European Commission

User Needs for Technology Infrastructures

Analytical report

Independent Expert Report

Research and Innovation

User Needs for Technology Infrastructures Analytical report

European Commission
Directorate-General for Research and Innovation
Directorate E - Prosperity
Unit E1 – Industrial Research, Innovation & Investment Agendas

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Manuscript completed in February 2025
First edition

PDF ISBN 978-92-68-23655-0 doi:10.2777/4186567 KI-01-25-001-EN-N

Luxembourg: Publications Office of the European Union, 2025

EUROPEAN COMMISSION

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2025 Directorate-General for Research and Innovation

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Acknowledgements

The members of the Expert Group would like to thank the colleagues from the Unit for Industrial Research, Innovation and Investment Agendas at the European Commission, DG Research and Innovation, for their support and engagement in the preparation of this report. The Expert Group is also grateful to Jelena Angelis from the European Future Innovation System (EFIS) Centre for facilitating the analysis of the user needs survey, as well as appreciates the contributions provided by the European Strategy Forum on Research Infrastructures (ESFRI), the project RITIFI and European Technology Platforms.

List of abbreviations and acronyms

3D	Three-Dimensional
4D	Four-Dimensional
5G	Fifth Generation
6G	Sixth Generation
AEL	Alkaline Electrolysis
AEMEL	Anion Exchange Membrane Electrolysis
AI	Artificial Intelligence
AR	Augmented Reality
BIM	Building Information Modelling
CCAM	European Partnership for Connected, Cooperative, and Automated Mobility
CCS	Carbon Capture and Storage
CCU	Carbon Capture and Utilisation
CCUS	Carbon Capture, Utilization, and Storage
CDA	Carbon Direct Avoidance
CETP	Clean Energy Transition Partnership
CHP	Clean Hydrogen Partnership
CO	Carbon Monoxide
CO_2	Carbon Dioxide
CSP	Clean Steel Partnership
CTIS	Clinical Trials Information System
EII	Energy-Intensive Industries
EIT	European Institute of Innovation & Technology
EGTI	European Commission Expert Group on Technology Infrastructures
ERA	European Research Area
ERIC	European Research Infrastructure Consortium
ESFRI	European Strategy Forum on Research Infrastructures
ETP	European Technology Platforms
EU	European Union
EU27	Abbreviation of European Union (EU) which consists of 27 countries (Belgium, Bulgaria, Czech Republic, Denmark, Germany, Estonia, Ireland, Greece, Spain, France, Croatia, Italy, Cyprus, Latvia, Lithuania, Luxembourg, Hungary, Malta, Netherlands, Austria, Poland, Portugal, Romania, Slovenia, Slovakia, Finland, Sweden)
FOAK	First-of-a-Kind

GPU	Graphics Processing Unit
HCT	Human-Centric Technologies
HPC	High-Performance Computing
ICT	Information and Communications Technology
IoT	Internet of Things
IP	Intellectual Property
IPR	Intellectual Property Rights
IT	Information Technology
KPI	Key Performance Indicator
MBSE	Model-Based Systems Engineering
NMC	Nickel Manganese Cobalt
NUTS2	Nomenclature of territorial units for statistics (basic regions (for regional policies))
NZIA	Net-Zero Industry Act
OEM	Original Equipment Manufacturer
P4P	Process4Planet Partnership
PCCEL	Proton Conducting Ceramic Electrolysis
PEMEL	Proton Exchange Membrane Electrolysis
PI	Process Integration
POC	Proof of Concept
PRO	Public Research Organisations
PROs	Public Research Organisations (plural)
PV	Photovoltaics
Q	Question
QKD	Quantum Key Distribution
R&D	Research and Development
R&D&I	Research, Development, and Innovation
R&I	Research and Innovation
RI	Research Infrastructure
RITIFI	Research Infrastructure Technology Infrastructure for Impact (Horizon Europe project)
RTO	Research and Technology Organisation
SCU	Smart Carbon Usage
SME	Small and Medium-sized Enterprises
SOEL	Solid Oxide Electrolysis
SRIA	Strategic Research and Innovation Agenda
TI	Technology Infrastructure
TRL	Technology Readiness Level
UK	United Kingdom
USA	United States of America
V2X	Vehicle-to-Everything
VR	Virtual Reality
XR	Extended Reality

1. Introduction

As part of the European Research Area (ERA) Policy Agenda, the European Commission is developing a European approach to Technology Infrastructures (TIs) in close collaboration with stakeholders at both the Member State and European levels. This approach is in line with the recent Draghi[1], Letta[2] and Heitor[3] reports which all refer to TIs as key for EU competitiveness and innovation capacity. TIs are important for industry to lower the costs and risks of technology maturation, prototyping, validation and upscaling prior to industrial application and market entry. Given their functions and importance for European industry, they are essential for Europe's technological sovereignty, strategic autonomy and competitiveness.

The Commission's objective is to develop an ecosystem approach to infrastructures supporting research, technology development and innovation, to ensure an adequate supply in Europe of worldclass facilities and services, to strengthen synergies and complementarities between research and technology infrastructures as well as to address the specific challenges facing each type.

The European Commission is engaged in extensive evidence gathering to better understand the current policy landscape relevant for TIs, to identify barriers and challenges in relation to their use, and to propose policy measures that would improve the provision of TI facilities and services across the European Union (EU).

This report presents the findings of a comprehensive collection of information and inputs performed in the framework of the Commission Expert Group on Technology Infrastructures on the user needs. The sources of information used in the report include:

- A public survey addressed to individual enterprises,
- Strategic research and innovation agendas of selected European Partnerships,
- European technology platforms and industrial technology roadmaps,
- National initiatives aimed at mapping TI user needs,
- Findings of the Horizon Europe funded project RITIFI, and
- Reports of the European Strategy Forum on Research Infrastructures (ESFRI).

2. Results of the survey addressed to enterprises

To understand the industrial perspective on user needs for TIs, including the awareness of enterprises about TIs, the perceived barriers to access them and solutions to improve the quality of services provided by TIs, and their general experience with those, the European Commission conducted an extensive online survey. Invitations to participate in the survey, launched on 19 August 2024, were sent through umbrella organisations, Member States contact points for ERA action 12 and disseminated nationally by Members of the Commission Expert Group on Technology Infrastructures (EGTI). The survey was open until the 30 November 2024. In total, 328 answers were received. For context, the original survey questions have been added in the annex (see Annex 7).

It should be noted that like any data collection survey, this assessment of user needs has some limitations. While 328 received responses is quite large number for such a technically focused EU wide consultation, the survey was circulated through several cluster and umbrella associations and could potentially have generated a sample of respondents who were attuned to the topic. The

[1] The Future of European Competitiveness, Pat B. See : https://commission.europa.eu/topics/strengthening-european-competitiveness/eu-competitiveness-looking-ahead_en

[2] Letta, E. (2024). Much more than a Market. Speed, security, solidarity – Empowering the Single Market to deliver a sustainable future and prosperity for all EU Citizens. European Council, Brussels.

[3] Align, act, accelerate - Publications Office of the EU

population of respondents also does not equally represent the full European industrial landscape of enterprises which may be TI users. Also, the survey generated more answers from specific countries. This could lead potentially to a certain bias in the results. It should also be noted that some questions were non-compulsory, meaning that not all respondents may have answered those. The following analysis specifies when this is the case.

2.1. Introducing enterprises and their links with Technology Infrastructures

Out of the 328 responses, the majority (251 responses, or 77%) came from enterprises based in EU Member States (see Figure 1). The largest proportion of non-EU based enterprises came from Norway (35 responses), Turkey (31 responses) followed by Switzerland, China, Taiwan, UK, India, US, and Ukraine.

The majority (289) of the respondents target markets beyond their national borders, from a regional EU market to the global market. Less than half (42%) perform a majority of their research and development (R&D), and innovation activities in-house (138 respondents).

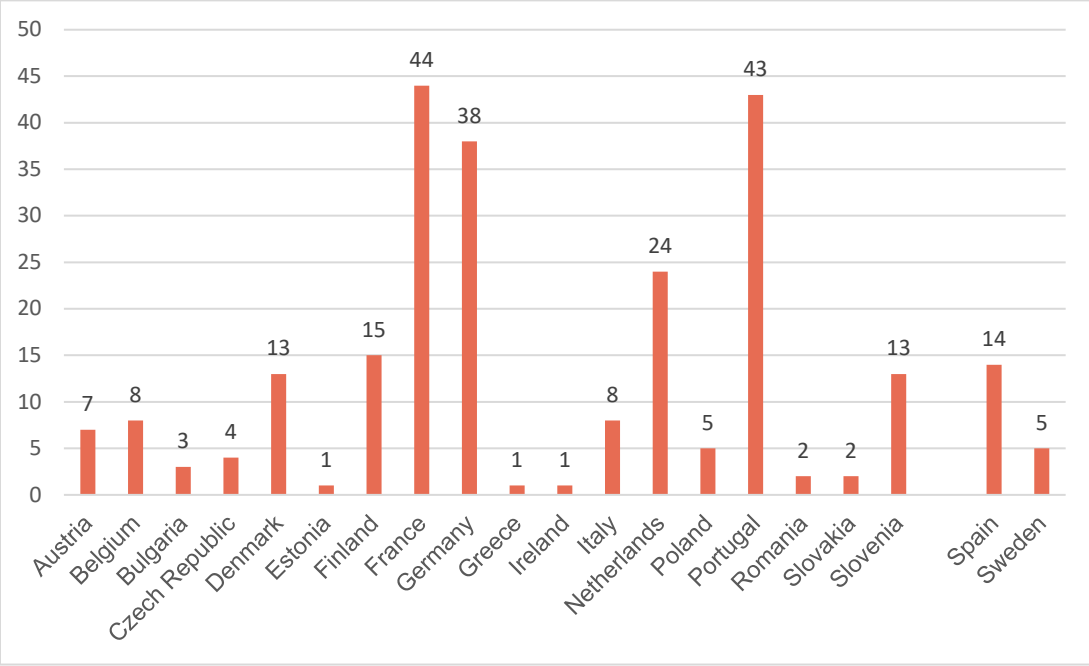

Figure 1: Number of survey responses coming from EU-based enterprises.

2.1.1. Size of enterprises

The largest respondent's group was SMEs (i.e. enterprises with up to 250 employees) (149 responses, or 45% of all respondents). A nearly equal number of responses (59 and 54) came from start-ups and enterprises younger than 5 years on one hand (18%); and from very large enterprises (with more than 3000 employees) on the other hand (17%). Other respondents were enterprises of intermediate size: 27 (8%) have between 250 and 500 employees, 16 (5%) have between 500 and 1000 employees, and 23 (7%) have between 1000 and 3000 employees (see Figure 2).

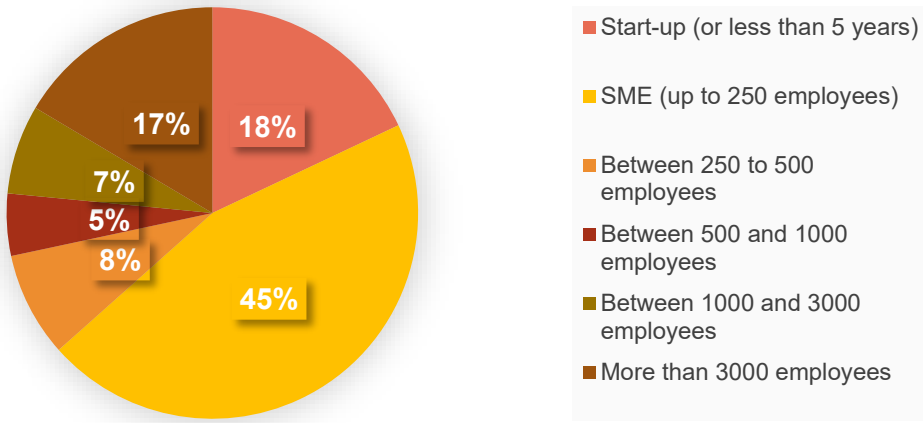

Figure 2: Typology of enterprises participating in the survey (Q1 of the survey).

2.1.2. Industrial ecosystems and technology areas

The Commission has identified 14 industrial ecosystems while working on the financial liquidity and investment needs of the EU27 in response to the COVID-19 crisis.[4] These ecosystems play a crucial role in shaping Europe's economic landscape and driving innovation. The survey respondents operate notably in mobility/transport, health, aerospace and defence, digital, energy & renewables as well as energy intensive industries, electronics and agri-food. The less represented industrial ecosystems were construction, textile and tourism, cultural and creative industries, social economy and civil security, retail and proximity (see Figure 3).

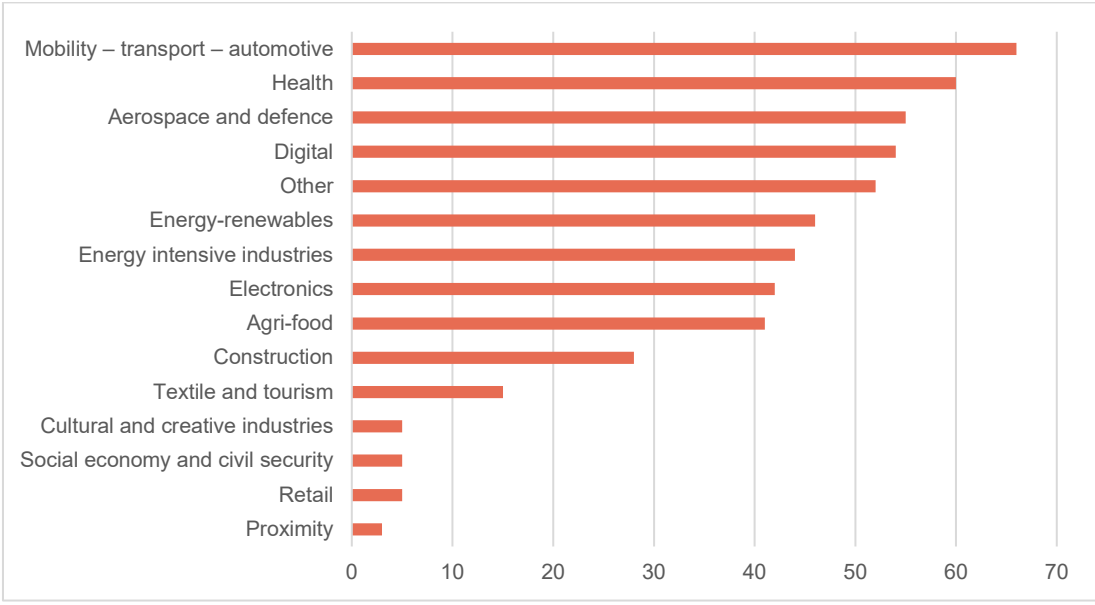

Figure 3: Number of enterprises across the industrial ecosystems (Q7).

[4] They are described in the Annual Single Market Report 2021, https://eur-lex.europa.eu/legal-content/en/TXT/?uri=CELEX:52021SC0351

Moreover, 72 respondents indicated that they either totally belong to or are active in 'other' industrial ecosystems not on the list (see Table 1). It has been possible to attribute some of these answers to the listed industrial ecosystems, leaving only 52 'other' industrial ecosystems. Some of these answers can also be organised in specific industrial fields, e.g. seven enterprises are active in 'metal industries', four in 'chemical industries' and two in nuclear energy. Annex 1 lists all received answers to this 'other' category.

To have an even better understanding of the profiles of the enterprises, they were asked to indicate (1) which technologies they currently use in their production processes, (2) which technology areas they consider as an investment priority in the next two years, and (3) whether are enough TIs in the technology areas. Production processes in this question meant all the work that an enterprise is doing to produce its applications, products or services.

The list of technologies depicted in Table 1 and Figure 4 builds on the list of Key Enabling Technologies[5], the net-zero technologies identified by the Net-Zero Industry Act (NZIA)[6] and the Commission's Recommendation on critical technology areas for the EU's economic security[7].

Among the respondents there is a good distribution of enterprises using different types of technologies. Most of them are linked to advanced manufacturing and processing: additive manufacturing, autonomous systems, sensor technology, industry 4.0; artificial intelligence: deep learning, quantum ai, robotics, autonomous systems, AI-as-a-service; robotics and autonomous systems; security and connectivity technologies: standards (5G, SigFoc, etc.), network architectures, cryptography, IoT networks and protocols, distributed ledgers; and recycling technologies. A number of 'other technologies' were mentioned by the respondents (see Annex 2).

Table 1: The list of technologies used in the survey
Advanced manufacturing and processing: Additive manufacturing, Autonomous systems, Sensor technology, Industry 4.0Advanced (nano)materials: Biomaterials, three-dimensional (3D) printing and design, Chemicals, polymers, metals, glass, rapid prototyping
Life-science technologies: Neurotechnology, Bioengineering, AI in biology and biotechnologies, bioelectronics, Medical engineering
Micro/nano-electronics and photonics: Integrated circuit design, quantum computing and technologies, IoT sensors and tokens, high performance computing
Artificial intelligence: Deep learning, Quantum AI, Robotics, Autonomous systems, AI-as-a-service
Security and connectivity technologies: Standards (5G, SigFoc, etc.), network architectures, cryptography, IoT networks and protocols, distributed ledgers
Robotics and Autonomous systems

[5] Key Enabling Technologies (KETs) | Knowledge for policy
[6] https://commission.europa.eu/strategy-and-policy/priorities-2019-2024/european-green-deal/green-deal-industrial-plan/net-zero-industry-act_en
[7] https://defence-industry-space.ec.europa.eu/commission-recommendation-03-october-2023-critical-technology-areas-eus-economic-security-further_en

Table 1: The list of technologies used in the survey
Recycling technologies
Solar photovoltaic and solar thermal technologies
Onshore wind and offshore renewable energy
Batteries and storage
Heat pumps and geothermal energy
Electrolysers and fuel cell
Sustainable biogas/biomethane
Carbon capture and storage (CCS)
Grid technologies (which also include electric vehicles smart and fast charging)
Sustainable alternative fuels technologies
Advanced technologies to produce energy from nuclear processes with minimal waste from the fuel cycle
Small modular reactors
Space and propulsion technologies

Overall, some caution is needed when interpreting this information in Table 1 and Figure 4. The high proportion of enterprises indicating that particular technologies are currently being used in their production processes does not necessarily indicate the predominance of these technologies. It can simply be influenced by the profile of enterprises that responded to this survey.

Participants were also requested to mention technologies which they believe are or will be at the core of their competitive R&D and innovation plans (see Annex 3). Looking in detail, a correlation can be observed between the above results, in terms of missing TIs and technology areas considered as priority by enterprises for future investment.

In the opinion of the respondents, there are not enough relevant TIs in the (1) advanced manufacturing and processing: additive manufacturing, autonomous systems, sensor technology, industry 4.0 and (2) artificial intelligence: deep learning, quantum AI, robotics, autonomous systems and AI-as-a-service.

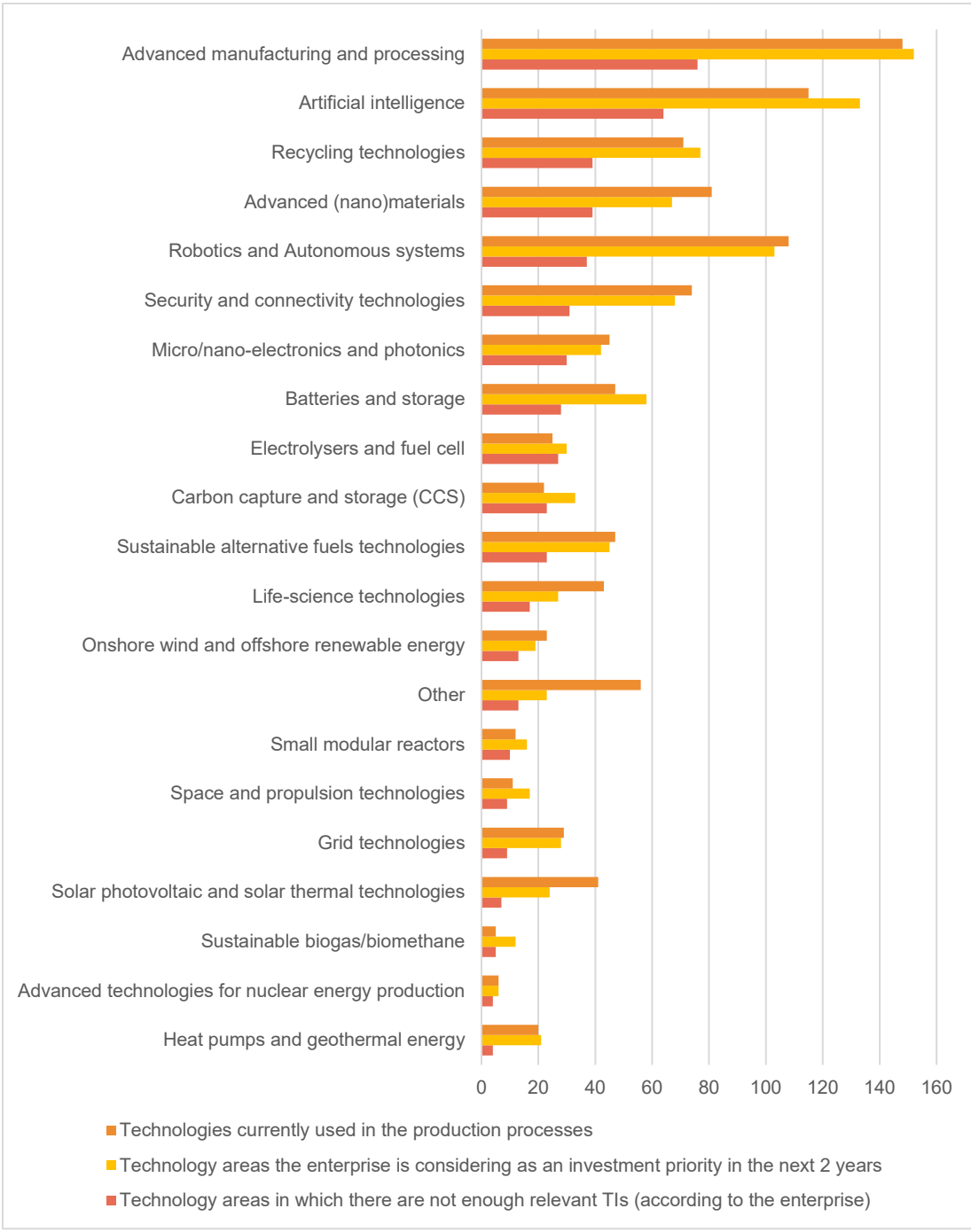

Figure 4: Enterprises and the use of technologies in relation with Technology Infrastructures (Q8; Q22; Q23).

However, this observation is based on a relatively small sample of enterprises: 76 and 64 enterprises respectively chose these technology areas out of the total 258 enterprises which responded[8].

[8] If Q8 and Q22 were compulsory to answer, Q23 was not.

Hence, it is relevant to determine a ratio of enterprises declaring that a specific technology area is lacking a TI in relation to the total number of enterprises declaring that they consider this technology area as an investment priority in the next two years (See figure 5). Interestingly, electrolysers and fuel cells (1), micro/nano electronics and photonics (2), carbon capture and storage (3), onshore wind and offshore renewable energy (4), advanced technologies for nuclear energy production (5), life-science technologies (6) and Small modular reactors (7) and space and propulsion technologies then appear as technology areas clearly missing TIs for the needs of enterprises planning to use them in a near future.

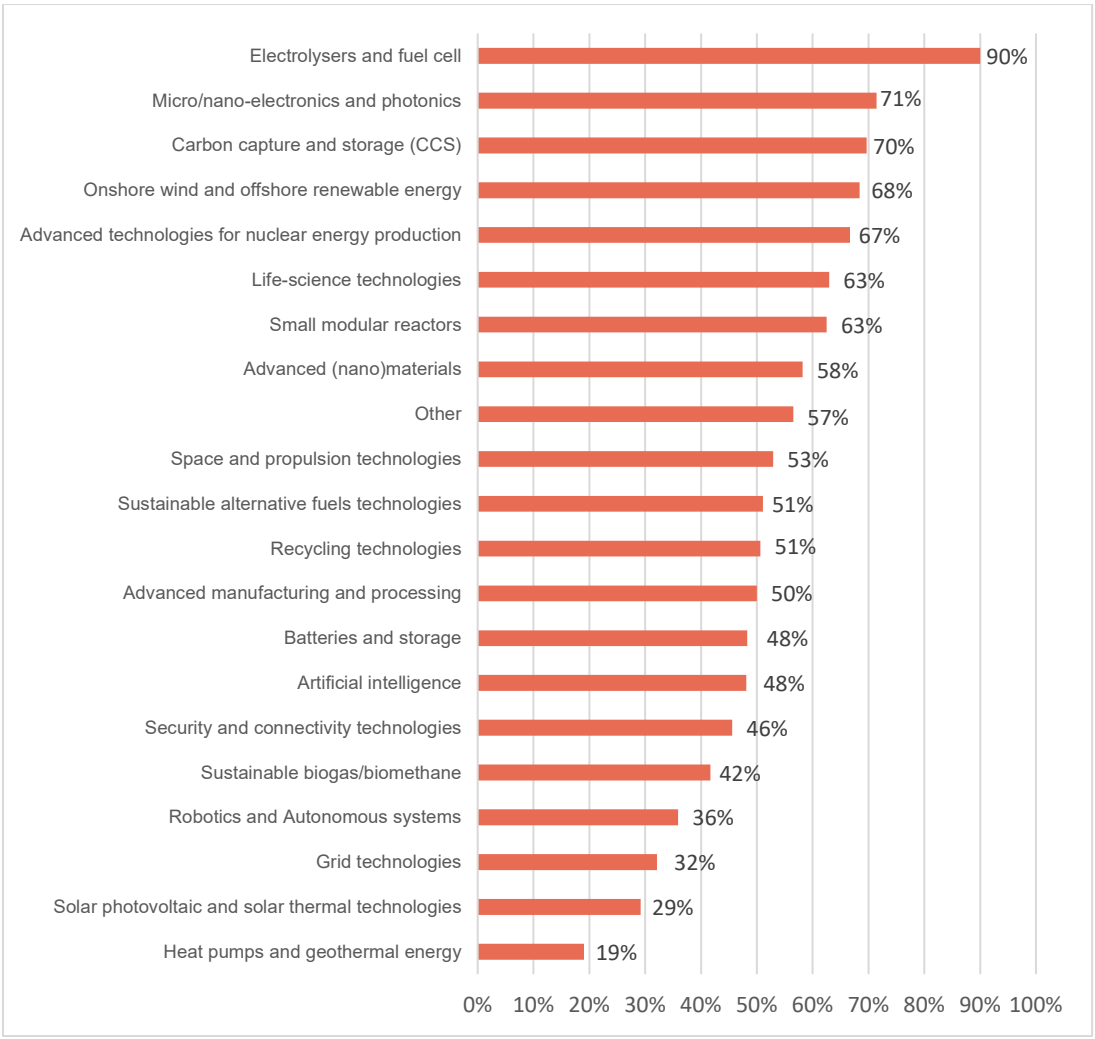

Figure 5: Proportion of TIs missing in technology areas seen by enterprises as an investment priority in the next two years (Q22 and Q23).

Not all enterprises are necessarily ‘fluent’ in the terminology used in the TI field and by the European Commission when describing or classifying technologies. Some survey respondents also declared that not only advanced technologies are critical for their R&D and innovation efforts.

2.2. Current use of Technology Infrastructure

2.2.1. Awareness about Technology Infrastructures

Awareness about TIs among the participating enterprises varies. A large proportion of enterprises (i.e. 57% or 187 responses) know the concept of TIs. Of these, 122 respondents (37% of total answers) stated that they know about TIs available to them, while 65 respondents said that they do not know any TIs. Another 104 enterprises (or 32% of total responses) know infrastructures which could be TIs but are not familiar with the concept. The smallest group (37 respondents, or 11%) include enterprises which are neither familiar with the concept nor aware of available TIs.

Box 1: SME's and start-ups awareness of TIs

When considering only SMEs and start-ups (208 answers), the awareness about TIs seems to be similar: 112 (54%) of them know the concept of TIs but of these only 68 (33%) are also aware of available TIs available. Another 67 enterprises (or 32% of total responses) know infrastructures which could be TIs but are not familiar with the concept. The smallest group (29 respondents, or 14%) include enterprises which are neither familiar with the concept nor aware of available TIs.

2.2.2. Reasons for using Technology Infrastructures

The majority of enterprises participating in the survey (264 or 80%) declared that they use TIs. TIs are important either because an enterprise wants to develop a new technology, method or process (253 responses, or 77%), test their product and processes in real life conditions (239 responses or 65%), to perform tests on their manufacturing processes (232 responses or 60%), or to increase their skills-base (233 responses or 61%).

Enterprises surveyed use TIs for various reasons (see Figure 6) from the development of new technologies, methods, products, processes and solutions, to testing their products and processes in a near-close environment, to prototype development and to increase competences for the adoption of new technology. In detail, 81% of respondents (264 enterprises) stated that they use TIs either to a large extent (104 respondents, or 32%) or somewhat (160 respondents, or 49%).

Among those who had other reasons the following were mentioned: scale-up, process optimisation, customised manufacturing (as highly needed), or the need to test products from their suppliers to adapt to their customers' requests.

Only 52 respondents (16%) indicated that they do not at use TIs at all for the development of a new product, service or process, technologies or methods. The reasons given are presented in Annex 4 and can be grouped into broad categories. Half of the 52 respondents have insufficient knowledge / information about TIs in general and about the availability of specific TIs. Other reasons were a too great a geographic distance from a TI, a difficulty to access TIs, a lack of fit of the TI to the specific needs of the enterprise, regulatory approval constraints or a lack of financial resources. As a reason for not needing TIs, some respondents also answered that they sometimes find more relevant to have a live test at a customer's location rather than in a TI.

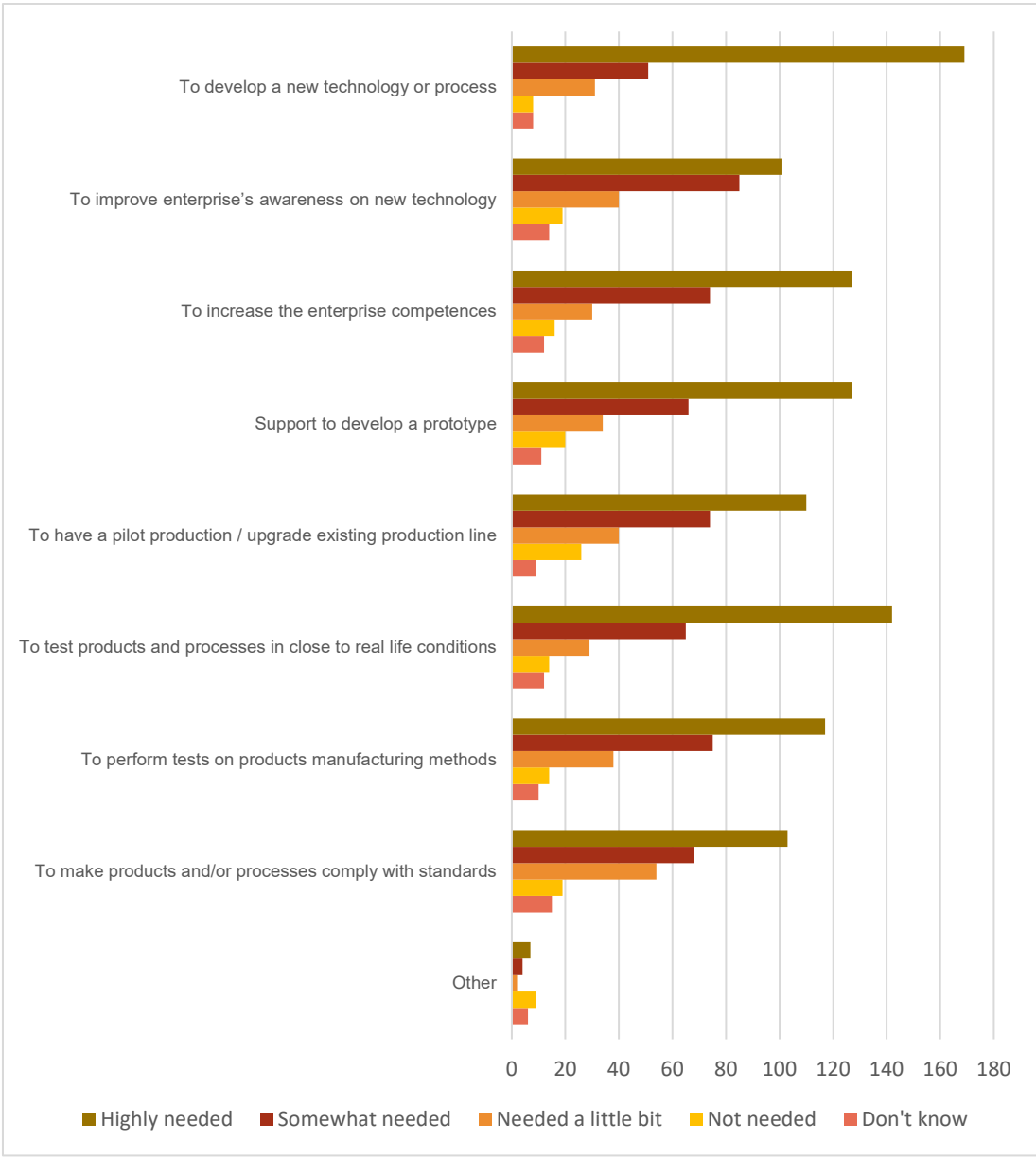

Figure 6: Main reasons for using technology infrastructures (Q14).

2.2.3. Perceived reasons for missing Technology Infrastructures

Some enterprises, see Figures 4 and 5, responded that in their opinion in some technology areas the offer of TI services is not sufficient. The mentioned reasons include a perception that there are simply not enough TIs, that access to the TI is too complicated for industrial users, that TIs are not relevant for the industrial needs, that they are inconveniently located, or that facilities are not state-of-the-art (see Figure 7). Among 'other' reasons the following are worth highlighting: regulatory constraints; lack of qualified personnel; fear of leakage of technology/knowledge; too many national specificities across the EU Member States; the feeling of having not enough control or feedback due to the TI being part of a very vertical organisation.

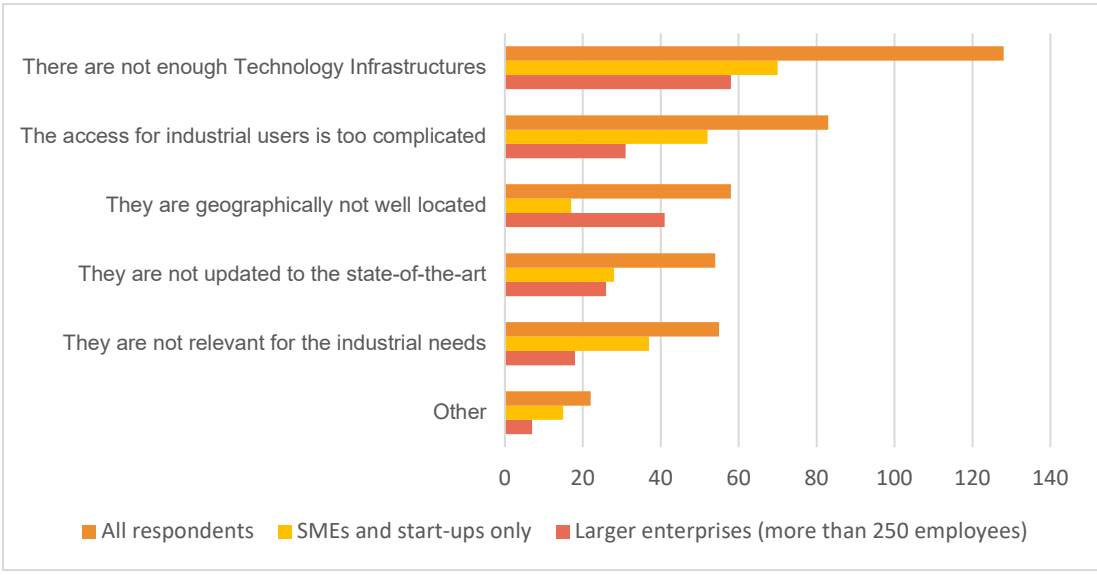

Figure 7: Perceived reasons for lacking TIs in specific technology areas (Q24).

Box 2: Perceived reasons for lacking TIs depend also of the size of the enterprise

Taking a closer look at the answers given by SMEs and start-ups (153 answers to this question – Q24- were received from such enterprises[9]) and comparing them with the answers given by larger enterprises to this question (91 answers received from this category of respondents having more than 250 employees), the perceived reasons for lacking access to TIs differ depending on the size of the enterprise replying. For instance, even if for both categories the fact that there are not enough TIs arrives in 1st position among the answers, we can notice that this is a much more important reason for larger enterprises (64% of answers) than for SMEs and start-ups (46%). Larger enterprises also more often consider that TIs are not conveniently located (45%) than smaller enterprises (11%).

The following table gives the respective ratio of enterprises of both categories to this question.

Perceived reasons for lacking TIs in specific technology areas	**SMEs and start-ups only** *In % out of 153 answers*	**Bigger enterprises (more than 250 employees)** *In % out of 91 answers*
There are not enough Technology Infrastructures	46%	64%
The access for industrial users is too complicated	34%	34%
They are geographically not well located	11%	45%
They are not updated to the state-of-the-art	18%	29%
They are not relevant for the industrial needs	24%	20%
Other	10%	8%

[9] To be noted that the question #24 was a noncompulsory follow-up question to the question #23, also not compulsory to answer, where respondents were asked to state which technology areas were missing TIs (if any). 84 respondents did not answer to Q24 and 70 did not answer to Q23. The 14 respondents who declared that TIs were missing for at least one technology area but did not specify for which perceived reasons are not counted in the explanations above.

2.2.4. Access to Technology Infrastructures

When considering the form in which access to TIs is provided, of the 273 enterprises that answered this question[10], the most commonly used form of access to TIs is through collaborations with research organisations or universities hosting such facilities (see Figure 8), followed by own testing and scale up facilities as well as collaborative projects financed by the EU, regional or national funds which facilitate access to knowledge and facilities. Other forms of engagement such as direct procurement of services, paid access to facilities at market terms, as well as the use of intermediaries are also frequent forms of engagement with TIs.

One additional access form, not on the proposed list, was indicated namely access via suppliers and customers. This type of access should not be confused with an access through an intermediary organisation. In terms of intermediary organisations, the list of which agency, platform or other intermediary organisation the participating enterprises use or have used in the past is in Annex 5.

Of those enterprises that do have access to TIs, 47% (or 155 respondents) use TIs at least 4 times a year. 35% (or 114 respondents) carried out more than 40% of their R&D&I within at least one TI.

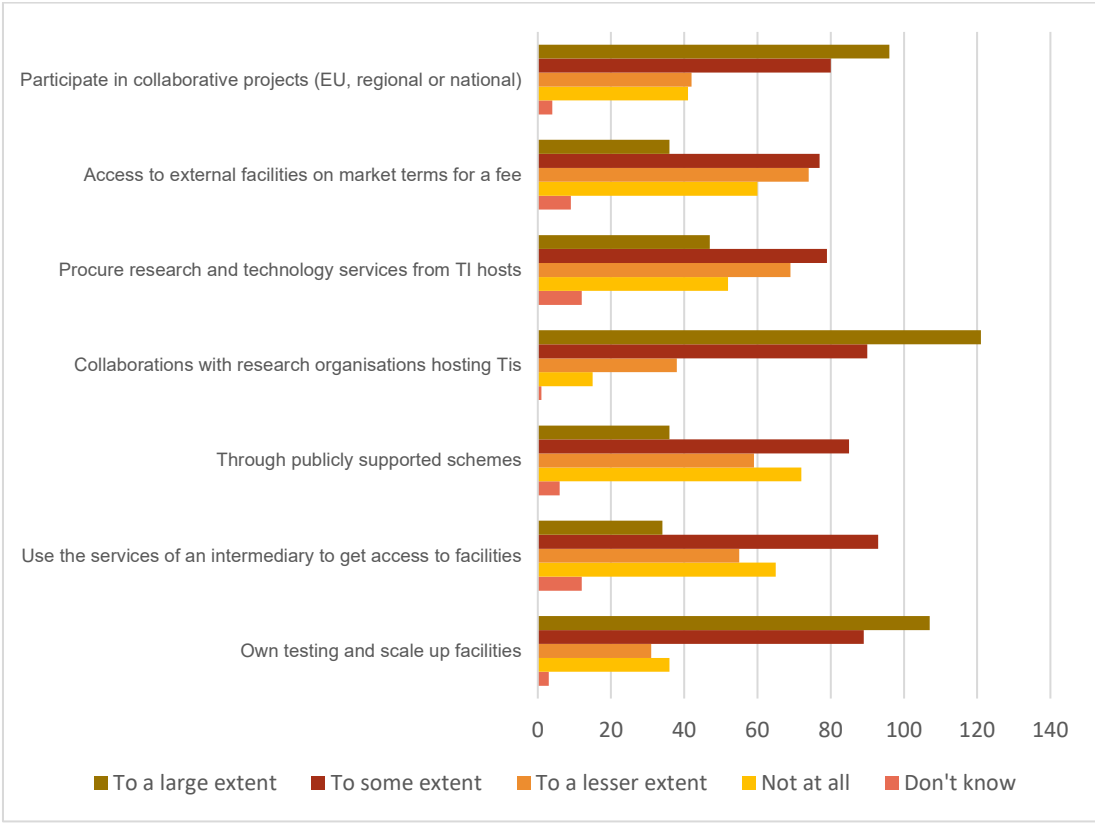

Figure 8: Forms of access to TIs (Q15).

Regardless of the conditions for access, all enterprises declare experiencing barriers to access (see Figure 9). The most significant barriers are on the side of the enterprises themselves, in particular the lack of financial resources to access TIs and the lack of staff. However, significant number of enterprises reported barriers on the side of TIs, including confidentiality concerns, lack of support staff or complex access conditions. Additional barriers suggested by the responding enterprises are listed in Table 2.

[10] The question #15 was also a non-compulsory one.

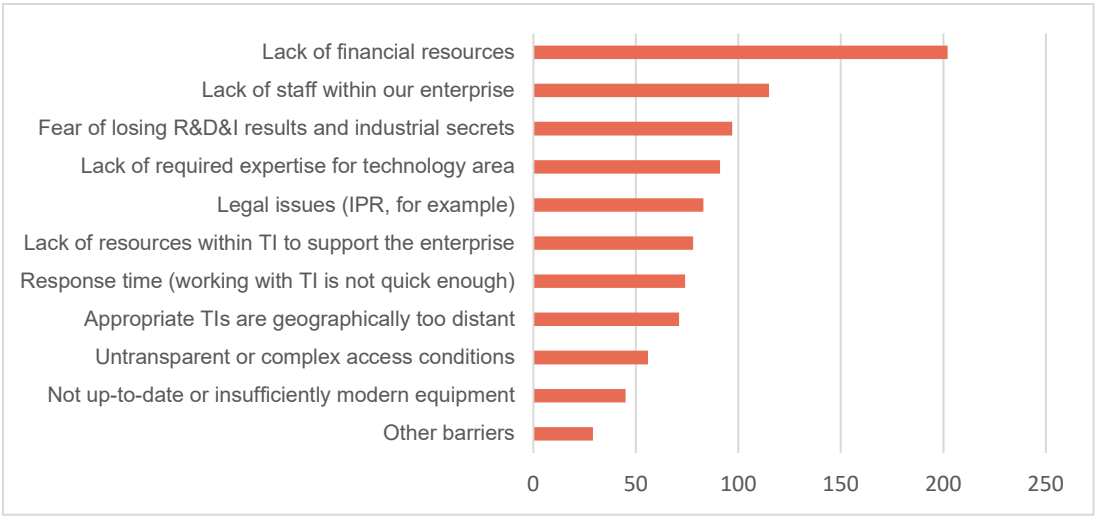

Figure 9: Barriers to access to TIs as seen by all enterprises (Q19).

Box 3: SME's and start-ups perceived barriers to access TIs are different than those perceived by larger enterprises.

Considering SMEs and start-ups (208 answers), the perceived barriers to access TIs are rather similar to those of the whole population of respondents. However, a much higher proportion of SMEs and start-ups (69%) declare a lack of financial resources to access TIs. Only 47% of the larger enterprises (more than 250 employees; 120 answers) quoted this reason as a barrier. The following Figure 10 detailed these results for each category of perceived barriers.

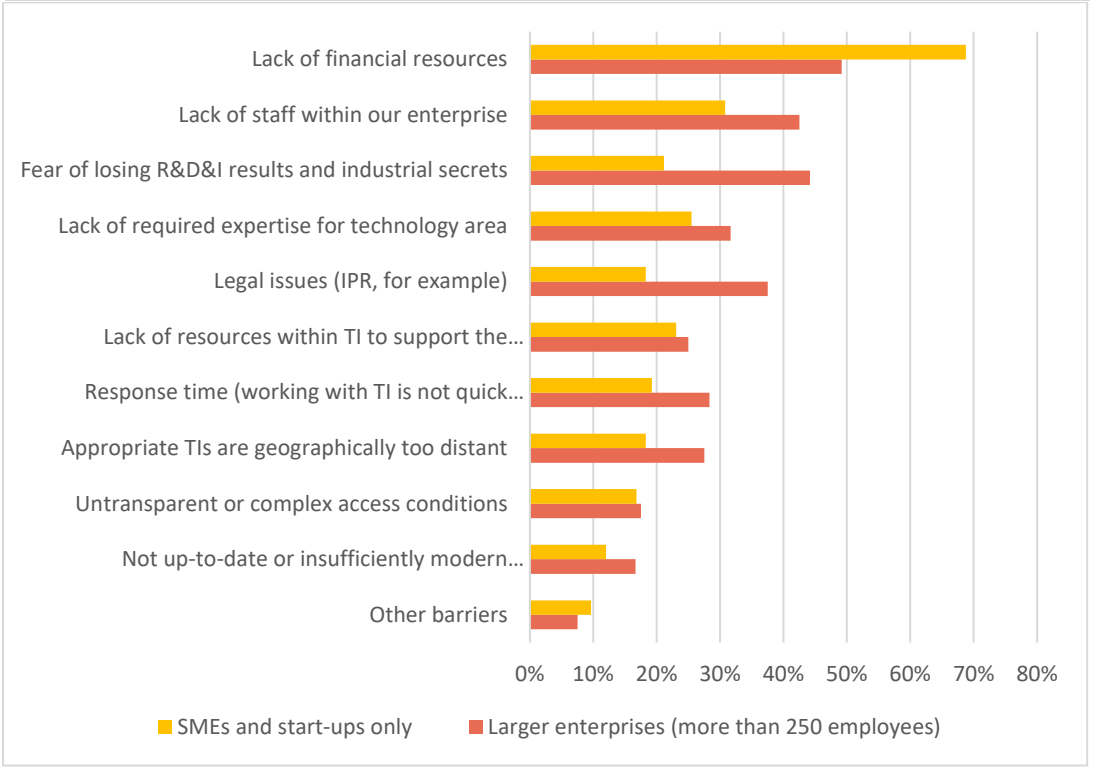

Figure 10: Percentages of main categories of respondents declaring seeing barriers to access to (Q19).

Table 2: Additional barriers for accessing TIs
Availability of TIs
Lack of existing TI for activities of interest
The chemical industry is currently undergoing the biggest transformation process in its history. On the one hand, it needs to become climate-neutral, and on the other hand, it needs to create the conditions for transitioning from a linear to a circular economic model. However, suitable TIs are not yet available.
Often it is more relevant to have a live test at a customer's location rather than a "living lab".
Capacity
Learning curve
Barriers exist to virtual testing - models of high fidelity do not exist sufficiently, digital twin facilities are lacking, computing capability is lacking
Scale of TIs is too small to illustrate industrial scale processes.
TIs capable to accompany the scale-up towards ‘real’ advanced innovations do not exist in a particular territory or (thinking to one specific case) have limited access (i.e. preferences are given to large enterprises).
Not being able to find qualified personnel to employ
Cooperation aspects
Universities do not always like to cooperate with a SME that is in certain ways more knowledgeable than they are. They tend to pursue their own "hobbies.
Priorities of the participating institutions
We would prefer free access to all research papers funded by public funds.
Incentives and motivation of public research organisations (PROs)
PRO priorities towards basic research; focus of public institutions

Table 2: Additional barriers for accessing TIs
TI will not invest in infrastructure relevant to only one company (fuel cell development test beds).
Technical issues
Technical choice
Data flow, data ownership
Visibility of TIs
Lack of knowing about TIs
TI possibilities are unknown.
Confidentiality issues
Some of our clients do not want to make the activities we work on visible outside.

2.3. Improving the use of TIs by enterprises

There are different options to help enterprises increase their usage of TIs (see Figure 11). The two that resonated the most with the surveyed enterprises are (1) making existing TIs more visible by offering (better) insights into their services (with 196 out of 328 respondents mentioning it); and (2) availability of funding to 'purchase' access to TIs (with 188 respondents indicating this). All other ideas for increasing the use of TIs were also found relevant by many enterprises.

The survey suggests that while SMEs and start-ups would benefit from better information about the services of TIs and from funding to purchase access to them, larger enterprises first preference is for the establishment of a 'one stop shop' access point. These results are coherent with the fact that larger enterprises have a better insight on what TIs can offer them and are more able to invest into accessing them.

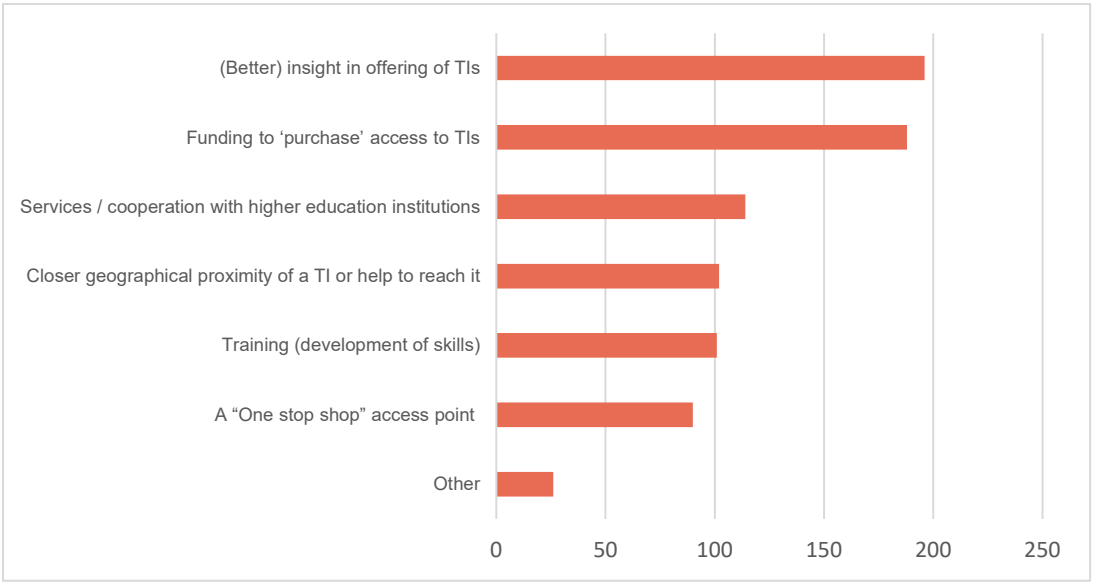

Figure 11: Help needed to increase usage of TIs (Q20).

Box 4: Best options needed to improve access depends on the size of enterprises

All enterprises answered to this question (SMEs and start-ups - 208 answers; enterprises with more than 250 employees; 120 answers). The results suggest that the most useful options to increase the usage of TIs depend a lot on the size of the responding enterprise.

For instance, while only 5% of the larger enterprises consider that having more information about what TIs can offer them could help them increase their usage of TIs, a high proportion (60%) of SMEs and start-ups consider that this better insight would help in using more TIs. It is the most important idea for this category of users. In the same way, SMEs and start-ups interest in funding to purchase access to TIs is double that of larger enterprises (48% versus 22%). On the contrary, a much higher proportion of large enterprises (63%) than SMEs and startups (37%) consider that a 'one stop shop' access point would help them increase their usage of TIs.

The results are coherent with other findings of the EGTI on access to TIs. Larger enterprises are already more used to work with TIs and are looking mainly to ease the administrative process to access them whereas SMEs often have limited or no experience with TIs and need information and help to access them, sometimes for the first time.

The following table gives the respective ratio of enterprises of both categories to this question.

Perceived reasons for lacking TIs in specific technology areas	**SMEs and start-ups only** *In % out of 208 answers*	**Larger enterprises (more than 250 employees)** *In % out of 120 answers*
(Better) insight in offering of TIs	60%	5%
Funding to 'purchase' access to TIs	48%	22%
Services / cooperation with higher education institutions	33%	31%
Closer geographical proximity of a TI or help to reach it	34%	29%
Training (development of skills)	31%	36%
A "One stop shop" access point	37%	63%
Other	13%	60%

Additional suggestions from respondents on how to increase the usage are presented in Table 3. These cover diverse aspects including culture, communication, funding, investments, legal and technical.

Table 3: Additional suggestions on how to increase the usage of TIs.
Cultural aspects and communication
Being more pragmatic and entrepreneurial oriented.
Universities to be more open to the needs of enterprises. There should be an incentive for universities to support highly technical SMEs to grow and scale-up. This includes scientific communication.
Capacity at TIs to cooperate
TI needs to open for co-funding/collaboration with universities/institutes to ensure technology transfer to industry. Currently TI and research infrastructure funding programmes are blocking each other's collaboration.
Funding and investments
Dedicated funding for upgrading to up-to-date or state-of-the-art instrumentation/equipment.
Higher incentives for PROs to increase industrial use of R&D infrastructure, lower admin burden (e.g. state aid rules)
Federated and pre-standardised infrastructures (e.g. Sylva project for Telco-Cloud) that could be utilised between various ICT actors at EU level
TI needs to invest in relevant equipment (fuel cell testbeds)
More internal resources to coordinate the external cooperations.
Legal aspects
Better IP and KH protection conditions
More data security, legally binding agreements (in case of data breach)
Safeguard of trade secrets, IPR etc

Table 3: Additional suggestions on how to increase the usage of TIs.
Strategic aspects
Management awareness and strategic prioritisation
Technical aspects
Adapted TI to new technologies
Equipment adapted to business (12" wafers)
Standardised procedures and protocols about how to introduce TIs into new developments/ production ramp-ups.

Offering specific (or additional) services for enterprises to enhance their capabilities to innovate and develop their innovation(s) and technologies further could result in even greater demand for TIs. When enterprises were asked about such services (see Figure 12), support to develop a new technology, method, product, process, and/or solution enterprise is working on, and support to test their product(s) and/or process(es) in an environment close to real life conditions (e.g. living lab to scale up) were chosen as the two types of services that are highly needed (with 145 and 131 out of 328 respondents respectively). At the same time, for all other types of services listed, the positive replies significantly outnumber the neutral and negative ones.

In addition, 175 respondents provided suggestions of other services, which were not on the questionnaire list, and expressed their opinion about the extent such services will be needed in the future (see Table 4). A mix of services were mentioned from very specific technical services (e.g. bioprocessing, or virtual testing) to softer services around training (e.g. upskilling and reskilling), capacity building, and scientific communication.

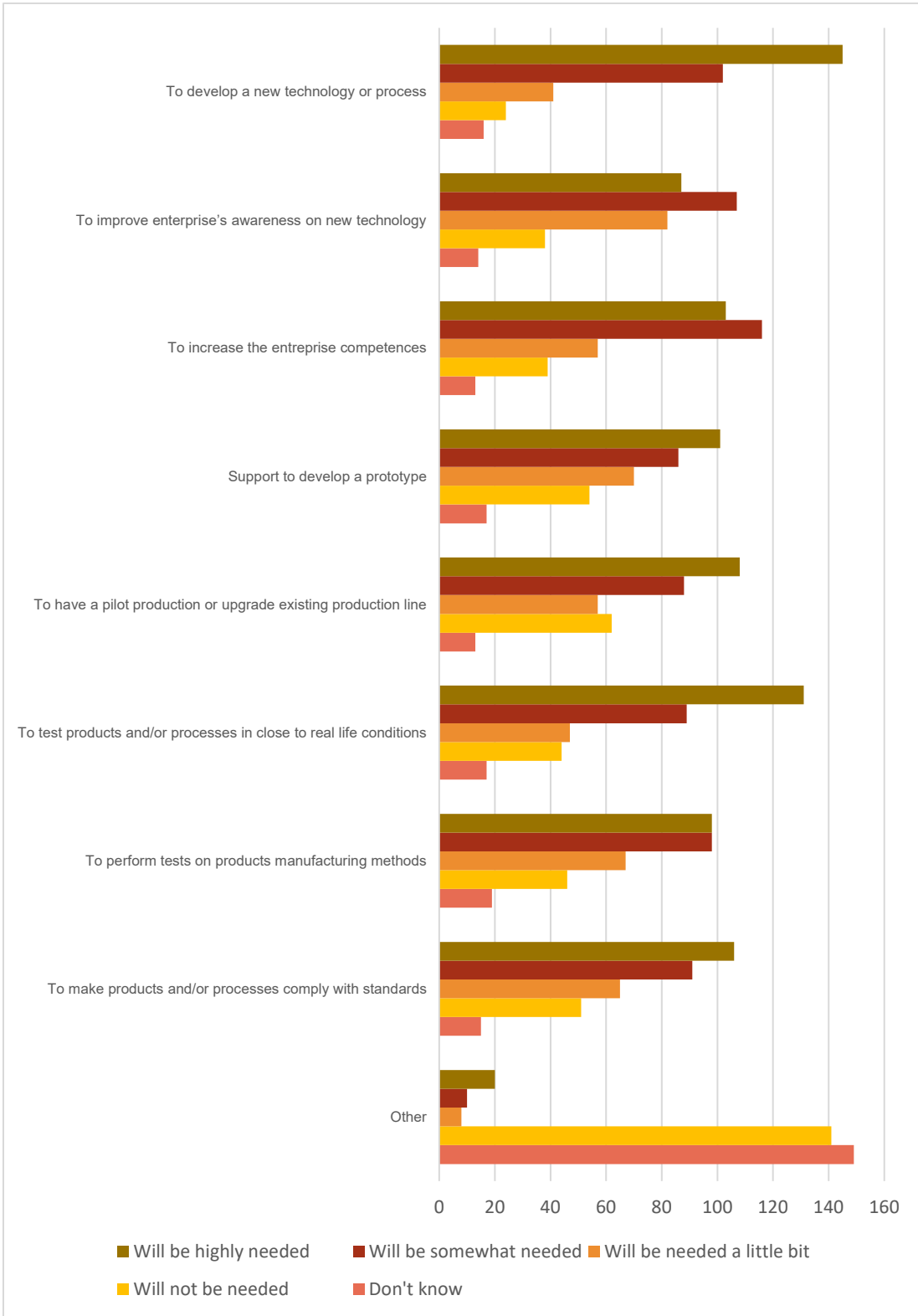

Figure 52: Support or services needed by enterprises to enhance their capabilities to innovate and develop innovation(s) and technologies further (Q21).

Table 4: A list of support or services	
Level of demand	**Type of support or services**
Will be highly needed	Bioprocessing Capacity building activities, e.g. how to adapt content and training materials to align with the cultural norms and expectations of local entrepreneurs and enterprises. Financial support to 'purchase' access to TI x 2 Scientific communication (papers, conferences, PhD's) and benchmarks with US based technology Training on intellectual property protection in the EU Support for virtual testing Support for training and education on industrially relevant products Support to create a CCS IT (in project in US for cement plants) Support in finding commercial development partners and independent / public testing centres Offshore wind, pipeline, cable, vessel, ports, offshore oil & gas
Will be needed a little bit	Training for upskilling and reskilling of resources Co-financing of R&D activities
Will be somewhat needed	High temperature characterisation capabilities Virtual and real environments are needed
Don't know	Support to find TI, corporate partner and funding/investment early Analytical work Education of highly skilled technical supporting work force More people

2.4. Concluding remarks and recommendations for future work

2.4.1. Additional observations from the survey

The analysis of the main results of the survey conducted of enterprises using or interested to use TIs, and which potentially would benefit from TI services, provides a snapshot of what industrial users could think about the topic. Building on the additional comments to the survey (see Annex 6), it is recommended to organise focus groups or interviews with the respondents who indicated that they are willing to provide further input into the topic. This would be an additional step in a consultation with existing or future users.

These additional observations vary a lot in their focus and nature (see Annex 2). Given that in many cases these are individual observations, it is not possible to draw generalised conclusions. However, the observations can be grouped into four overarching themes:

- **Funding and incentives** (including financial) for TIs is the largest common topic. If addressed this would ensure greater stability in the provision of services. This could include making funding available for (1) keeping the analytical equipment at TIs up-to-date and state-of-the-art; (2) conducting specific projects, e.g. demonstration; (3) training of personnel to use such equipment; (4) covering costs of access for SMEs to TIs. This could be done via a dedicated support instrument or (for some elements) through direct funding to TIs to support their operations. The views were slightly divergent regarding access to TIs funding which could be given directly to the enterprise buying the TI services versus the TIs holding a pot of money to financially support access. One comment made was to avoid any overlap of funding between national, regional and EU funds, on the one hand, and increase the investments from the private sector (i.e. large corporates and investments community), on the other.
- **Visibility of TIs and communication** about their service offering comes across as a weak point. Some enterprises welcome the idea of a joint repository of all TIs in Europe; other suggest focusing more on targeted activities, such as open days and webinars. This can be achieved through specific training and workshops that TIs could offer to enterprises to upskill their employees and engineers. This would potentially help the users and TIs understand better how TIs can be used to solve the needs of industrial users.
- **Design or set-up of TIs** was another area where many enterprises had an opinion. Access to data (e.g. data set and datahubs), data transfer as well as data storage questions should be properly addressed in TIs. All the aspects linked to data access, confidentiality etc. as well as potential (in some cases) IP ownership issues need to be addressed. TIs, although bringing valuable support to enterprises, in the opinion of some participants cannot really address all the needs for industrial technology development, and, hence, in some cases are perceived to not fit the needs of industrial users.
- **Efficiency in the use of TIs**. More co-operation between enterprises for the use of large TIs, thus ensuring cost and risk sharing.

3. RITIFI insights on User needs for Technology Infrastructures

Research Infrastructures (RIs) and TIs are essential and complementary elements for functional and efficient R&I ecosystems in Europe. The RITIFI (Research Infrastructure Technology Infrastructure For Impact) project[11] is contributing to better structure and strengthen the integration of the European landscape of RIs and TIs, and, thus, stimulate co-creation and knowledge-sharing interactions between the RI and TI communities to leverage their respective strengths. Launched in 2023, the project will develop an innovative framework that improves end-user access to RIs and TIs, formulate plans for enhanced policies and investments, and foster engagement with users, managers and policymakers.

The project also takes a look at the user needs for TIs based on a user experience and expectations survey, as well as interviews with industry representatives from five specific technology areas:

- biomedical,
- clean hydrogen,

[11] https://cordis.europa.eu/project/id/101095267/fr

- circular materials,
- particle accelerators and superconducting magnets, and
- microelectronics and semiconductors.

These technology areas have been selected because of the following criteria: some kind of TI-RI collaboration exist; they are of strategic importance in EU and national policies; they are mature with respect to integration of the RI and TI landscapes; success stories exist; and finally the project partners are involved in these fields.

The user expectations survey focused on the identification of services needs and customer value proposition, especially when linking lower-TRL activities at RIs with higher-TRL activities at TIs, impact of services, funding of services and barriers for using RI/TI services. A total of 36 responses to the user experience and expectations survey were received. Most of the respondents were from Nordic (14 Finland, 5 Denmark, 1 Sweden, 1 Norway) and Western Europe (2 Austria, 3 France, 6 Germany, 2 Switzerland) and 2 from USA. Most respondents were from large private enterprises (47.2%) or small-sized enterprises of less than 50 persons (33.3%). Half of the respondents had used mainly RIs, while the other half had used TIs.

The survey and interviews revealed that users value the complementary application of RIs and TIs, which broadens their effectiveness and output for application-related questions. However, users also highlighted several barriers to using integrated RI/TI services, including funding and pricing issues, long delivery times, and lack of knowledge about available services. The boundary between RIs and TIs is often fuzzy, with many service providers offering both types of services.

The respondents also highlighted the importance of having knowledge about the RIs and TIs, as well as their capabilities, in addition to purely infrastructure-related information. The respondents also emphasised the need for clear and transparent pricing, as well as simplified access procedures.

The case studies conducted in the five technology areas identified specific user needs and challenges. For example, in the biomedical area, users highlighted the need for streamlined processes, simplified customs regulations, and clearer points of contact for industry engagement. The biomedical industry also emphasised the importance of trust and long-term partnerships with RIs and TIs, as well as the need for specialized technologies and expertise. In the clean hydrogen area, users emphasised the importance of trust, proximity, and flexibility in collaborations with RIs and TIs. The clean hydrogen industry also highlighted the need for specialized testing infrastructure and efficient routine measurements for qualification.

The circular materials area highlighted the need for seamless collaboration between RIs and TIs, as well as access to supporting services such as techno-economic and environmental assessments. The circular materials industry also emphasised the importance of having access to R&D services across the entire technology readiness level (TRL) range, from fundamental research to commercial deployment. The particle accelerators and superconducting magnets area had a unique relationship between RIs and TIs, with TIs providing major components for RIs and industry using these components for various applications. The microelectronics area highlighted the need for access to highly sophisticated infrastructures, as well as the importance of expertise and knowledge in microelectronics.

Several best practices for RIs, TIs, and client enterprises to collaborate effectively, were identified. These include long-term partnerships, trust, and well-functioning collaboration in project implementation, as well as state-of-the-art open access TI/RI facilities with highly skilled staff. The report also notes that clear, professional, and flexible contractual terms and operation practices are essential for joint projects or commissions. The importance of proximity and regional service providers was also highlighted, particularly for SMEs.

Based on the findings, RITIFI provides several recommendations for improving the user experience and effectiveness of RIs and TIs. These include:

- Increasing awareness of RI and TI capabilities and complementary services by empowering regional nodes;
- Improving service efficiency and customer centricity, and promoting collaboration between complementary RIs and TIs;
- Developing access conditions of RIs and TIs for executing R&D projects and scale-up more effectively and collaboratively;
- Promoting and supporting collaboration between complementary RIs and Tis;
- Keeping RIs and TIs offering and capabilities competitive and updated for the needs of industry and society.

Additionally, results suggests that for some case studies, public investment supports could be bound to the strategic research and innovation agendas (SRIAs) of the EU's Horizon Europe framework programme partnerships or industry organisations. Results also highlight the importance of a continuous dialogue between RIs, TIs, and industry, as well as the need for a coordinated approach to address the challenges and barriers identified. By implementing these recommendations, RIs and TIs can better support research and innovation in Europe and contribute to the development of new technologies and industries.

4. Addressing technology development needs of Horizon Europe Partnerships

Europe's ambitious goals for a green and digital transition demand robust innovation ecosystems that support the advancement, upscaling, and uptake of cutting-edge technologies. In the EU, there is a plethora of breakthrough but under-developed technologies, that struggle to reach a market, which could benefit from TI services, in addition to RI services, which in some cases are also relevant. The Horizon Europe Partnerships, through the SRIAs, identify sectoral and cross-sectoral technological development needs in the areas they cover. In some cases, they also explicitly refer to the needs of TIs in supporting them.

4.1. Sector-specific needs and the role of Technology Infrastructures

From clean energy to advanced manufacturing, mobility, and hydrogen, each EU industrial sector is working on rapid technological advancements aimed at securing Europe's global competitiveness. However, further advancement can be hindered by underlying challenges.

The battery sector, driven by the ongoing clean energy transition and the uptake of zero-emission mobility, has risen to be of strategic importance on a global level. The **BATT4EU Partnership**, aims at establishing the world's best battery innovation ecosystem by 2030, by building a competitive, sustainable, and circular European battery value chain to support the shift toward a carbon-neutral society. Achieving the ambitious goals outlined by the Partnership requires bridging technological gaps, ensuring consistent funding, and fostering collaboration across stakeholders to maintain Europe's competitiveness in a rapidly evolving global market. Key areas for further development identified by the partnership include advanced materials, battery cell design and manufacturing, as well as circular economy initiatives, for which coordinated efforts are needed to develop cutting-edge technologies. In particular, sustainable processing and refining methods for lithium-ion and sodium-ion batteries, targeting resource efficiency, emissions reduction, and circularity, are central to these efforts. Moreover, advanced materials such as high-nickel NMC cathodes and solid-state batteries are prioritised, while sodium-ion batteries and vanadium redox flow batteries are identified for stationary storage demonstrators to enhance lifecycle performance and sustainability. Additionally, digitalisation tools and safe-by-design frameworks need to be integrated into pilot lines to optimise manufacturing and recycling systems, improving efficiency and safety. Emerging technologies, including non-lithium chemistries like organic and aqueous

flow batteries and biomimetic self-healing materials, are at a less mature stage and require further R&I at earlier TRLs before scaling.

Another important sector, where the development and upscaling of innovative solutions is pivotal to secure Europe's competitiveness, is that of mobility. The **European Partnership for Connected, Cooperative, and Automated Mobility (CCAM)** is dedicated to advancing key technologies in the sector for safe, sustainable, and automated road transport. To drive this innovation, CCAM stresses the importance of large-scale demonstrations, and the use of pilot lines and living labs as essential platforms for testing and validating these technologies in real-world conditions. These solutions include on-board decision-making systems, vehicle perception systems, and high-resolution mapping and localisation tools that ensure accurate positioning in dynamic environments. Additionally, advancements in technologies such as 'fail-operational' safety systems, vehicle-to-everything (V2X) communication and edge AI for real-time predictive system awareness are also required. Developing and deploying CCAM systems requires rigorous testing and validation. However, high development costs and regulatory uncertainty hinder progress. TIs can address these challenges by providing controlled testing environments, reducing costs and ensuring compliance with existing safety standards and certification requirements.

The **Clean Hydrogen Partnership (CHP)** aims to advance a variety of hydrogen technologies essential for achieving the EU's carbon neutrality by 2050, with a focus on scaling up low-carbon hydrogen production, storage, and distribution. At higher TRLs, the main focus in on water electrolysis using renewable electricity, with a particular emphasis on upscaling electrolysers such as Alkaline Electrolysis (AEL), Proton Exchange Membrane Electrolysis (PEMEL), and Solid Oxide Electrolysis (SOEL). Beyond water electrolysis, other renewable hydrogen production methods, including solar-driven processes, biological methods (e.g., algae and microbes), and biomass gasification, need to move beyond pilot projects to larger-scale demonstrations, integrating these technologies into broader energy systems. Advanced storage solutions and distribution technologies, such as large-scale underground hydrogen storage, are equally critical for supporting a future integrated hydrogen energy network. Despite these advancements, significant challenges remain. Many technologies are still at lower TRLs (e.g. Anion Exchange Membrane Electrolysis (AEMEL) and Proton Conducting Ceramic Electrolysis (PCCEL)), requiring substantial R&I efforts to achieve commercial readiness. Scaling up production capacity, improving cost competitiveness, and establishing robust distribution infrastructure are key areas requiring coordinated efforts. Overcoming these hurdles will enable hydrogen to play a pivotal role in Europe's decarbonisation strategy and energy transition.

The **Clean Steel Partnership (CSP)** aims to achieve the decarbonisation of the European steel sector and transform it into a vital, sustainable, and circular industry by developing technologies at a high readiness level (TRL 8). To achieve this, the partnership focuses on two main technology areas: Carbon Direct Avoidance (CDA) and Smart Carbon Usage (SCU). CDA emphasises green hydrogen and electricity to avoid emissions, while SCU incorporates carbon capture, utilisation, and storage (CCUS) and process integration (PI) to repurpose or minimise emissions. Key technologies requiring scaling include advanced gas injection systems for process gas reuse, hydrogen-based direct reduction, plasma reduction reactors, and low-carbon electric arc furnaces for melting pre-reduced ore and scrap. Other priorities are low-carbon sintering and pelletisation, waste heat recovery for energy efficiency, and AI-driven process optimisation and IoT-based energy management. Despite the significant advancements realised in the sector, significant challenges hinder the further development and scaling of these technologies, many of which, remain still at lower TRLs, necessitating substantial investment to bridge the "valley of death" between research and deployment. Scaling these technologies to industrial levels requires overcoming high capital intensity, long investment cycles, and the risks inherent in adopting breakthrough methods. Additionally, the steel sector faces competitive pressures from global markets, a lack of zero-carbon electricity and hydrogen availability, and the need for carbon capture and storage (CCS) infrastructure. Demonstrators, repeatedly highlighted throughout the SRIA, are essential for scaling steel technologies to industrial levels. They can help to address critical barriers, optimise processes, and integrate innovations into steelmaking, paving the way for large-scale implementation.

These examples demonstrate that while Europe has made significant progress in developing cutting-edge technologies to drive the twin transition, there is still considerable room for further advancements across various sectors to fully achieve this goal, while maintaining EU competitiveness. For instance, continued progress in advanced materials, automation processes, hydrogen efficiency, and low-carbon steel production is crucial. Addressing these needs will require targeted support from TIs, alongside increased investment and cross-industry collaboration, to drive successful commercialisation and advance Europe's decarbonisation objectives.

4.2. Cross-Sectoral Technology Advancement Needs

While individual sectors have unique needs, cross-sectoral technologies, ranging from CCUS to digital twins can benefit from shared support structures provided by TIs, benefiting a plethora of industries.

In the process industries, a wide range of technologies require further development to achieve climate neutrality, resource circularity, and EU's global competitiveness by 2050. The **Process4Planet Partnership (P4P)** explores a wide list of key technologies needing further advancement including: renewable energy integration, like the use of large-scale solar and wind power combined with industrial energy storage systems; hydrogen integration, exemplified by green hydrogen production through electrolysis and its use as a feedstock or energy carrier in steel manufacturing; CO_2 capture and utilisation, including innovations like CO_2-based concrete production and catalytic conversion of CO_2 into synthetic fuels; and digitalisation of processes, such as the deployment of digital twins for process optimisation and intelligent monitoring systems to improve energy efficiency. While these technologies are at varying stages of development, many are at pilot or demonstration stages, with the need to upscale towards first-of-a-kind plants (TRL 8-9) for commercial deployment. TIs in conjunction with cross-sectoral collaboration, investment in infrastructure, and fostering innovation hubs can play an important enabling role to achieve this.

The **Clean Energy Transition Partnership (CETP)** supports achieving climate neutrality through advancements in clean energy technologies. The partnership's SRIA identifies key areas requiring progress: zero-emission power, energy storage, heating and cooling systems, CCUS, and cross-cutting digital technologies. For zero-emission power technologies like photovoltaics (PV), offshore wind, and concentrated solar power (CSP), priorities include improving efficiency (30-40%), cutting costs (35-50%), and enhancing integration through pilot lines, hybrid solutions, and circular materials. Similarly, energy storage technologies need advancements in materials, integration, and digital monitoring to address short-to-seasonal storage demands. Heating and cooling solutions—such as district systems, heat pumps, and geothermal energy—require increased efficiency, cost reduction, and flexibility, alongside better urban integration and climate resilience, validated through regional demonstrators. Meanwhile, CCUS technologies are vital for decarbonising hard-to-abate sectors, with a focus on cost reduction, scaling infrastructure, and public acceptance. Lastly, cross-cutting digital technologies (e.g., AI, IoT, advanced modelling) enable automation and interoperability but face barriers like regulatory misalignment, resource shortages, and funding gaps.

The **Made in Europe SRIA** outlines essential technology developments for advancing the European manufacturing sector. Innovations are critical for improving production efficiency, enabling circular economy practices, and driving digital transformation. Key focus areas include advanced manufacturing technologies, such as additive manufacturing, smart mechatronic systems, and recycling technologies. Technologies like simulation, digital twins, and AI are also emerging but require further development for full-scale industrial application. To bridge the gap between innovation and real-world application, the SRIA stresses the importance of demonstrators, as part of the main key performance indicators (KPIs), as well as pilot lines. These facilities will enable validation, optimisation, and scaling of processes, such as zero-defect manufacturing and predictive maintenance, in line with sustainability and resource efficiency goals.

The **Photonics21** SRIA outlines the strategic research needs for advancing photonics technologies in Europe, which are vital for numerous sectors, including high-performance computing, quantum technologies, augmented reality, virtual reality (AR/VR), space, defence, and agriculture. To maintain Europe's technological leadership in this area, the SRIA focuses on advancing photonics technologies, including silicon photonics, optical components, and energy-efficient displays. These technologies offer significant potential for improving performance, reducing costs, and creating new applications across industries. However, addressing the technological gaps in materials, fabrication processes, and integration challenges remains crucial for realising the full potential of photonics. While many technologies are at TRL 6 or 7, and their scalability must be demonstrated in real-world environments, TIs can enable this process through pilot lines and demonstrators, where pilot manufacturing and real-world testing can accelerate their commercialisation.

Conclusion

As showcased by this selection of Horizon Europe Partnerships, many groundbreaking solutions need dedicated support to scale up and progress beyond experimental development in order to achieve full industrial application. This is due to various common barriers across the sectors and industries, including high capital costs, technological and regulatory hurdles, material resource constraints, as well as infrastructure bottlenecks. Addressing these challenges through coordinated innovation ecosystems, underpinned by state-of-the-art TIs, comprehensive policy support, and continued cross-border collaboration will be essential to realising the full potential of these transformative technologies.

5. Identifying Needs in Industrial Sectors through Industrial Technology Roadmaps

The current and future needs for TIs in specific industrial sectors are closely linked with the key trends and future directions in technology development. There are different sources of information providing such outlook, for example industrial technology roadmaps or European Technology Platforms (ETPs). This section highlights two types of such roadmaps: industrial technology roadmaps developed by the Commission in the framework of the ERA and selected sectoral roadmaps developed by industrial associations. In addition, the section analyses inputs gathered from five ETPs.

5.1. ERA Industrial Technology Roadmaps

The ERA Industrial Technology Roadmaps provide valuable insights into the development priorities for low-carbon solutions, circular innovations, and human-centric technologies, highlighting where advancements are most needed. Thus, by showcasing and assessing the maturity of the most relevant technologies required across key industrial sectors, these ERA roadmaps help in understanding the main needs of TI users.

Decarbonisation solutions for Energy-Intensive Industries (EII)

The "ERA industrial technology roadmap for low-carbon technologies in energy-intensive industries" highlights key pathways for decarbonisation, focusing on steel, chemicals, cement, and other EII sectors. These pathways include electrification, green hydrogen usage, CCS, CCU, alternative feedstocks, renewable energy integration, energy/materials efficiency and circular economy principles.

These technologies show varying maturity levels. Specifically, electrification of thermal and electrically driven processes has medium to high TRLs solutions applicable particularly in chemicals, metals, iron and steel, ceramics, and glass. Green hydrogen, crucial for energy but also

as a chemical reducing agent in key sectors, remains mostly in pilot stages, with moderate readiness for adoption.

CCS/CCU solutions exhibit high potential in cement, chemicals, and iron and steel, reaching medium to high TRLs (7-9). Similar maturity applies to alternative fuels, bio-based resources, and renewable energy technologies. Scaling mature technologies (TRL 9-10) is vital to meet 2030 targets, while achieving 2050 zero-emission goals will rely on technologies currently at lower TRLs (4-8).

Pilot lines, demonstrators, and industrial symbiosis hubs are essential for first-of-a-kind (FOAK) projects to mitigate risks and accelerate uptake. Challenges like long investment cycles, regulatory uncertainties, and cross-sectoral collaboration require innovation hubs, better regulation, and knowledge-sharing to drive progress.

Circular Solutions for Textiles, Construction, and Energy-Intensive Sectors

The **"ERA industrial technology roadmap for circular technologies in the textile, construction and energy-intensive industries"** evaluates key technologies across three industrial ecosystems: textiles, construction, and energy-intensive industries (EII).

In textiles, technologies like recycled materials and near-infrared automated fibre sorting exhibit high TRLs (7-9), indicating advanced development. Secondary bio-based raw materials fall within medium TRLs (4-6), while material blend separation technologies are in the low TRL range, reflecting early-stage testing.

For the construction ecosystem, the focus is on building information modelling (BIM) and advanced manufacturing technologies. BIM-compatible plug-ins and four-dimensional (4D) BIM applications reach high TRLs (6-9), while modular design and additive manufacturing technologies are in the mid-range (4-6), transitioning from piloting to wider application.

In the EII ecosystem, technologies for waste treatment, carbon dioxide/carbon monoxide (CO2/CO) utilisation in polymers, and improved recycling processes fall between TRLs 3-8, with some in pilot phases.

Lastly, digital technologies play a key role in the transition of all three industrial ecosystems to the circular economy, including in data collection, material tracking and waste management. Examples are technologies, like AI and machine learning for catalyst discovery and Digital Twins for resource optimisation that have great potential but are still in medium TRL levels.

The roadmap stresses the role of TIs (that are at the moment available mostly in textile and construction industrial ecosystems), which serve as platforms/facilitators for the industries, especially for SMEs and start-ups and are a key element in the development of local and regional innovation ecosystems.

Human-Centric Innovations for Industry Transformation

The **"ERA Industrial Technologies Roadmap on Human-Centric Research and Innovation**" highlights human-centric technologies (HCTs) as essential to Industry 5.0, focusing on innovations that enhance collaboration between humans and technology, prioritising safety, productivity, and user-centric design. These include AI, robotics, extended reality (XR), digital twins, and wearable technologies. Among these, applications, such as machine learning and natural language processing, and robotics (e.g., collaborative robots) are most actively adopted and invested in by enterprises, showcasing their maturity and direct applicability to industrial settings. Wearables and XR technologies are also gaining traction for training, inclusiveness, and safety but are less widely implemented.

Technologies still in early stages or being tested include advanced systems for human intention recognition, exoskeletons for physical augmentation, and some applications of AI-driven personalisation systems. These remain niche or experimental due to cost, complexity, and the need for extensive testing.

The roadmap stresses the importance of TIs like living labs, as they can accelerate the development and deployment of these technologies by providing real-world testing environments where stakeholders can collaborate. By integrating stakeholder input and iterative testing, such infrastructures bridge innovation and adoption effectively.

5.2. Sectoral Industrial Technology Roadmaps

Technology roadmaps developed within the industrial sectors highlight the directions in which industrial research and innovation efforts need to progress in order to strengthen the competitiveness of a given sector and its transition to climate neutrality. As an example demonstrating the relevance of such roadmaps as a source of information on current and future needs of TI services, a short analysis is presented of the Ceramic Roadmap 2050[12] prepared by the European Ceramic Industry Association, and an Action Plan for the European Chemical Industry's Innovation Leadership[13].

Ceramic Roadmap to 2050

The roadmap identifies four broad areas of new technology development needs:

1) Switching to more sustainable energy sources for production plants: increasing availability of green hydrogen and of related infrastructure, enhancing the electrification of ceramic manufacturing processes to reduce reliance on fossil fuels, and developing technologies for using alternative fuels like biofuels, biogas, and synthetic gases;
2) Developing and implementing CCS and CCU technologies to manage process emissions;
3) Recycling and Reuse: new technologies for increased use of recycled materials and improving methods for the reuse of ceramic products;
4) Energy efficiency Innovative technologies: microwave-assisted drying to enhance drying efficiency and heat pumps to improve energy efficiency for heating and cooling processes.

The roadmap also assesses the advancement status of the different technologies as well as barriers to their deployment. The ones requiring further experimental development include, in particular, CCS-CCU, synthetic gases, green hydrogen, electrification, and microwave-assisted drying. These are the areas where support of Technology Infrastructures could accelerate the decarbonisation of the ceramic industries.

Action Plan for the European Chemical Industry's Innovation Leadership

The action plan outlines what needs to be done to position the chemical industry in Europe as a leader in innovation in line with the overall objectives set in the "Antwerp Declaration"[14] published in February 2024. Out of nine points, two actions express the chemical industry's need for collaboration with TIs.

Action 2 calls for prioritising pilot plant facilities with flexible infrastructures to also support smaller enterprises across industries. It also proposes the establishment of a European network of technology parks with flexible, multipurpose infrastructure supporting the validation of new sustainable process technologies. The chemical industry considers that this is needed in order to maximise synergies and scale up breakthrough technologies, which are very capital intensive. In the pilot plant stage, development costs increase substantially compared to lab costs. For a breakthrough technology facing high uncertainty regarding market entry, shared pilot plant facilities offer a significant cost and speed advantage. Small enterprises, especially, have the possibility to use multipurpose facilities without making their own direct investment.

Moreover, Action 3 calls for fostering EU-wide collaboration across industries and academia, supporting cross value chain initiatives and sufficient joint centres of excellence for IP development

[12] ceramic-roadmap-to-2050.pdf
[13] Nine actions to boost the EU chemical industry's innovation leadership - cefic.org
[14] The Antwerp Declaration for a European Industrial Deal

and sharing. The industry considers that moving towards such an ecosystem approach will foster knowledge creation and sharing across the entire value chain.

5.3. European Technology Platforms

The Commission also reached out to the ETPs to gather information on needs for TIs in specific sectors, as seen from the perspective of public-private multi-actor fora focused around key technology and innovation areas. ETPs were the first type of public-private partnership established in the research field at European level. These industry-led stakeholders' fora define and implement a strategic research agenda aiming at aligning research priorities in a technological area. They have been sent the same survey than enterprises were able to answer, with some adaptations[15].

5 ETPs answered the questionnaire:

- Aquaculture (active in the production of aquatic foods)
- SusChem (sustainable chemistry)
- Photonics21 (photonics[16])
- FABRE TP (animal breeding and reproduction)
- Textile (textile and clothing industries)

These ETPs members are active in a wide range of industrial ecosystems. Only those of construction, cultural and creative industries, proximity, social economy and civil society, and retail were not covered. A large number of members, from different ETPs, are active in the agri-food and energy related ecosystems. All these ETPs members need advanced manufacturing and processing technologies with a large amount also needed life-science technologies. Advanced (nano)materials, AI, and robotics and autonomous systems.

The questionnaire also shows that improving information on TIs is needed for ETPs members. To the exception of the ETP FABRE TP, whose members know the TI concept but are unaware of available TIs, all other ETPs declared that their members know some infrastructures that could fit the description of TIs but did not know about the concept of TIs before. All ETPs declared that their members need TIs for their development to a certain extent.

The enterprises get access to TIs mainly through the use of the services of an intermediary, collaborations with research organisations or participation in collaborative projects. The main barriers to use TIs concern the lack of financial resources, the lack of required expertise or support for area of technology needing to be addressed, an insufficient geographical proximity of TIs, and the lack of resources within TI to support industry needs. All respondents declared that funding to purchase access to TIs would help their members, 80% added that a better knowledge in offering of TIS and an better geographical proximity of TIs would help too.

When asked which are the technologies, in the next two years, that are at the core of their members' existing competitive development (R&D and innovation) plans and therefore are considered as a priority area in which they need to invest, AI and robotics and autonomous systems are the most needed according to 80% of respondents.

All ETPs consider that there are not enough TIs. Some also say that they may be irrelevant for industrial needs, for example because they were mostly developed for other sectors (with the example of materials, advanced manufacturing & robotics). In general, they call for a more transparent information on TIs and related services offered by RTO's & universities, allowing also an access to them as easy as possible, especially for SME's. The benefits of European funded transnational access programmes are also noted.

[15] Such as the replacement of enterprise's individual perspective by the collective perspective of ETPs members and deletion of inappropriate questions.
[16] Photonics is a technology encompassing all of the products and processes around the emission, manipulation and detection of light.

They state that their members would need some specific services often not available at TIs. In addition, they identified area where TI could improve, such as the administrative and financial support offered by TIs, a better promotion of the relevance and potential of TIs, an engagement from TIs towards other industrial ecosystems and technology fields. Other comments are rather addressed to policy makers and financing bodies, calling for a geographically denser network of suitable TIs together providing better availability and financing of capacity/use time.

There are some specificities depending on the field concerned. For instance, the ETP Aquaculture underlines that the aquaculture sector is highly diverse and fragmented (covering multiple species and production systems, both in marine and freshwaters and across all EU members states). Therefore, not all sectors are at the same level of development. In addition, some 80% of European aquaculture production is through micro producers, for whom the focus is on day-to-day farming rather than engaging in R&D, innovation or technology transfer. This is coherent with the evidence from the user needs survey on the difference of needs and perceptions between SMEs and larger enterprises. The FABRE TP highlights particularly the need for developing TIs in the field of high-performance computing and data analysis. The Textile ETP also regrets the absence of TIs in textile-specific digital (automation/robotics) or circular (recycling) innovation domains, which also leads to a shortage of support and services such as demonstration/testing, consulting, and training that could be offered to SMEs.

5.4. Conclusion

The ERA Industrial Technology Roadmaps, the Ceramics Roadmap as well as the action plan of the chemical industry highlight diverse technological needs and readiness across sectors, from advanced solutions like electrification and recycled materials to emerging innovations such as green hydrogen and exoskeletons. Achieving industrial transformation towards climate neutrality goals and boosting industrial competitiveness require more effective and faster scaling-up and maturation of a very broad range of technologies, advancing from early-stage development towards commercial deployment.

TIs, including living labs and pilot lines, are vital for fostering collaboration, accelerating development, and bridging gaps to enable sustainable industrial transformation. To maximise impact, the industrial technology roadmaps recognise the need for wider utilisation of TIs in particular to advance the currently numerous low-to-medium TRL technologies to higher readiness levels and commercial viability.

The ETPs broadly highlight that the currently available TI services are not sufficient for their sectors or not adapted to their specific needs. They report that significant barriers still exist to broader collaboration between enterprises in their sectors and Technology Infrastructures. The barriers identified by ETPs are consistent with the conclusions of the survey and the findings of ESFRI.

6. National initiatives and perspectives on user needs

The European Commission commissioned a study on “Policy Landscape Supporting Technology Infrastructures in Europe”[17], which was published as a set of reports in September 2024. This very comprehensive study provides an overview of the policy landscape supporting TIs in Europe, across all Member States as well as in five third countries. While they do not primarily focus on user needs, the reports mention the importance of supporting the creation, upgrade, and long-term use and accessibility of TIs and provide insights on the way to answer efficiently user needs.

First, any TI roadmapping process needs to be rooted in demand and, more specifically, enable the anticipation of demand in a five to seven year time horizon. In that respect, the direct

[17] Technology Infrastructures - European Commission

involvement of TI operators and users in the roadmapping processes is seen as essential. Leveraging TI operators' capacity to anticipate user needs based on their technology expertise, strong ties with both academia and their market knowledge and foresight capabilities is also key to staying ahead of market curves and societal needs. A coordinated roadmapping exercise and gap analysis at the European level could enhance policymaking and avoid unnecessary duplications. In some cases, a cross-border market analysis covering both supply and demand would ensure an adequate use of the TIs' capacity based on users' needs.

Regarding funding, ad-hoc funding streams to support large- to mid-scale capital investments in TIs usually occur on an ad-hoc basis, through direct discussions and negotiations between TI operators and national/regional governments. Such ad hoc funding streams enable a demand-driven approach and require a sound business case adapted to users' needs. However, if this approach allows for a demand-driven funding model adapted to users' needs, it complicates long-term strategic planning and systematic assessment of user demands. In addition, both voucher schemes and competence centre schemes can support users' access to TIs Infrastructures in more or less structural or targeted manners.

A coherent multi-level policy landscape with a robust needs assessment and prioritisation mechanisms to prevent gaps in TIs in Europe will need establishing consistent policy support across the EU, with conceptual, strategic and operational alignment to assess the needs of TIs and their users. Ensuring visibility for policymakers on the available TIs across Europe in strategic technology fields is also needed and could foster the accessibility and complementarity of TIs across Europe. This also requires the establishment of sound processes to anticipate TI users' needs and assess potential gaps, currently and in the future.

To collect and answer user needs, place-based intermediaries and regional development agencies enable the fostering of TI accessibility by assessing users' needs and directing them towards TI operators and/or funding streams. The multiplicity of initiatives providing 'single entry points' to TIs could be streamlined through a coordinated approach.

Some national reports provide insights into the kind of TI users are needing, the barriers to access, or whether they have access to enough and appropriate TIs . In particular, it can be noted that:

- In Czechia, there is a need for more advanced TIs to support the development of emerging technologies such as AI and the Internet of Things.
- The Danish report highlights the importance of ensuring that TIs are accessible and usable by a wide range of users, including SMEs and start-ups. Like several smaller countries in the EU, Denmark is trying to ensure that their national enterprises can access TIs abroad, especially in areas where they do not have the critical mass necessary to build specialised state-of-the-art skills and facilities.
- The French report highlights the importance of supporting the development of TIs in areas such as high-performance computing, data storage, and cybersecurity.
- In Germany, ensuring that TIs are accessible and usable by a wide range of users, including research institutions and industry, is considered important.
- The Greek report highlights the need for more investment in TIs to support the development of emerging technologies.
- Regarding Malta, the national demand for TIs services can only be answered with access to TIs of other Member States, highlighting the need for more cooperation and access to TIs at the EU-level.
- Regarding user needs, the Polish report mentions that there is a need for more advanced TIs to support the development of data-driven technologies and digital innovation.
- In Portugal, it is important to ensure that TIs are accessible and usable by a wide range of users, including SMEs and start-ups.
- The Slovenian report highlights the importance of supporting the development of TIs in areas such as cybersecurity, data storage, and cloud computing.
- The report for Sweden mentions the need for more investment in TIs to support the development of emerging technologies, such as AI and the Internet of Things.

- In Romania and Estonia, significant investments in digital infrastructure, including the development of a national data platform and the promotion of digital skills have been done.
- The Finnish report, as well as the Slovakian, mentions that there is a need for more collaboration and coordination between different stakeholders, including research institutions, industry, and government, to ensure that TIs are developed and used effectively by all potential users.
- The reports for Latvia, Lithuania, Luxembourg, Hungary, Ireland, Italy and Netherlands highlight the importance of TIs in supporting R&I of industrial enterprises, and the need for more investment and coordination to ensure their effective development and use.

Further evidence gathering conducted by the EGTI allowed a deeper dive in some countries to observe how they have, or are in the process to, set up a kind of road-mapping process to identify the current and future needs for TIs by industrial users:

- For instance, in Finland, the project INNOVATE[18] is mapping out all RIs and TIs in Finland. Interviews are organised with business representatives as part of mapping of the services of the infrastructures. SMEunited also conducts SME barometers twice a year, also focusing on cooperation with educational and research institutions. It shows the efficiency of such collaborations to strengthen the knowledge base and competences of SMEs.
- In Sweden, an inventory of national and international testbed capacities has been established by RISE. It led to an overview of the international testbed landscape available for Swedish enterprises and a recommendation to establish an international support office to provide structured and ongoing support for the internationalisation of Swedish testbeds and collaborations with foreign testbeds.
- In Norway, catapult centres have been established in specific technology areas by consortia committed to offering services to enterprises to answer their user needs with services such as tests (short time testing to long time testing), industrial competence offerings from industrial experts and business guidance. A customer feedback on services offered has been filled out by nearly a 1000 enterprises, helping to assess and adapt the system.
- In Belgium, an online survey was used to provide a full view of how shared pilot facilities (open access research and demonstration facilities investing in a broad spectrum of state-of-the-art equipment and offering required expertise with the aim to help innovative enterprises scale-up their successful research to an actual industrial innovation) for industrial biotechnologies are perceived by users. It also looked upon user needs for TIs, barriers to access, the type of services needed now and in the future.
- In Portugal, a mapping process, including an online survey of national TIs and bodies has been conducted in 2024, taking into account the ongoing work from the European Commission and the EGTI, to identify the TIs that promote the development and dissemination of knowledge to the business fabric. An online survey was conducted with TI hosts and providers, looking at connections with industrial users and the private sector.
- In Denmark, 150 advanced, technology-based enterprises within the agricultural, food, construction or energy sectors answered a questionnaire on how they work with the development of new products, services or production processes for the green transition. More than half of the enterprises surveyed said that access to test, demonstration, and development facilities is crucial for their green transition efforts. Indeed, enterprises need access to such facilities to test and develop new technologies. There is a growing demand for full-scale testing (not only of individual components) in natural environments and for testing of system solutions. Enterprises

[18] INNOVATE | LAB.fi

declared increasingly needing to collaborate in open innovation networks to access the necessary expertise and facilities. It was found that the Danish innovation system faces challenges in meeting the demand for such facilities as it supports the creation if industrial test, demonstration and development facilities only to very limited extent and on ad hoc basis. It was recommended that the Danish government should invest in strengthening the GTS association (Danish Association of Research and Technology Organisation) institutes' role in providing access to those facilities. The need for such facilities is not limited to small enterprises; large enterprises with their own internal facilities also need access to these test, demonstration and development facilities, in which the testing by an external and impartial actor in conjunction with documentary evidence can be really beneficial.

7. Industrial user needs of Research Infrastructures

When analysing user needs for TIs, it is relevant to consider the needs of industrial users for Research Infrastructures. From the ESFRI reports published since 2023, four contain relevant messages: Landscape Analysis (2024), Report on Access to RIs (2024) and two Reports on Cooperation of ESFRI Landmarks with Industry (2023). In this context, the relevance of the ESFRI reports for TIs lies in the indication of existing gaps in services that are relevant for industry, degree of cooperation between RIs and industrial partners indicating to what extent the RI services are used by enterprises, as well as the challenges that RIs face when cooperating with industry.

7.1. ESFRI Landscape Analysis 2024[19]

The objective of the Landscape Analysis report is to identify existing synergies, complementarities, and gaps, and propose improvements on accessibility, networking, clustering, associating and potential merging of European, national and regional RIs, and their deeper integration in a fully functional and interoperable European RI ecosystem. The report covers six ESFRI domains,[20] providing some examples of services available at ESFRI RIs. The services that are mostly relevant for industry are found in RIs in physics (mostly analytical facilities), health and food, energy as well as digital research infrastructures (high-performance computers). In particular, in the field of energy, the document notes high relevance of the services for industry of ESFRI RIs, and thus their potential significant synergies with TIs. Specific services mentioned, include among others:

- material analysis and characterisation,
- outdoor test facility for solar energy,
- tools for designing, screening and optimizing candidate drugs,
- expertise and tools for industrial biotechnology,
- data storage, processing and access services,
- computing services,
- community building and market intelligence in carbon capture and storage,
- offshore renewable energy systems.

The ESFRI Landscape Analysis also identifies the existing trends and gaps in services. Some of these gaps are also relevant for industrial users. In particular, in the field of energy a lower number of ESFRI RIs is noted, pointing to a lower level of integration of RIs at EU level in this field. The specific areas where RI and TI gaps were identified include electrification, energy production and

[19] landscape2024.esfri.eu
[20] Physical sciences and engineering, Environment, Health and Food, Energy, Social and Cultural Innovation, and Data, Computing and Digital RIs.

storage (including hydrogen production) and synthetic fuels. ESFRI advocates that this gap needs to be addressed with a 'vigorous' programme for RIs and TIs to address existing needs.

In the Health and Food domain, multiple RIs are of potential relevance for industry, in particular in industrial biotechnology, plant genetics and phenotyping, RIs supporting clinical research and therapeutic development. With currently little support of governments for use of these RIs by enterprises, ESFRI report suggests that they develop a business model dedicated to services to the private sector. In the Health and Food domain, a number of specific infrastructure gaps were identified, including in animal farming or enabling multinational clinical trials.

RIs in physical sciences, in particular different types of analytical facilities, offer services of high relevance for industry, for example for new materials development, testing and analysis of their properties, or for medical instrumentation and development of treatments and therapies (e.g. cancer). However, for the moment, collaboration with industry constitutes a small but growing fraction of activities of these infrastructures.

Taken into account the specificities of the three domains, and the relevance of RIs in this area for the private sector, there is a strong potential for synergies and collaboration with TIs.

7.2. Reports on cooperation of ESFRI RIs with industry

ESFRI published two reports on cooperation of the ESFRI Landmarks with industry. The first report, based on a survey of ESFRI Landmarks[21] conducted in 2022 found that for all but one European Research Infrastructure Consortium (ERIC) (96%) and for over 80% of national entities, collaboration with industry constitutes less than 10% of total revenue. However, 73% of them declared that their 'equipment, services or data are accessible through test beds, pilot lines, demonstrators and testing facilities', which arguably could be seen as more akin to TIs.

Specific barriers to cooperation with industry that were found include different goals and expectations, administrative and legal burdens, access rules and IPR issues.

Some RIs also expressed a view on the need for TIs. Some of them were positive, underlining the relevance of TIs for industry and for supporting industrial competitiveness. Many pointed out to the need for better defining TIs, especially in relation to RIs and to better their interactions, especially at the level of the RI and TI hosting organisations.

The second report, based on the survey of enterprises[22] reached through a network of Industry Contact Officers/Industry Liaison Officers based at RIs, established through the ENRIITC project[23], gives significant insights into the type of RI services used by enterprises and the barriers experienced. Overall, 92% of survey respondents (145 out of 157) confirmed they collaborate with RIs. Approximately one third of users indicated that cooperation was required to accelerate their business and deliver on their strategy, whereas a quarter stated that cooperation with RIs was not strategically planned and was ad hoc when the need for specific services required the RI use.

53% of the respondents indicated that they cooperate with RIs several times per year, while only 4% reported a one-off cooperation. Access to facilities was the most frequently identified type of service at RIs that enterprises mentioned (55%). Full service (e.g. support in sample preparation, data analyses, interpretation, etc.) were indicated by 35% and nearly a quarter of respondents identified access to data or collection as an offered service.

In terms of identified barriers for cooperation with RIs, only 11% of the respondents stated that there were no barriers. Nearly half of the respondents highlighted a lack of financial resources (53%) and a lack of staff on the company side (49%) as the main barriers. Other barriers include legal issues (e.g. IPR), response time, and lack of available technical personnel at the RI.

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[21] Cooperation of ESFRI Research Infrastructures (Landmarks) with Industry | www.esfri.eu
[22] Survey Report on Cooperation of ESFRI Research Infrastructures (Landmarks) with Industry | www.esfri.eu
[23] European Network of Research Infrastructures & IndusTry for Collaboration | ENRIITC | Project | News & Multimedia | H2020 | CORDIS | European Commission

It is noticeable that the barriers to accessing RIs identified in the ESFRI report are consistent with the barriers reported by enterprises with regard to access to TIs, as stated in Chapter 2.

7.3. ESFRI Report on Access to Research Infrastructures and Charter on Access to RIs[24]

The Report on Access takes stock of the types of access, modes of access, main users and access plans and policies. It also identifies barriers and challenges for a broad and effective access to RIs, covers selected specific issues and discusses a way forward. It is based on a consultation of RIs themselves and a number of stakeholders. However, very few inputs were gathered from RI users and none from industrial users. Due to this, the report does not refer to the existing demand for access to RIs.

On the supply side, only around 17% of access is market driven (paid), with no information on the share of the private sector. At the same time, ESFRI RIs express willingness to engage more in collaborations with industry. The report notes however, that most RIs are set up to work with expert users, while increasing the share of industry users, who typically have much less experience in working with RIs, require more intensive and professionalised support. It would also require integrating a quality management culture into the research infrastructure that will standardise the protocols and procedures and guarantee the same level of quality of service. These changes would, therefore, demand significant changes in the priorities of the RI and require considerable additional funds. In addition, RIs have typically little experience in IPR management, in particular shared IPR, which is an important issue when establishing collaborations with industry.

8. Conclusion

The analysis presented in this report draws upon a number of different sources of information, resulting both from direct engagements with enterprises on their needs for TIs and the barriers they experience, as well as the examination of strategic documents outlining the technology development directions in selected industrial ecosystems. The main conclusions across all the inputs are highly consistent.

First, an important role of TI in supporting innovation and technology development activities is broadly recognised and enterprises across different sectors and technology areas are interested to engage in collaboration with TIs.

Second, while the need for support from TIs is expressed by enterprises of all sizes, from start-ups to very large corporations, the barriers to such collaboration significantly differ. For smaller enterprises they are mostly related to lack of resources and insufficient awareness of how TI can support them, while for larger enterprises they lie more in the location and adequacy of TI facilities and services. Moreover, the barriers to access to TIs are very similar to those reported to RIs, hence it would be optimal that any activities aimed at mitigating these barriers, cover both RIs and TIs.

Third, the perceived availability of TIs varies significantly across sectors and technology areas. For example, in the area of heat pumps, geothermal energy and solar energy technologies, less than 30% of enterprises which plan to use these technologies reported a lack of available TIs (though barriers to access them still persist). At the same time, a very substantial share of enterprises reported insufficient availability of TIs for their future development needs for electrolysers (90%), micro/nano electronics and photonics (71%) and carbon capture and storage technologies (70%).

[24] ESFRI Report on Access to Research Infrastructures and Charter on Access to RIs | www.esfri.eu

Fourth, this report confirms the relevance of the broad approach to the identification of user needs that allows to combine direct insights from enterprises with the broader perspective on the needs of technology development. It also demonstrates the interest of enterprises to engage with policy makers on their specific needs in relation to TI services in their sector or technology area. It also shows the potential of engagement with organised industrial communities, such as European partnerships, technology platforms or industrial associations to design policy actions best suited to the needs of the users.

Finally, this analysis points already in some specific directions where sectoral initiatives on TIs could have the most significant impact and could be used for designing first policy actions in areas strategic for the EU, especially if these findings are corroborated by additional sources of information. At horizontal level it clearly demonstrates the need for policy action to improve the accessibility of TIs, as such action promise to have high impact that could be quickly achieved.

Annexes – Additional information from the survey addressed to enterprises

Annex 1 – Other industrial ecosystems identified by respondents

When answering Question 7 (*What is your enterprise's primary industrial ecosystem(s)?)*, 72 enterprises chose "Other" as an option. The table below lists all received answers under this category.

3D printing	Industrial Bioeconomy	Raw materials
Agricultural technologies and machinery	Industrial automation / control drive technologies	Roads & railways
Automotive, medical, pharma, food, packaging, dispensing, agri, etc.	Industry tools and machines	Semiconductors
B2B product development and special engineering	Machine and plant engineering / Machine building	Shipbuilding
Business valuation and modelling	Maritime	Software, Information Technologies, Big Data, Manufacturing, Machining
Cybersecurity	Mechanical and plant engineering	Supply/Survey of critical metals, ore and industrial minerals, Carbon-storage (CCS), climate change and water resources.

Chemical manufacturing / chemical industries	Metal machining industry / metal parts manufacturing	Superconductors
Cross-market (especially production and logistics)	Mining equipment	Support to innovation
Forest industry	Mouldmaking and injection moulding	Surface engineering
High tech advisory services	Nuclear / nuclear energy	Sustainable bio-products from natural sources
High tech systems & materials	Outdoor activity equipment	Transit, tour, and intercity buses
HPC, AI, Data Analytics	Plastics	Turn-key hot rolling mill plants
Home appliances	Power line monitoring	Watch industry
ICT	Production of biocarbon to replace fossil reductants in metallurgical industry	Water and sewage

Annex 2 – Other technologies highlighted by respondents

When answering Question 8 (Which technologies does your enterprise currently use in its production processes?) some respondents chose “Other” as an option. The table below lists all received answers under this category.

Aeronautics and space/satellites	Tier-0 computing centres	Particle accelerators
AI: new approaches, methodology and use of artificial intelligence for business assessment and monitoring	Digital health	Plant protection products
Agriculture: precision agriculture	Drones	Plasma chemistry technologies (incl. Chemical characterisation of materials and fluids)

Agricultural robotic systems	Electro discharge machining (die sinking-edm & wire-edm)	Pyrolysis of various wood sidestreams for biochar
Healthy animal production	Fineblanking	Regenerative production of bio-based materials
Automated assembly	Grid technology for monitoring and utilisation of unused capacity in the power grid	Software development tools
Bluetooth connectivity	Heat pumps and geothermal energy	Stamping
Carbon composites	Hydro power in river and ocean streams	Structural materials (lightweight)
Chemical engineering technologies	Industrial biotechnology	Sustainable cities and territories of tomorrow
Chemical specialties - heterogeneous catalysts	Lifting equipment	Rubber & plastic technologies
CNC machining and additive manufacturing of welding	Next generation sequencing	Telecommunications
Coatings technology and application	Nuclear fusion	Weaving machines
Complex casting processes	Oil refineries	

Annex 3 – Other technologies in the future R&D&I plans of enterprises

When answering Question 8 (*Which technologies does your enterprise currently use in its production processes?*) some respondents answered "***other"*** technologies that, in their opinion, will be at the core of enterprises competitive development in the next two years. The table below lists all received answers under this category. Please note that technologies that were mentioned by more than one respondents are marked with * and that some technologies may relate to technologies areas that were selectable (when it was the case, the data presented in figure 4 was corrected accordingly).

Aeronautics and space/satellites
Biotechnologies
Bluetooth technology
Coating and interface technology*
Design for re-use and remanufacturing (Circular)
Development tools in general, like MBSE or other digital twinning technology
Digital health / eHealth*
Dielectric heating
Electrified vehicles, robotics, machine vision, autonomous systems
Energy efficient and low carbon Manufacturing
Extrusion, Coating*
Foam-based processing, waterless forming technologies, cellulose dissolution platform, composite materials, engineered wood products
Further development of formal methods (mathematics). Also in combination with AI.
Industrial biotechnology
Motion control and industrial automation
Next Generation Networks: 6G*
New radiation technology / particle accelerators*
Nuclear fusion and superconductors
Numerical simulation for dynamic mechanical analysis

Power Electronics and electrification in general.
Produce and test our new hydro power unit for rivers and ocean streams in full scale
Reliability services, application centres*
Smart valves
Supply of critical metals (for several of the above-mentioned technologies)*

In a related aspect, when answering Question 22 (*In the next 2 years, which are the technologies that are at the core of your existing competitive development (R&D&I) plans and therefore are considered as a priority area in which your enterprise needs to invest?*), some respondents also answered "***other"*** The table below lists all received answers under this category.

Maintenance & repair technologies
Formal methods (very important to create trustworthy cyber-physical systems
Any complex IT
Open datahubs
API gateways
Quantum telecommunications (i.e. QKD) and computing
AI enabling hardware capabilities (i.e. GPU) integrated in Telco cloud solutions)

Annex 4 – Reasons behind not using TIs

When answering Question 13 (*If you don't use any Technology Infrastructures, please explain why*), respondents gave the following answers.

"Not available or practical useable for the type of innovation and developments done"
"They are not available in our region or very difficult to access."
"We develop tools for our customers' infrastructures, based on industrial data and real-life use cases. We cannot afford to use data that is disconnected from reality."
"Resources and costs of POC"
"We use high-performance computing GPU processor infrastructure that is not available in TI."

“There’s no existing demo environments of latest recycling technologies here in [COUNTRY NAME] which would demonstrate industrial scale processes. Since waste exports are tightly controlled testing in other European countries isn’t easy and waste composition varies a lot country by country so foreign waste processing doesn’t give a realistic picture of capabilities of the latest technologies.”
“The TI does not have correct infrastructure for product development. Only TI for product verification in a system after completed development exists, and we don’t need that. Our technology is very new and innovative, and we are the only developer of fuel cell modules in our country and TI (catapult center) does not want to invest in infrastructure applicable to only one company.”
“[…] the TI is located in a developed region with high density of maritime enterprises […]. Our facilities are in a less developed region […] with few/none other enterprises to collaborate with on infrastructure. The TI setup does not work for district regions.”
“We did not find (yet) the technology infra structure we need to support our innovations”
“In my region there are a few of these (and if existing, not with open access).”
“Our enterprise is equipped with a high machine center […], featuring advanced technology engineering. However, our team faces challenges due to a lack of expertise in machine operation. 1. There have been cases where products have not met the required standards at the prototype stage. During the transfer of engineering designs to operators, several intermediate experts were involved, but the efforts did not achieve sufficient success. As a result, there has been a shift towards designing products that minimize the possibility of errors by operators. However, this approach has led to a decrease in product quality. 2. During the prototype or production stage of a project, there are often problems with timing and delay. These problems can arise due to various factors, such as unexpected disruptions in the design or production process. Another factor that can cause delays is the need to conduct certain tests abroad, which can lead to logistical difficulties and long delivery times. 3. It has been observed that enterprises suffer significant financial losses when the products they produce or sell fail to meet the required quality standards and are delayed in delivery to customers. Therefore, enterprises need to make sure that their products are of the highest quality and delivered to customers on time in order to avoid financial losses and maintain a positive reputation in the market. Therefore, operators and trainers are needed to use high-tech machines effectively.”
“not aware of any affordable and accessible TI for development of our software in near-business context”
“Majority of production is handcraft and to small”
“We have inhouse capabilities for testing and also use partners for testing, but I cannot tell from your website whether these are part of the TIs concept as the link to the download is not working.”
“because we don't know them”
“In […] there is no transparency about the costs of access to such TIs and if there is, the costs are way higher than private alternatives.”
“I do not have enough information about Technology Infrastructures.”
“in-house pilot available”
“We need to get regulatory approval before we can start using it.”

“They are too high tech”
“The development of new products is kept under a strict company confidential regime. Nothing leaves the company before the new products are mature.”
“Because I did not know about these or did not have the right information on how to contact them.”
“TIs is unfamiliar concept”
“We have primarily tested inhouse and at customer sites”
“Because we don’t have any production activities”
“Development in our sector need to take place in the production facilities”
“I didn't know it existed”
“unknown/unaware”
“Having own test infrastructure, for further testing we go directly in real environment”
“We have no information about them.”
“We are not aware of any current TI addressing the needs of SMRs.”
“I did not know at all about the TIs concept and available TIs for my enterprise.”
“No knowledge on available TI.”
“I was not aware about the existence of EU Technological Infrastructures with the exception of Catapult in the UK.”
“I don't know such thing exists.”
“We don't have those capabilities. Our partners may have them, but I don't know.”
“Lack of knowledge”
“Not aware of TI”

Annex 5 – A list of organisations considered as intermediaries mentioned by respondents

When answering Question 16 (*If you are using an agency, platform or other intermediary organisation(s), please specify which one(s).*), respondents gave the following answers.

Geographical coverage	Name of intermediary
European level	
	European Institute of Innovation & Technology (EIT) Urban Mobility ESRF CTIS (Clinical Trials Informaton System) IPIFF Pilot4u
Global level	
	Amazon AWS

	Google Cloud
National level	
Austria	Christian Doppler Forschungsgesellschaft (CDG)
Bulgaria	District information center – Vidin (for rising awareness about EU cohesion policy)
Denmark & Greenland	The Geological Survey of Denmark & Greenland (GEUS)
France	CEA
	CNR
	Tenerrdis
Germany	ATI Küste GmbH
	Fraunhofer (5G industry campus Europe)
	MCC Maritimes Consulting Center GmbH
	RWTH Aachen
Netherlands	Brainport Development
	BOM
	LIOF
	RVO
	TNO
Norway	IFE
	Inventas
	Kongsberg Technology Cluster
	Manufacturing Technology Norwegian Catapult Centre
	MultiConsult
	Norner
	Norsk Katapult
	Norwegian Defence Research Establishment
	SIVA (Proventia and Innoventus Sør from SIVA)
	VAAGER Innovation
Portugal	ANI
	APICCAPS
	IAPMEI
	University of Coimbra
	TICE.pt
Slovenia	TECES
	SiEnE
Spain	AEMPS

	AseBio
	Barcelona Supercomputing Center
	CENER
	Ciemat
	IHCantabira
	Tecnalia
Sweden	EuroFins
	NorConsult
	RISE / AstaZero
Turkey	Agrigenomics Hub (AgriGx)
	BUTGEM
	BUTEKOM Laboratories
	CopeTract
	Ekoteks Laboratories
	Rototip
	Technology Development Zones
United Kingdom	Compound Semiconductor Applications Catapult (CSAC)

Annex 6 – Additional comments from the survey participants

When answering Question 26 (*Do you have any other comments or recommendations with regard to industry or industrial users' (enterprises of all sizes) use of Technology Infrastructures?*), respondents gave the following answers.

“Focus and make choices. Rather a few good ones that can make a difference instead of trying to service all.”
“IP ownership is problem using co-development.”
“Dedicated direct option for funding of up-to-date or state-of-the-art analytical equipment and associated expert personnel.”
“Organisation of open days visits to TIs, or webinars to inform on capabilities of TIs.”
“Stop giving EU grants to importing Green energy and Blue Hydrogen.”
“Supporting the build up of consortia that are not dominated by the big enterprises”
“Make it easier to get R&D funding to cover part of the cost of using Technology Infrastructures. The funding need to go to the company buying the TI services, not directly to the TI facilities.”
“We must have access to elaborated process data.”
“TI are not designed for industrial users.”
“There should be incentives for universities to support SME's to grow and scale.”
“Technology infrastructure must have better way to grow the organizations”

“Focus on new technologies and hand on engineers, not only at bureau or lab. Building and machines facilities. Instead of pay a fee to attract young engineers.”
“Need for data sets and datahubs to be included in the Technology Infrastructures concept for R&D purpose.”
“Need for lasting R&D Technology Infrastructures and for the related stability in terms of security or sovereignty requirements and in terms of regulation.”
“Need for mutualised Technology Infrastructures provided by some European champions or ad-hoc consortiums, and for the related homogeneity across EU in terms of security or sovereignty requirements and in terms of regulation.”
“There is a gap between the identification of needs in the industry and how to use a TI to solve them.”
“TI cannot answer all needs for industrial technology development. They can be well adapted to generic pre-competitive development but not to competitive technologies that need to fit specific industrial conditions.”
“It is therefore of high importance to develop and maintain in parallel to TI, funding mechanisms for specific demonstration projects.”
“As a developer I will say that we have good help for the first steps in [….], but a huge hole in between first prototype until commercialization. Very difficult to raise fundings for realisation of the work we have done over the last years.”
“Recommend to fund the large technology clusters to establish relevant technology infrastructures like Innovations centres.”
“Provide sustainable funding for these facilities. We as an organization cannot start from scratch every time. We also notice that many consultants are hired by governments, which makes it difficult for us, since they are more or less market players who also work for other organizations and sometimes competitors of ours.”
“There could be more collaboration in the use of large TIs (cost and risk sharing).”
“It seems TI values "collaboration" and "industry funding" to such high degree that it is impossible for enterprises located in remote districts to be heard when it comes to which infrastructure is needed and where it should be located. All TI seems to be established in already highly developed districts. The big enterprises with good economy (who might not actually need it) gets the highest benefits from TI. The SME gets low benefits from TI.”
“Focus on proof of concept”
“If financing the creation of new TIs, please set conditions rewarding the access by SMEs.”
“European’s chemical industry is largely fossil based and advanced materials like high performance plastics are commonly not recycled. While fundamental research over the last decades has proven the basic feasibility of approaches for material recycling and for building advanced materials from biobased sources the use of most of these technologies has not reached large scale commercialization. The reasons for this are manifold and include the lack of suitable pre-sorted waste streams for material recycling. Most importantly easy access to pilot facilities is lacking and the considerable investment needed for chemistry related pilot facilities turns out to be cost prohibitive for achieving higher technology readiness levels (TRL). The capability to provide pilot quantities of sustainably produced chemical products is crucial for the market introduction, since potential customers must test these at pilot scale first to ensure that all application requirements are met, and harmful side products can be excluded. Only through synthesis at pilot scale, reliable data for yield and purity can be generated. Thus, production cost estimates for business case calculation become more reliable.”

“Providing technical infrastructure for scaling-up chemical processes necessary for the sustainable transformation of the chemical industry will be essential for bringing new technologies from lab scale proof-of-concept towards higher TRLs and finally, successful large-scale commercialization. The availability of piloting facilities will help enterprises to speed up their development times, since no time is needed for planning and building pilot reactors. Thus, enterprises can become more competitive.”
“Increase international infrastructure system, avoid too large ineffective consortia, avoid overlap of funding eg national/regional/EU, increase involvement of large EU corporates and investment/funding ecosystem in technology infrastructure systems, improve ability to identify and access appropriate TI at the right time with clarity on services and costs upfront.”
“Data transfer and data storage. Data retention policy, data user access and the identity of different types of data (levels of confidentiality)”
“Accessibility and Affordability: For many small and medium-sized enterprises (SMEs) in […], the cost of accessing advanced Technology Infrastructures, such as pilot lines, testing facilities, or simulation labs, is often prohibitive. To foster innovation across all business sizes, there should be more programs that offer affordable or subsidized access to these resources. In addition, the government should provide an accreditation and certification process in the field of Advanced Manufacturing and Processing.”
“Training and Upskilling Programs: Enterprises, particularly those adopting advanced manufacturing technologies, often face a skills gap. Technology Infrastructures should offer comprehensive training programs and hands-on workshops to upskill employees, operators, and engineers. This would not only boost productivity but also ensure the workforce is prepared to operate cutting-edge technology effectively. It would be beneficial if these programs were offered at various levels, from beginner to advanced, with the knowledge and technology transfers.”
“Is there an information somewhere to view all existing IT in Europe?”
“The importance of simulations is growing”
“Possibility to the private partners to get a support if they want to share their own Technology Infrastructure and/or to have a second hand and/or cross sectorial market when pilot or demonstrators have been developed and could serve other R&I industries.”
“Whatever is proven, developed or tested in TI, needs to be easily transferrable to a production environment which is outside of the TI.”
“Not every SME is familiar with it or has resources available to invest in cooperation with it”
“We're out of control due the vertical organizations build and lack instant feedback”
“Offshore testing infrastructure simply is too expensive.”
“More X-fertilisation between enterprises on ideas and needs and cooperation”
“Living labs! go for living labs, these have potential !”
“There is no active (or too less) relationship between the TI and OEM's of food equipment”
“This is highly needed but the ecosystem is not aware of it, specifically start-ups that lack resources to pay such infrastructures.”
“Lack of continued funding to support enterprises in developing new business areas.”
“The funding for the TI activities is crucial for a better service to the industry.”
“We are extremely satisfied with the TI in […]. Located close to us, they have offered easy access to technology and knowledge crucial for our SMBs development and growth.”

“We are very happy with the effective support we received. It was easy to apply, no bureaucracy, quick answers, and service minded contact persons.”
“Currently funding only consider SMEs.”
“The document summing up the TI is good starting point. However, a study on the impact and added value to the European community of the existent TI should be made so that we can know what health products were developed with the support of these specialized expertise and capacity. A website joining all the TI available by sector (health, energy, ..) should be developed and disseminated among all the innovation players in EU.”
“Yes, ask directly enterprises what they need and not a government agency.”
“Involve high tech enterprises as consultants to better manage the TI.”
“More flexibility”
“TI (RTO, labs etc) are not willing enough to be coordinator of HORIZON projects.”
“Suggestions/recommendations to improve the use of IT by industrial users of all sizes: 1 Accessibility and Affordability: Ensure TIs are accessible to enterprises of all sizes, particularly startups and SMEs, by offering tiered pricing structures and subsidized access for early-stage enterprises. High costs often exclude smaller enterprises. 2 Transparency in Selection Processes: Reform application and selection processes for using TIs to ensure fairness. Programmes must be transparent, merit-based, and not disproportionately favour large corporations. 3 Tailored Support for Startups and SMEs: Offer specialised services for startups and smaller enterprises, such as hands-on technical support, training programs, and simplified access to prototyping and testing facilities. 4 Real-World Pilots: Provide genuine pilot opportunities that benefit enterprises of all sizes, ensuring startups and SMEs can test their solutions in realistic environments without being overshadowed by larger players. 5 Cross-Sector Collaboration: Facilitate partnerships between startups, SMEs, large enterprises, and academic institutions. Collaborative projects should be encouraged, with clear structures to ensure equitable benefits. 6 Streamlined Processes: Reduce administrative burdens for accessing TIs, particularly for smaller enterprises with limited resources. Simplified application and reporting procedures can make TIs more approachable. 7 Outcome-Driven Metrics: Evaluate the success of TIs based on tangible outcomes, such as the number of startups scaling successfully or the diversity of enterprises benefitting, rather than metrics that may favour larger enterprises (e.g., total revenue or funding raised). 8 Promotion of Inclusivity: Actively address imbalances in industry access, ensuring underrepresented sectors, regions, or smaller players are included and supported. 9 Feedback

To truly hear from startups as end beneficiaries, gathering fully transparent feedback would enable the measurement of objectives like accessibility, effectiveness, inclusivity, and the real-world impact of Technology Infrastructures, ensuring they deliver meaningful outcomes for smaller enterprises

Annex 7 – Questionnaire of the survey on the user needs for Technology Infrastructures

Enterprises were invited to complete this short survey and to share their awareness about and/or experience with TIs as well as their views about how the needs of enterprises could be addressed by TIs. The questions were organized in a section about enterprises themselves (Q1 to Q10; and Q27-28), a section about their uses of TIS (Q11 to Q26). Some complementary explanatory texts were included but are not copied in this Annex for the sake of conciseness and clarity. When questions number are underlined, those were not compulsory to answer.

Q1 – How big is your enterprise?

- We consider ourselves a start-up and/or our enterprise has less than 5 years of experience of operations
- We are an SME (up to 250 employees)
- We have up to 500 employees
- We have up to 1000 employees
- We have between 1000 and 3000 employees
- We have more than 3000 employees

Q2 – How do your organise your Research, Development and Innovation (R&D&I) activities? *(Several options)*

- We have an internal R&D&I department and perform the majority of our R&D&I in-house
- We have an internal R&D&I department and outsource the majority of our R&D&I work
- We only have a R&D&I coordinator/manager and thus outsource all of our R&D&I work
- Other (please specify)

Q3 – In which EU Member State(s) do you carry out most of your R&D&I activities? *(Several options)*

Q4 – If your head office is located in a country which has a clear regional structure (e.g. Belgium, France, Germany, etc.), please indicate in which region do you carry out most of your R&D&I activities *(Free field with request to use NUTS2 classification if possible)*

Q5 – Which of the following markets are your current target markets? *(Several options)*

- A domestic (local) market
- A domestic (national) market
- A regional EU market (i.e. in a geographic area comprising few EU member states)
- The whole EU market
- A global market

Q6 – Among those markets, which one is your primary target market?

- A domestic (local) market
- A domestic (national) market
- A regional EU market (i.e. in a geographic area comprising few EU member states)
- The whole EU market
- A global market

Q7 – What is your enterprise's primary industrial ecosystem(s)? *(Several options)*

- Aerospace and defence

- Agri-food
- Construction
- Cultural and creative industries
- Digital
- Electronics
- Energy intensive industries
- Energy-renewables
- Health
- Mobility – transport – automotive
- Proximity
- Social economy and civil security
- Retail
- Textile and tourism
- If you think that your enterprise does not fit in any of those categories, please specify

Q8 – Which technologies does your enterprise currently use in its production processes? *(Several options)*

- Advanced manufacturing and processing: Additive manufacturing, Autonomous systems, Sensor technology, Industry 4.0 ,
- Advanced (nano)materials : Biomaterials, 3D printing and design, Chemicals, polymers, metals, glass, rapid prototyping
- Life-science technologies: Neurotechnology, Bioengineering, AI in biology and biotechnologies, bioelectronics, Medical engineering
- Micro/nano-electronics and photonics: Integrated circuit design, quantum computing and technologies, IoT sensors and tokens, high performance computing
- Artificial intelligence: Deep learning, Quantum AI, Robotics, Autonomous systems, AI-as-a-service
- Security and connectivity technologies: Standards (5G, SigFoc, etc.), network architectures, cryptography, IoT networks and protocols, distributed ledgers
- Robotics and Autonomous systems
- Recycling technologies
- Solar photovoltaic and solar thermal technologies
- Onshore wind and offshore renewable energy
- Batteries and storage
- Heat pumps and geothermal energy
- Electrolysers and fuel cell
- Sustainable biogas/biomethane
- Carbon capture and storage (CCS)
- Grid technologies (which also include electric vehicles smart and fast charging)
- Sustainable alternative fuels technologies
- Advanced technologies to produce energy from nuclear processes with minimal waste from the fuel cycle
- Small modular reactors
- Space and propulsion technologies
- If you think that your technologies do not fit in any of those categories, please specify

Q9 – In the next 2 years, does your enterprise plan to develop any new product, service or process?

- Yes, to a large extent
- Somewhat
- No
- Don’t know *(i.e. this is not your area of responsibility in the enterprise, and you do not know about future plans)*

Q10 – In the next 2 years, does your enterprise plan to develop any new technologies and/or upgrade them?

- Yes, to a large extent
- Somewhat
- No
- Don't know *(i.e. this is not your area of responsibility in the enterprise, and you don't know about the future plans)*

Q11 – How well are you aware about available Technology Infrastructures and their services that can support your technology development needs?

- To a large extent as I both know the concept and available TIs for my enterprise.
- I know some infrastructures that could fit the description of TIs as explained in this survey but did not know about the concept of TIs before.
- I know about the concept but I am not at all aware about available TIs for my enterprise.
- I did not know at all about the TIs concept and available TIs for my enterprise.

Q12 – For the development of a new product, service or process, technologies or methods, to what extent does your enterprise use Technology Infrastructures?

- To a large extent
- Somewhat
- Not at all
- Don't know *(i.e. this is not your area of responsibility in the enterprise, and you do not know about future plans)*

Q13 – If you don't use any Technology Infrastructures, please explain why, and then move directly to the question 19. If you use some, please move to the next question (Q 14) *(Free field)*

Q14 – If you are using Technology Infrastructures, what are the main reasons for using them? *(Matrix table with several options – see Figure 6)*

- To develop a new technology/method/product/process/solution our enterprise is working on
- To improve our enterprise's awareness and capabilities to use technology/new method
- To increase the competences to be able to adopt new technology and/or automate industrial production
- To develop a prototype
- To have a pilot/small-scale production or upgrade existing production line
- To test our product(s) and/or process(es) in an environment close to real life conditions (e.g. living lab context to scale up)
- To perform some tests on our product(s) manufacturing methods and/or process(es)
- To make our products and/or process(es) comply with standards, legal norms, or similar
- Other (Please specify)

Q15 – In what ways do you get access to (or wish to get access to) Technology Infrastructures? *Matrix table with several options – see Figure 8)*

- We have our own testing and scale up facilities
- We use the services of an agency, platform or other intermediary organisations to get access to needed facilities
- We get access to needed facilities through publicly supported schemes (e.g. using innovation vouchers or through a specific programme)
- We enter into collaborations with research organisations and/or universities hosting such facilities
- We procure research and technology services (research contracts) from specialised organisations and TI hosts, having access to such facilities through them

- We get access to external facilities on market terms for a fee
- We participate in collaborative projects financed by the EU, regional or national funds to have access to knowledge and facilities.
- Other (Please specify)

Q16 – If you are using an agency, platform or other intermediary organisation(s), please specify which one(s). *(Free field)*

Q17 – How often does your enterprise use (directly or through research organisations / universities / technology centres / intermediaries) Technology Infrastructures?

- Several times per year
- 1-3 times per year
- Less than once per year
- One-off use
- Not at all
- Other

Q18 – How much of your enterprise R&D&I activity is carried out within at least one Technology Infrastructure?

- More than 80 %
- Between 60 to 80%
- Between 40 and 60 %
- Between 20 and 40%
- Less than 20%
- None at all
- I do not know

Q19 – Where do you see the main barriers to use Technology Infrastructures? *(Several options)*

- Lack of financial resources
- Lack of staff within our enterprise
- Legal issues (IPR, for example)
- Fear of losing control over own R&D&I results and industrial secrets
- Lack of required expertise or support for area of technology needing to be addressed
- Untransparent or complex access conditions
- Geographical proximity of the appropriate TI for our enterprise
- Response time (i.e. we fear that using or cooperating with a Technology Infrastructure will not be quick enough for our needs)
- Not up-to-date or insufficiently modern equipment
- Lack of resources within TI to support industry/our enterprise
- Other barriers

Q20 – What would help your enterprise to increase your usage of Technology Infrastructures? *(Several options)*

- (Better) knowledge of/insight in offering of TIs (equipment, capabilities services)
- Geographical proximity of a TI with fitting offer (or help in using/collaborating with TI on further distance)
- Services from/cooperation with higher education institutions, related to technology development, testing and scaling up
- Training (development of skills)
- Funding to 'purchase' access to TIs
- A "One stop shop" access point (for TI and related services)
- Other

Q21 – In the next 2 years, what kind of support or services would your enterprise need to enhance its capabilities to innovate/develop its innovation(s) and technologies further? *Matrix table with several options – see Figure 11)*

- Support to develop a new technology/method/product/process/solution our enterprise is working on
- Support to improve our enterprise's awareness and capabilities to use technology/new method
- Support to increase the competences to be able to adopt new technology and/or automate industrial production
- Support to develop a prototype
- Support to have a pilot/small-scale production or upgrade existing production line
- Support to test our product(s) and/or process(es) in an environment close to real life conditions (e.g. living lab context to scale up)
- Support to perform some tests on our product(s) manufacturing methods and/or process(es)
- Support to make our products and/or process(es) comply with standards, legal norms, or similar
- Other (Please specify)

Q22 – In the next 2 years, which are the technologies that are at the core of your existing competitive development (R&D&I) plans and therefore are considered as a priority area in which your enterprise needs to invest? *(Several options from the same list as Q8)*

Q23 – According to your enterprise, which technology areas are currently lacking enough relevant Technology Infrastructures? *(Several options from the same list as Q8)*

Q24 – If you considered in the previous question that some technology areas are lacking relevant Technology Infrastructures, please tell us why? *(Respondents were also requested to specify for which technology areas they answer)*

- There are not enough Technology Infrastructures
- They are geographically not well located
- They are not updated to the state-of-the-art
- They are not relevant for the industrial needs
- The access for industrial users is too complicated
- Other

Q25 – What support (including access to technical facilities) or services would your enterprise currently need but cannot get at Technology Infrastructures? (*Free field)*

Q26 – Do you have any other comments or recommendations with regard to industry or industrial users' (enterprises of all sizes) use of Technology Infrastructures? (*Free field)*

Q27 – Would you agree to give us more information about your enterprise *(Table to fill)*

Q28 – Would you be willing to be contacted to discuss some of the questions / answers in more detail in an online interview? *(Table to fill)*

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This analytical report “User Needs for Technology Infrastructures” complements the Expert Group on Technology Infrastructures report “Towards a European Policy for Technology Infrastructures, Building Bridges to Competitiveness”.
The report gathers extensive evidence on user needs for TIs, presenting the findings of the Expert Group, mainly gathered through a public survey addressed to enterprises, as well as a comprehensive collection of inputs and analyses of other relevant bodies and initiatives.

Studies and reports

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