
- In that sense, UL is convinced that European manufacturing needs Cyber-Physical System (CPS) as a vector of organization in manufacturing and more precisely its extension to the concept of **CPPS (Cyber-Physical Production System)** allowing a functional and spatial fragmentation of the activities of the manufacturing value chain, where the human being has a main role;
- This vision on **symbiosis between human – digital – interaction to form CPPS**, is of high importance to leave the classical models of companies of mainly hierarchical decision making to move towards models directed by "collective creation" leading to "more agile, and resilient manufacturing factory". This emergence favors in the long term the Self-Management (Self-X) of the manufacturing companies.

This can be summarized by the following research question: whatever the manufacturing level concerned, how to model, control, evaluate, simulate and optimize the behavior of these advanced/distributed CPPS, based on the emerging principle of "collective creation", in order to respond to the new challenges/associated performances... and this throughout the system life cycle?

What Europe wants

To answer more globally to this question and for going beyond the topics already proposed in the different past calls (until now) of the “Made in Europe” partnership (see HORIZON-CL4-202x-TWIN-TRANSITION-01-XX)

What do we propose

UL would like to propose to contribute to reinforce the European competitiveness and strategic autonomy on:

- *Models of "creative" control considering human factors and putting Human at the center of the decision loop (empowerment) while optimizing overall performance (investigations on anthropocentric vs. biocentric engineering; the Social Internet of Object; coordination/cooperation mechanisms inspired by social systems).*
- *Models of human activity in a Human-Digital synergy considering all the parameters having an impact on the operator's health (e.g., physical, psychological, physiological) in all situations of use.*

² Made in Europe – The Manufacturing partnership in Horizon Europe; European Commission & EFFRA; Consultation version 20-05-2020; <https://www.effra.eu/made-in-europe-state-play>

- *Disruptive approaches for manufacturing such as bio-intelligent manufacturing, biologicalization, circular manufacturing.*
- *Formalized industrial symbiosis approach to circularity.*
- *Models of the evolution of the organization routines for the production in the consideration of "collective creation".*
- *New modelling approaches for CPPS considering advanced interaction types to favor robustness and resilience.*
- *Advanced formalization of data and its semantic representation using AI tools (prospective or descriptive) for the modeling and capitalization of business know-how and the development of a knowledge base supporting cyber-physical systems and their interactions*
- *Global foundation and exploitation of the concept of Digital Twin as a key element in support of the adaptation to the internal and external dynamics of these advanced manufacturing systems (AI tools coupled with Digital Twins are needed).*

4. An economic system to produce biomolecules which reconciles food safety, sustainable agriculture, and the use of renewable biological resources for industrial purposes
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Over the last several years, European member States have jointly agreed to prioritize the transition towards a more innovative, resource-efficient economy. The overall aim is to establish a low-emissions bioeconomic system, preserving biodiversity (see European Green Deal) and increasing the health of the environment. To achieve these ambitious goals, the European Commission has established a Bioeconomy Strategy and an Action Plan. This strategy has been enriched by the French Strategy for Bioeconomy and, more locally, by the Grand-Est region, which has identified three strategic themes: industry, health and the bioeconomy.

What do we do

The main bioeconomy domains developed in Lorraine are the exploitation of biomolecules, from initial discovery and isolation, to optimization via functionalization/vectorization, to multi-level biological testing, with the goal of identifying novel compounds for diverse applications in the food, agrochemical, cosmetics and medical sectors. Until now, these molecules have been made from petroleum derivatives which are no longer sustainable. In the forestry field, focus is done to design trajectories for ecological and industrial transitions, based on adaptation and mitigation of global changes in forest socio-ecosystems. UL wishes European support for large project on biosourced molecules which will respond to customers and stakeholders who are seeking more environmentally friendly solutions.

What do we propose

For this purpose, UL and Lorraine stakeholders aim to create a research nexus recognized at the European level as one of the leaders in innovation of biomolecules sourced from microbes, as well as from regional agricultural and forestry resources. *The development of green processes and the incorporation of advanced artificial intelligence approaches in direct inspiration from the "computing" and "industry for the future" areas are developed for new biomolecules assessment and production. These programs will develop high speed assessment of biomolecules properties and transfer to production through demonstrators. This achievement is already based on a vastly-expanded academic and industrial collaboration but required strong European support to reach international leadership.*

5. Forests and wood resources: a necessary integration of fundamental processes of tree responses to environmental constraints in forest ecosystem (multiple-risk approach)

European-managed forests offer a triple lever to mitigate climate change, through carbon sequestration in trees and forest soils, substitution of petrol by wood-based construction and energy to carbon emitting technologies, while stocking carbon in long lasting wood products. However, they are also ecosystems particularly vulnerable to climate change, which could jeopardize all these benefits. – mitigation potential included. Forest ecosystems are under the increasing scrutiny of citizens as they are perceived as refuges against the threatening degradation of the planet and its biodiversity.

What do we do

In this context, UL is financing and actively supporting an excellency laboratory around the forests and wood sector (Labex ARBRE³), which is a major international hub for developing forest sustainability scenarii, forest-related bioeconomy and related graduate schools, Such cooperation between academic (such as RPOs INRAE⁴, IGN⁵/ENSG, ANSES⁶, AgroParisTech), education, social and industrial partners (ONF, CRittBois, CNPF, IGN forestry inventory is a strength of this community and is essential to stimulate innovations for a more sustainable forestry production system, more favourable to biodiversity and more resilience to climate change.

Research at UL and the Lorraine ecosystem covers a large range of forest research disciplines, from cutting-edge molecular (omics) and cellular physiology, ecophysiology, ecology, social and economical sciences, to foster more integrative approaches such as forest monitoring, silviculture and forest management, in the context of an increased need of forest resources, wood processing and new societal requirements (e.g., energy transition, detoxication, decomposition).

The research program around forest and wood sciences is strongly integrated in a European network, as for example the NFZ (Nancy – Freiburg – Zürich) network, and the EFI (European Forestry Institute), as well as being strongly involved in the ongoing RIA “EUFOR” on an ‘European Forest Research and Innovation Ecosystem’.

What Europe wants

The EU forest strategy⁷ sets a vision and concrete actions to improve the quantity and quality of EU forests and strengthen their protection, restoration and resilience.

What UL proposes

UL therefore proposes to meet European challenge by focusing on the integration of fundamental processes of tree responses to environmental constraints (multiple-risk approach), taking into account the soil/tree/atmosphere continuum as well as plant-plant interaction of a forest ecosystem, with the objective to manage resilient forest ecosystems, which comply with demands from the forest sector as well as the society.

6. Overall recommendations

³ <https://mycor.nancy.inra.fr/ARBRE/>

⁴ <https://www.inrae.fr/>

⁵ <https://www.ign.fr/>

⁶ <https://www.anses.fr/fr>

⁷ https://environment.ec.europa.eu/strategy/forest-strategy_en

- SSH in UL are integral part in meeting European challenges

What do we do

UL has set-up an organization as interdisciplinary research, innovation and education centers which enable to meet societal challenge in a holistic approach.

What does Europe want

EC wants to reinforce the SSH participation to European project as well as a multidisciplinary and interdisciplinary approach

What UL proposes

- Some projects related to the societal challenges of the different clusters and even being technology-centric, should be mandatorily coordinated by SSH stakeholders for a more comprehensive inclusion of the societal issues,
- However, SSH researchers should be more systematically involved in the drafting phase of interdisciplinary calls focusing on societal issues. Too many "SSH targeted" calls only contain a standard sentence claiming that "*proposals should involve appropriate expertise in social sciences and humanities*", whereas in actual fact the human or social dimension is insufficiently developed.
- The participation of SSH experts should also be systematized in the evaluation of the proposals, as long as that is justified.
- SSH scientists should not be put to use merely to assess the social acceptability or impact of a technology, but should be involved in the earliest stage of the projects

- Boosting research, innovation and skills

UL has developed an interdisciplinary and holistic approach, bridging research, innovation and skills development. Just like the EIT, MSC Actions have paved the way for co-programming and co-management measures from DG RTD and DG EAC. As such, they demonstrate that skills should be taken into account in the research and innovation framework programmer, just as research should become more embedded in the Erasmus+ program (particularly in the cooperation, strategic partnerships, Erasmus Mundus):

- The "research, innovation and skills" triangle is indeed key in the MSC Actions, as evidenced by doctoral networks which have led to fruitful cooperation between the academic and non-academic sectors. An increase in the budget of the MSC Actions would make it possible to strengthen and accelerate the momentum thus initiated, with spillover effects on socio-economic sectors.
- In the same vein, the "research, innovation and skills" triangle should be brought to bear on Pillar 2 projects with high TRLs (Innovation Actions), by integrating skills creation and skills development into the expected results of these projects. The visibility and impact would be measured through the hiring rate of graduates educated in HEI's.

- Support for targeted international cooperation

Both transnationally (in Europe) and internationally (in the world at large), it is key to work with all the stakeholders in a local ecosystem in research and innovation, and to meet the skills needed to support collaborative research as well as innovation and entrepreneurship in the territories. UL a great experience in international cooperation, especially with Africa. Therefore, UL propositions are the following:

- In order to strengthen the dialogue with various regions of the world, as in Africa for instance, a strong level of collaboration and a more precise targeting of the needs and expectations of international partners is expected through the development of shared thematic orientations, joint strategies, and other instruments.
- Interregional collaboration, aiming at bringing together international stakeholders, might similarly be encouraged on the basis of shared interests/themes and not merely on an area-by-area basis. This would enable universities to position themselves on skills and expertise needs.
- In order to limit the effects of competition barring potential partners from access to funding, UL similarly encourages the creation of a simplified instrument, with a small, ring-fenced budget, enabling new international stakeholders to take part in the R&I framework program. Measures to increase the attractiveness of the instrument would include incentives to take the lead and coordinate projects.
- **Support for European values**

UL commends recent orientations developed under Horizon Europe in order to renew and strengthen the European Research Area by tying it more closely to political considerations and European sovereignty. In particular, the promotion of shared values is a welcome development, though increased attention for the co-construction of the ERA is needed.

- **Putting research infrastructures at the service of the European Research and Higher Education Areas**

- **Training at the heart of infrastructures**

Research infrastructures are wonderful tools for training students not only in research practices, but also in R&D and innovation. They mobilize various skills necessary for their use, their management, their development but also in order to ensure the transfer of technology. Such skills may also change as infrastructures develop or new ones emerge.

Accordingly, Université de Lorraine,

- would like to see infrastructures better acknowledged for their role in training for and through research and innovation
- calls for the setting up of a dedicated call for proposals in the 2025-2027 MSCA program, aiming at promoting and incentivizing mobility and training of early-career researchers at doctoral and post-doctoral levels through distributed research and innovation infrastructures. Consortia of transnational universities, including European universities alliances, would benefit from the establishment of this new call.

- **An integrated approach to infrastructures**

- Université de Lorraine supports an integrated approach to infrastructures and believes that the separation between research infrastructures and technological infrastructure is counter-productive, insofar as there is a continuum of expertise and needs between both of them.
- Research infrastructures should be made to meet the needs of blue-sky research and be simultaneously equipped to satisfy the needs of specific sectors and actors further downstream in the innovation process.

- Some of the infrastructures may contribute to several sectors at once. Accordingly, instead of being allocated to a specific sector, it is the whole of their possible contribution to these sectors that must be taken into account.

- **Collaborations between research infrastructures in Europe and with third countries**

Infrastructures are key drivers of open science at the service of accelerating knowledge so as to meet the societal demands of today and tomorrow. According to Université de Lorraine:

- Infrastructures should also be supported for the role they play in international collaborations and scientific diplomacy, provided these are based on reciprocity and shared values with like-minded partners.
- Collaborations between research infrastructures can be strengthened by setting up intercontinental mobility instruments facilitating access for researchers and technical staff alike to the most relevant infrastructures for their work, and promoting the exchange of good practices for the benefit of all stakeholders.
- Accordingly, université de Lorraine proposes to strengthen training and mobility programs in connection with international infrastructures, by relying primarily on transnational university consortia, including European universities alliances.

- **Funding and investing in infrastructure**

Within the ESFRI Forum, discussions are under way to design new instruments for financing research infrastructures from 2027 onwards.

- For sustainability and upgrading purposes, the EU should invest in the purchase of heavy and medium-heavy equipment while encouraging Member States to align national investments with such funding.
- Policy reviews should be carried out on a regular basis to ensure the complementarity of infrastructures, thus funded at national and European levels.
- Lastly, European investments in research infrastructures should also aim at strengthening links with society and citizens through participatory mechanisms.

• **Greater balance between low and high-TRL European projects must be reached**

Despite the need to strengthen value chains and accelerate reindustrialization in European countries, supporting basic research in R&I will remain key over the next 10 years. Instead, launching lots of calls geared towards innovation might dry up upstream research which is needed to feed into the next FP.

Today, funding for *blue sky research* is essentially reserved to pillar 1 (ERC, MSCA), and has limited place in pillars 2 and 3 via the RIAs. We recommend to reinforce the budget for this type of project in the next FP.

• **Achieving balance between large and small projects is needed**

As they make it possible to implement actions from research to innovation and even design products close to the market, large projects, often of the AI type, are of interest to a large number of stakeholders. However, this should not be detrimental to smaller-scale projects, which are easier to manage.

Such projects are attractive to a broad range of partners. As such, they are particularly suited for exploratory research actions aiming at triggering the participation of new stakeholders.

- **Lump sum funding**

Subject to further examination, lump sum funding in Horizon Europe seems to be a great source of simplification, thus allowing the community of researchers to focus on the projects themselves, the deliverables, and the expected results, instead of administrative issues. In particular, this mechanism allows for a better distribution of tasks.

According to France Universités, lump sum funding must be further reviewed. Communication, exchanges of good practices and tools for project leaders and institutions must be further developed.

As regards Erasmus + and Horizon 2020/Horizon Europe projects, lack of harmonization in the rules and tools of the lump sum type still prevails. Further harmonization is thus required.

- **Rules of participation**

The Horizon Europe portal should be simplified in order to make the administrative information requested for submitting projects more easily accessible.

Two years after the official launch of Horizon Europe, publication of the final version of the AGA is still pending.

In the absence of specific, formalized rules, responding to calls for projects and even setting up projects is more difficult.

The proposal template should be simplified – for instance, to this day, open science and data management practices are to be found in two different sections, while on the other hand information regarding infrastructure and publications are requested in both part A and part B.

As the amount and degree of information communicated in the ESR's still vary a lot from pillar to pillar and even cluster to cluster, more explicit and specific / personalized feedback from the evaluators would be most welcome for all kinds of projects.