D3.2 – Target users' needs and profile

WP3 – Test Line upgrade & Long Term business strategy

Document Detail

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Survey privacy

Data reported in this document were collected from an online survey. By submitting the filled form, users consented to the collection and processing of their personal data for the purpose of managing communication with startups and SMEs. Data were handled in compliance with the GDPR (General Data). The Privacy Policy can be found here: http://bit.ly/3Clwb99.

1 General information on the potential user

The aim of this document is to analyse in deep the profile of the main users of the Open Innovation Test Bed (OITB), and consequently to understand and to implement a customization of the offer of scientific and technical services for every single category of user profile, to optimize innovation. In principle, the target users of the OITB are several, mainly across EU but also coming from area of the World rich of H_2 activities (North America, Asia, Australia), and can be categorized mainly in:

a. Hydrogen sector companies
b. SMEs rich of H_2 professionals
c. Individuals, teams, and institutions from academia
d. Research organizations
e. Local authorities and policy makers active in the green transition

The survey received a total of 14 valid responses (on December 17th 2024). Among the different categories of possible users, the survey resulted in the following share (Figure 1). It results that:

- Most respondents (93%) are companies/SMEs in the hydrogen domain.
- A small fraction (7%) comes from academia.
- The other categories are not represented by any user.

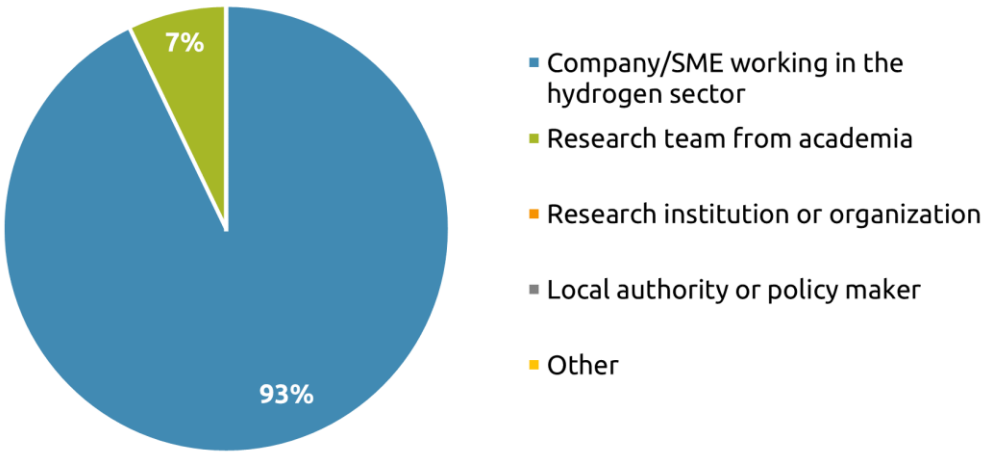

Figure 1. Share of potential users of the Test Lines.

Since H_2SHIFT prioritizes a collaborative approach, with incumbents (large industry players) and insurgents (startups and SMEs) cooperating with research centers and academy towards a solution that effectively works for launching and accelerating innovative hydrogen production technologies, with the aim of establishing and strengthening effective relationships among the diverse stakeholders in the ecosystem, then **the survey's results are in line with this major goal of the project**. Since SMEs and companies are likely focused on practical applications and commercialization of hydrogen technologies, **these outcomes suggest a strong industry-driven and final use-driven interest, coherently with the project ambition** of, among others, **scaling up** emerging hydrogen production technologies as defined in the Clean H_2 JU SRIA in a coordinated way.

The survey obtained a small but significant number of replies by potential users that represented the entire hydrogen value chain. A future survey can be re-organised in a mid-term of the project, widening the area of potential users in order to include more startups and SMEs companies.

2 Current activity of the potential user

2.1 Segment of the H_2 value chain

In terms of ongoing projects or current activities of the respondents, the entire hydrogen value chain was represented in the survey, as summarized in Figure 2. The entire value chain was subdivided into five main categories, namely:

a. Hydrogen production
b. Hydrogen storage
c. Hydrogen distribution
d. Hydrogen final uses
e. Other

Most of the potential users currently deal with **hydrogen production (36%)**, coherently with the **main focus of H₂SHIFT**. Hydrogen storage, distribution, and final uses cover almost evenly 52% of the answers (16%, 16%, and 20%, respectively). A non-negligible remaining portion of 12% represent other segments of the value chain, such as hydrogen purification, separation, detection, and analysis, with two thirds involving separation and purification.

While is expected that most of the interest on the platform should come from hydrogen production technology providers, an important percentage, 52%, represent hydrogen storage, distribution and final users technology providers. This result highlights a strong interest from the entire value chain and the need of this platform to accelerate the scale-up and industrialization of innovative technologies.

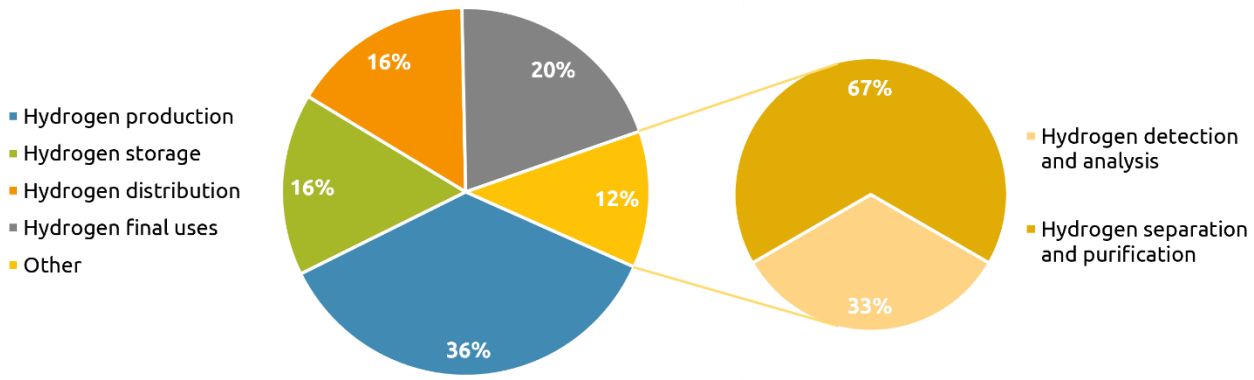

Figure 2. Share of the H_2 value chain segments, resulting from the survey.

Looking closer at the hydrogen production share in terms of current activities of the respondents, representing the focus of the project, the resulting share from the potential users is reported in Figure 3, also summarizing the options related to TL8 (technology upscaling services) and TL9 (non-technical services). The largest portions are the TL2 – Anion Exchange Membrane (AEM) electrolysis (21%), and the "other" (21%) options, not explicitly represented by the seven technical Test Lines 1-7. These latter alternative options, aggregated in the "other" category, include hydrogen production from dark fermentation and microbial electrolysis, Proton Exchange Membrane (PEM) electrolysis, ammonia, aluminum-water reaction, and hydrogen sulfide.

The remaining portions of the responses are shared, in decreasing order, among high-temperature electrolysis (17%), biogas reforming and/or biomethane cracking (12%), bioethanol reforming (4%), thermochemical water splitting (4%), and production in offshore environment (4%). No answers were recorded for TL6 photo-electro-catalytic hydrogen production (0%). TL8 – Technology upscaling services (including prototyping for industrial

scalability and computational modelling) covered 13% of the total share, while TL9 – Nontechnical services (techno-economic analysis; life cycle assessment; legal and regulation compliance; business development; professional mentorship) were represented by 4% of the answers.

In general, all the TLs resulted to be well represented (except for TL6), suggesting a wide interest in the services offered by the project framework in the hydrogen production sector through innovative and non-conventional technologies. The significant share of the "other" category (21%) suggests a strong interest from companies to explore alternative technological solutions for hydrogen production, distinct from those currently covered by the OITB. In the future, the number of the OITB test lines could expand to cover more technological options and widen the number of possible users.

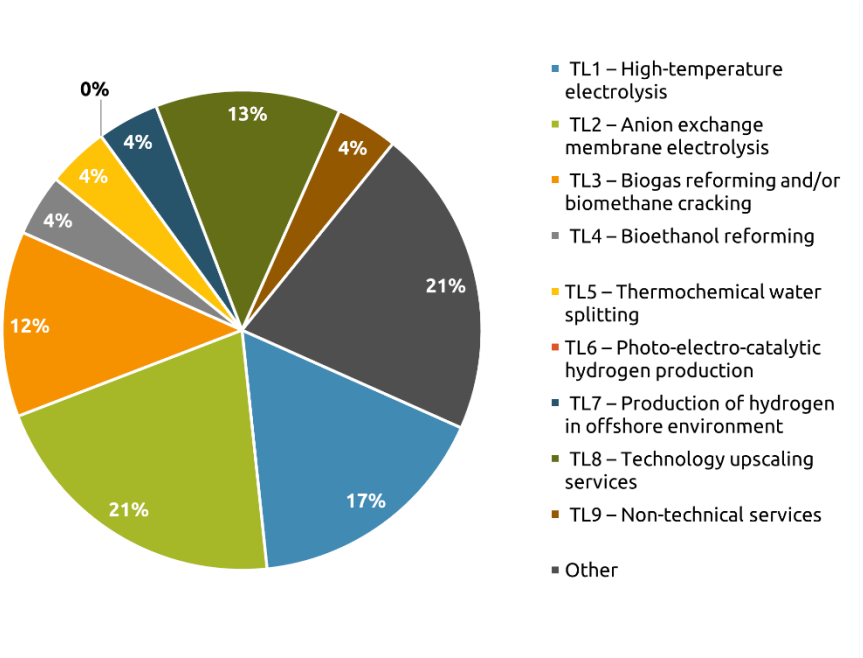

Figure 3. Share of the currently implemented hydrogen production technologies from the users, resulting from the survey.

2.2 Technology Readiness Level (TRL)

According to the EU classification, the TRL scale is as follows:

- TRL1 – Basic principles observed
- TRL2 – Technology concept formulated
- TRL3 – Experimental proof of concept
- TRL4 – Technology validated in lab
- TRL5 – Technology validated in relevant environment
- TRL6 – Technology demonstrated in relevant environment
- TRL7 – System prototype demonstration in operational environment
- TRL8 – System complete and qualified
- TRL9 – Actual system proven in operational environment

Figure 4 shows the distribution of the TRL for the current users' activities, as resulting from the survey. TRL1-2 were not reported (0%). A relatively large share of 33% is represented by TRL3, TRL4, and TRL5 (11% each), spanning from technologies that are being developed in laboratory up to successful validation in a relevant environment. These intermediate levels are typical of lab-scale activities and could be associated to applied academic research, as well as to SMEs or startups addressing technological development of innovative solutions.

TRL6-7 are covered by a 58% share (28% each), representing the largest portion among the potential users. Finally, TRL8-9 were indicated by 11% of the respondents overall.

The resulting share suggests that there is a wide interest in the H_2SHIFT services at the demonstrative level (TRL6-7), that is the most represented part. These levels of readiness are typically the transitioning stages between applied research in academic context, and scale-up development of a given technology, and constitute a target of utmost importance for the H_2SHIFT project goals.

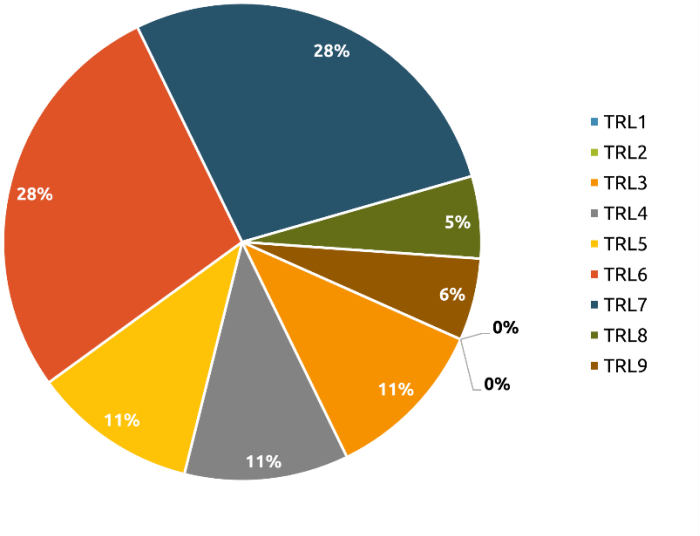

Figure 4. Share of the TRL of the current users' activities related to the hydrogen sector.

On the other hand, Figure 5 shows the distribution of the TRL for the planned activities involving the use of the lab services provided by H_2SHIFT, as answered by the respondents. The planned share does not differ much from Figure 4, with TRL6-7 still covering the largest portion of the requests (50%). Once more, it seems that validation and demonstration of innovative technologies in relevant and operational environments mainly drives the interest of the potential users.

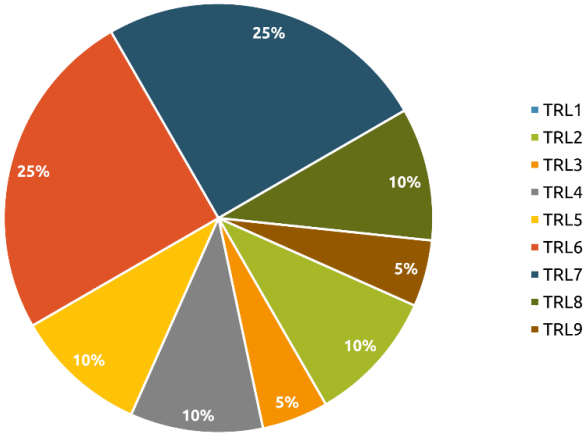

Figure 5. Share of the TRL of the planned users' activities related to the hydrogen sector, using H2SHIFT lab services.

3 Planned activity of the potential user

3.1 Technical Test Lines (TLs 1–7) of interest

In terms of experimental test benches of interest to be used by the potential users (i.e., TLs 1–7), the resulting share is shown in Figure 6. As can be seen, the interest is quite evenly spread over the seven technical TLs, except for TL4 (bioethanol reforming), not indicated so far by any respondent. This homogeneous share suggests that all the proposed innovative hydrogen production technologies could benefit from the project services in terms of investigation, development, and upscaling.

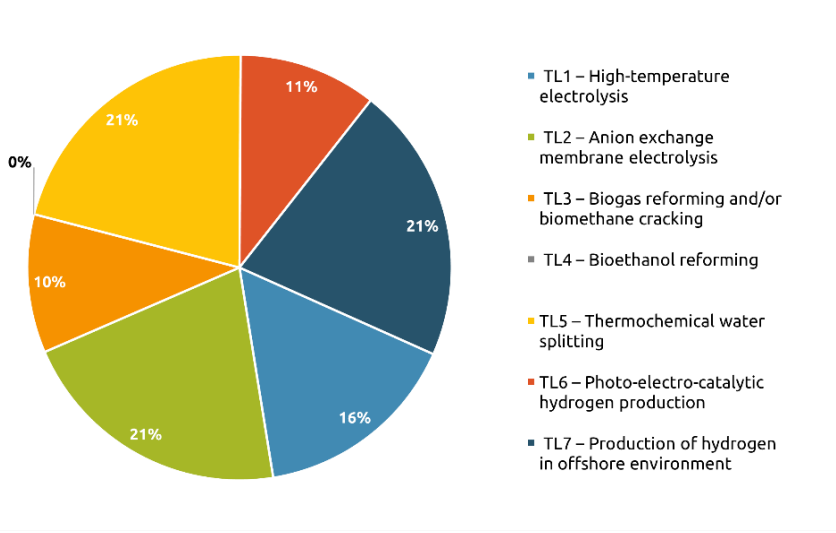

Figure 6. Share of the potential users' interest in using H2SHIFT experimental test benches (technical TLs 1–7).

3.2 Experimental tests of interest

In terms of use of the technical TLs, the survey also revealed which kind of experimental activity would be of interest to be developed for the potential users. The possible typologies of experimental tests were categorized as follows:

1. Stationary tests (i.e., fixed, steady operating conditions)
2. Dynamic/transient tests (i.e., time-dependent, or cyclic operating conditions)
3. Exploratory or preliminary tests (e.g., on new materials, components, etc.)
4. Stability/durability/long-duration tests (e.g., to assess the materials or component's reliability and stability over time, or the long-term performance of the process under investigation)
5. KPI evaluation/performance/efficiency/optimization/parametric tests (e.g., tuning operational parameters of a known process in order to optimize the operating conditions for maximizing the efficiency or other specific KPIs of interest)
6. Safety or stress tolerance tests (e.g., tests in particularly stressing conditions, such as high temperatures or high pressures)
7. Material/component-gas atmosphere interactions tests (e.g., to test the given material or component resistance and/or compatibility within certain gas atmospheres, or degradation phenomena, or similar)
8. Accelerated aging tests
9. Scalability or reproducibility tests (e.g., to check whether previous small-scale results can be scaled and/or reproduced in up-scaled components or systems)
10. Tests for assessing the effect or impact of contaminants and/or impurities

11. Technology validation/demonstration tests (e.g., at relatively high TRLs)
12. Tests aimed at model validation
13. Other

The information related to the users' need in terms of potential experimental tests is gathered in Figure 7, where the same numbering reported in the list above is used. The most represented category is the one involving stability/durability/long-duration tests (category 4, 28%), followed by the category including KPI evaluation/performance/efficiency/optimization/parametric tests (category 5, 18%). Categories 3, 8, 9, 10, and 12 were not represented so far (0%). The remaining options share potential users' interests evenly, with 9% each.

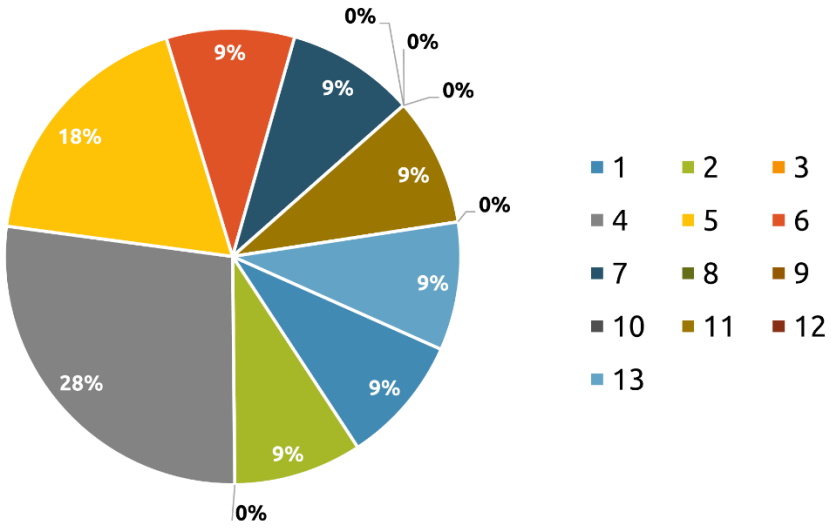

Figure 7. Share of the potential experimental activities of interest for the potential users, to be developed using technical TLs in H2SHIFT.

3.3 Size and scale for the planned experimental tests

The questionnaire gathered responses about the size of experimental facilities required by potential users for testing their technologies of interest. The results revealed that 70% of users have well-defined requirements in terms of hydrogen production rates and electric power demand, with specific values widely varying based on whether they aim to test individual parts or complete components. Additionally, among the users interested in testing fully assembled products or entire components, many provided detailed system specifications and space requirements (20% of the total responses).

The share for the dimensions of the technology to be tested, in terms of its physical boundaries and control volume considered, are summarized in Figure 8. The majority of the answers dealt with testing an entire component (e.g., a stack or a reactor). This is compatible with the planned TRL of interest, that showed a peak interest in the range TRL6-7 (technology and/or prototype demonstration). This is encompassing several TLs, such as TL3, 5, and 7.

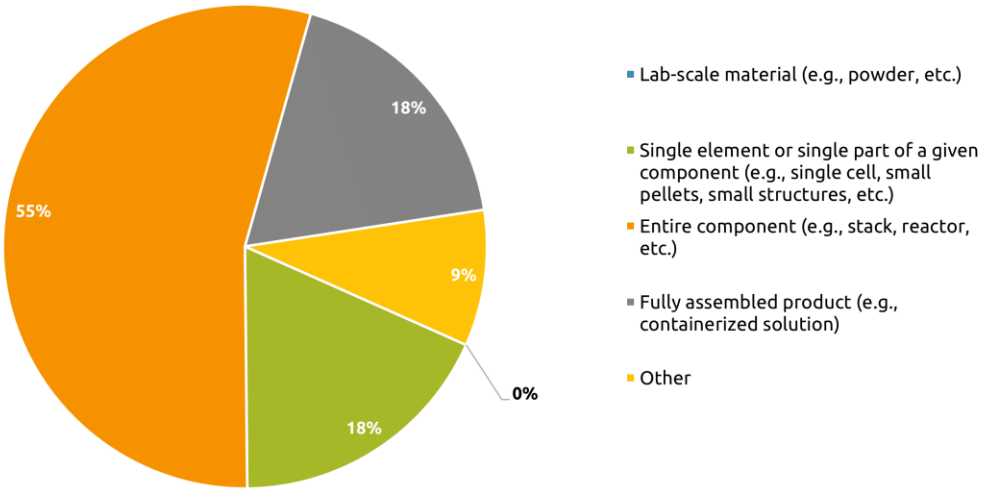

Figure 8. Size of the potential users' technology to be tested in the technical TLs of interest.

4 Expectations and support

The survey was also useful to have constructive feedbacks from the potential users regarding the expected support during the planned activities. This information was categorized according to the TLs groups – namely, technical services (TLs 1-7, i.e., experimental activity), technology upscaling services (TL8), and non-technical services (TL9).

4.1 Experimental activity

The potential support within the technical TLs framework was categorized as follows:

- Personnel training before starting
- Full support from the test line provider if maintenance on the test bench is needed
- Support from dedicated in-presence personnel during the test setup and/or operation
- Remote support from dedicated personnel during the test setup and/or operation
- Access to detailed technical documentation, equipment user's manuals, technical schemes
- Other

The resulting share from the survey is summarized in Figure 9. There is a predominance of requests for using the TLs with a certain degree of assistance from the provider (62% overall). In 23% of the requests, the experimental campaign for the user would be conducted entirely from the provider. Finally, a portion of 15% of the potential users would like to have full access to technical documentation, equipment user's manuals, and technical schemes, calling for a higher share in the user's direct role in running the proposed experiments. In general, both users and providers would be strongly involved in running the planned experimental campaigns.

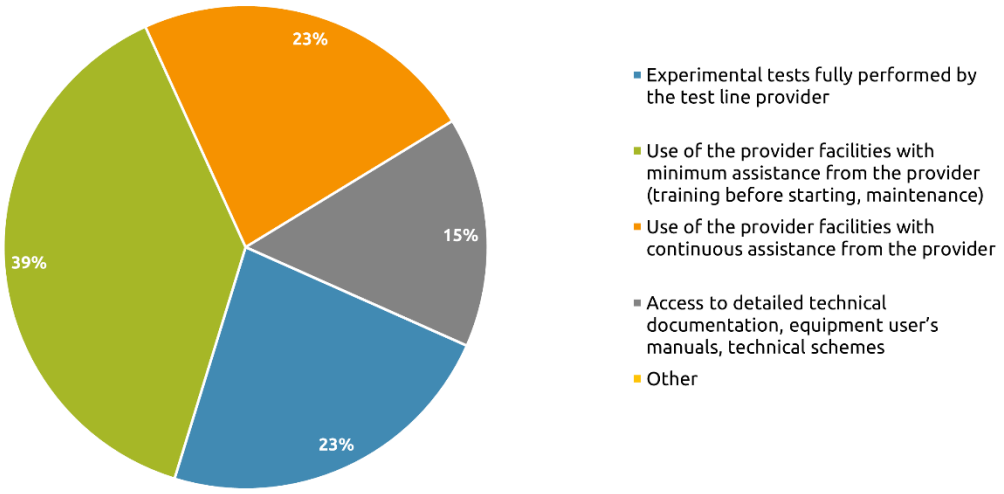

Figure 9. Share of expected support from the potential users during the experimental activity using the technical TLs 1-7.

4.2 Technology upscaling services

Concerning the expected support on technology upscaling services, the following categories were considered:

- Support and consultancy in multiscale and/or multiphysics and/or process-level computational modeling activities
- Support and consultancy for patent development and intellectual property protection
- Support and consultancy for technology transfer services
- Support in the prototype design and development
- Other

The expectations share from the respondents is shown in Figure 10, reporting quite evenly distributed expectations across the different services offered in the TL 8.

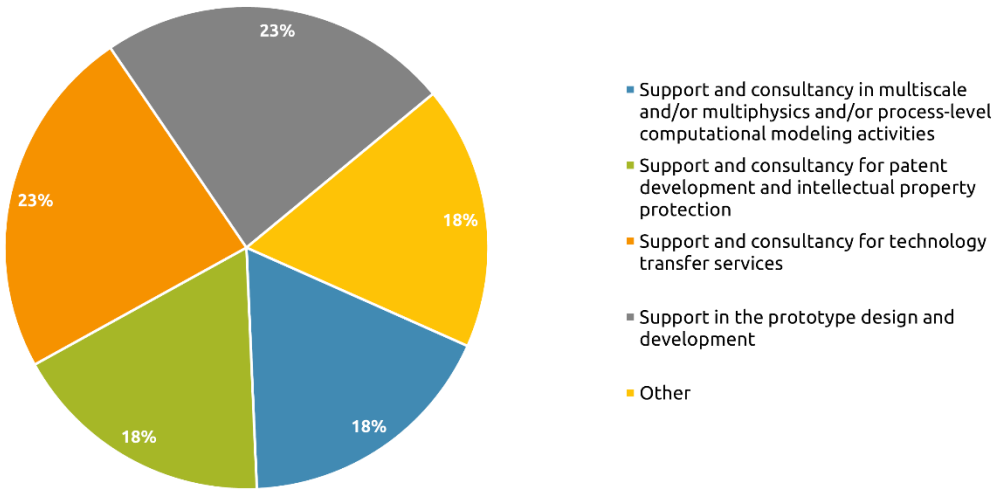

Figure 10. Share of expected support from the potential users for technology upscaling services using TL 8.

4.3 Non-technical services

In terms of non-technical services, the proposed categories were as follows:

- Techno-economic analysis
- Life cycle assessment
- Legal and regulation compliance
- Business development
- Professional mentorship

The share in terms of expected support for non-technical services (TL 9) is depicted in Figure 11. Most of the requests expressed interest for business development services (55%), followed by Life Cycle Assessment (LCA) services, and legal and regulation compliance services (18% each).

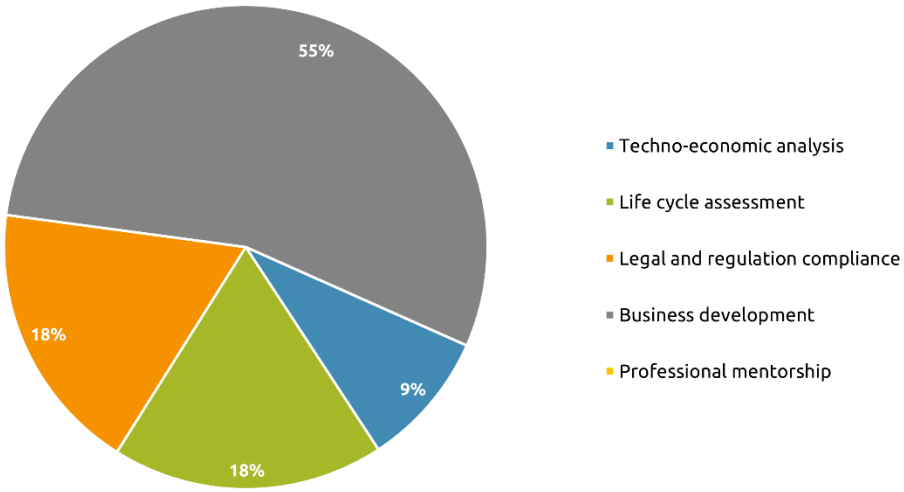

Figure 11. Share of expected support from the potential users for non-technical services using TL 9.

5 Conclusions

Through a dedicated online questionnaire, information on the profile of potential users of the Open Innovation Test Bed (OITB) have been collected. The results have been analyzed to understand user needs and to implement a customization of the offer of the scientific and technical services for every category of user profile.

The first release of the survey obtained a small but significant number of replies by potential users that represented the entire hydrogen value chain. Most of the potential users are active in the hydrogen production (36%), coherently with the main focus of H2SHIFT. The largest part of the respondents is active on Anion Exchange Membrane (AEM) and high-temperature electrolysis. The respondents are currently developing technologies mostly at TRL6-7 (58%). These results suggest that there could be a wide interest in the H_2SHIFT services at the demonstrative level. This is confirmed by the replies of respondents on the TRL of interest for using H_2SHIFT services, with TRL6-7 covering the largest portion of responses (50%).

In terms of experimental test benches of interest, the results show a homogeneous share of interest in all the test lines (except for TL4 - bioethanol reforming), suggesting that all the proposed innovative hydrogen production technologies could benefit from the project services in terms of investigation, development, and upscaling. The experimental activities most requested are stability/durability/long-duration tests (28%), followed by KPI evaluation/performance/efficiency/optimization/parametric tests (18%). The majority of the answers show interest in testing entire components (e.g., a stack or a reactor), in line with the target TRL6-7 declared by most of the potential users.

Regarding the support level anticipated by potential OITB users during activities, among the users interested in technical test lines, a majority of them (62%) expressed a preference for utilizing the TLs with some degree of assistance from the provider. Additionally, 23% indicated a preference for the experimental campaign to be fully managed by the TL provider. Concerning the expected support on technology upscaling services, responses are evenly distributed across the different services offered (modelling, prototype design and development, patent development and IPR protection, technology transfer services). In terms of non-technical services, most of the responders (55%) expressed interest for business development services.

Overall, the survey revealed that the primary interest of potential users in experimental services lies in the validation and demonstration of innovative technologies within relevant and operational environments, with a particular emphasis on long-term testing of complete components. Upscaling services also attract equal interest among users, while business development support is the most sought-after non-technical service.