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HP4All

Boosting demand for skilled Heat Pump professionals and end-user confidence.

HP4ALL

Index

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1 | Executive summary

The HP4All project is a 30-month project that began in September 2020 and lasted until February 2023. Throughout the project duration there were various phases of activities that were undertaken by the project partners, these include:

1. Market Analysis – analysis of the heat pump market in Europe and three pilot regions (Austria, Ireland and Spain). Taking into consideration the perspectives of different stakeholders all along the heat pump value chain, i.e., manufacturers, suppliers training providers, end users, system installers, and system designers.
2. Pilot Market Development – undertaking of pilot activities, awareness raising materials and training materials to boost heat pump skills and demand for high quality heat pump installations in the three pilot regions.
3. Replication Process – documentation on pilot activities undertaken and engagement with observer regions, knowledge transfer between regions and observer region market analysis. Other activities that can be classified as replication activities are the development of a Heat Pump skills and competency framework, a series of policy recommendations for increasing heat pump skills, as well as the implememtation of a HP4All replication plan and roadmap.

The HP4All project has developed the HP4All package, which is a set of innovative tools and resources.

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Breakdown of each of the pilot regions, stakeholders targeted, and key findings are listed below:

Irish Pilot

The Irish pilot has primarily focussed on local authorities and their respective heat pump installations, with a secondary focus on large-scale and private domestic heat pump installations. HP4All has delivered training to local authorities, in a first attempt to provide the staff that will be responsible for installations with the information they need. As a result, the main findings of the pilot were:

1. Customer/end-user handover is considered essential. In this sense, help and troubleshooting guides, forums are tremendously useful
2. There may be a need for a distinction between the heat pump system designer, the technician, and the plumber. Thus, leading to new trades and opportunities for less technical staff.
3. The public sector needs to lead the charge for the skills demand through tendering and procurement. This can create a snowball effect, resulting in higher quality installations and homes.
4. The plumbing apprenticeship must reflect the needs of the market and should include heat pumps as an integral part as they will become common place.
5. All heat pump courses in Ireland shall be coordinated and the minimum standard of course should be raised, as there is too much variation in courses.

Upper Austrian Pilot

The Upper Austrian pilot activities have mainly aimed , at developing the market for mid-/large-scale heat pump applications (commercial and industrial) in the region. Material was developed and activities were organised to overcome current challenges, namely low levels of awareness of promising application possibilities among planners and users, and the lack of required skills by planners and installers. Some of the findings for market transformation:

1. Policy packages such as incentives, regulation, awareness campaigns and innovation work synergistically (carrots, sticks, tambourines, and skateboards)
2. Market segmentation – know your market: different groups need different instruments!
3. Offer a range of technology portfolio, e.g., clean automatic bioenergy boilers, heat pumps, district heating from renewables and combined heat and power, energy efficiency.
4. Strong financial incentives: attractive, stable, and linked to strong efficiency criteria.
5. Energy advice services that are free, product-independent and offer reliable information help build trust and guide investment decisions.
6. Support market structures through training across the whole value chain, campaigns & networking of relevant companies.

Andalusian/Spanish Pilot

The pilot activities in Andalusia aimed at untapping the potential of the public sector as an outstanding driving demand force, as a public promoter and as a key market influencer through legislative, administrative, and financial initiatives. They have focussed primarily on public buildings (residential and non-residential) at local and regional level.

The pilot facilitated a more integrated approach using collaboration and dialogue among designers, manufacturers, and installers, all of them recognising that, so far, there was no dialogue happening. All of these aforementioned stakeholders are now more committed to reinforce, give visibility, and coordinate education, training, and upskilling / reskilling efforts, as well as, to provide a more coordinated and proactive approach in the heat pump sector. Another outcome of this pilot is that administrations are now more aware of the heat pump energy saving potential and are starting to include specific installation provisions in their social housing promotion planning and non-residential stock.

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2 | Introduction

HP4All brought together manufacturers, SMEs, installers etc) and the demand side (building owners, public sector etc.). This way, the project has enhanced, developed, and promoted the skills required for high quality, optimised heat pump installations within residential/non-residential buildings bringing Europe to the forefront of the climatisation sector.

The HP4All project has developed the HP4All package, which is a set of innovative tools and resources to be used by the different related stakeholders to help with replication of the success of the project in other regions. The package includes:

- **Piloted pilot activities, awareness, and training materials** – to engage key stakeholders to ensure high-quality Installations and greater uptake,
- A heat pump **competency framework** to facilitate mutual recognitions of heat pump skills across Europe and the construction sector,
- A digital heat pump **Knowledge Hub** to provide guidance, support and tools comprising technical information, case studies, and procurement guidance to increase the demand for heat pump skills and knowledge,
- a heat pump **Benchmarking Tool** enabling end users to consider options and performance of HP technologies within different building types.

3 | Market Analysis

From the very beginning, the **HP4All** project started reviewing the current best practice initiatives for increasing skills in the energy sector, evaluating the status of the market for heat pump skills in Europe via an online survey and finally carrying out a screening of the policy and legislation framework around Europe. For that, various actors along the value chain were engaged at an EU and national/regional level to ascertain their expectations, and needs, and identify relevant opportunities.

To review the best practice initiatives, information on state-of-the-art initiatives, projects, incentives, and policies was looked at in twelve European countries: Austria, Croatia, Finland, France, Germany, Italy, Ireland, Norway, Portugal, Romania, Spain, and Sweden. Below some findings and learning from this review can be found.

- Heat pump associations can act as a facilitator who can liaise between key stakeholders and use their networks to reach large audiences and professional bodies.
- The creation of energy networks of experts is proved to be a strong driving force for innovation.
- It is important to ensure training quality for energy professionals and installers by choosing the right training provider, continuously updating the curriculum, tailoring the training to the need of the audience, and ensuring that the training format is appropriate for the audience. Ensure the lasting impact of training programmes by developing suitable train-the-trainer materials.
- Training tools are a useful means of increasing awareness of near-zero energy buildings and, therefore, heat pumps.
- Monitoring and analysing the installed heat pumps' performance is necessary to avoid them performing poorly and not achieving the expected energy savings.
- It is important to keep any support initiatives simple and avoid excess paperwork and bureaucracy to ensure wide uptake of the solutions.

To evaluate the status of the market for heat pump skills and to identify the needs and opportunities in Europe an online survey was conducted. In total, 87 heat pump experts responded to the survey across the pilot regions. There were 14 respondents from Ireland, 15 from Austria, 9 from Spain and 49 completed surveys from around Europe. The main finding of the survey was that the specific actions for boosting the heat pump market in each of the pilot regions would differ from each other since each country's market is at a different level of maturity and exists within its policy framework.

Below a screenshot of some of the responses to a few of the survey questions can be found.

What are the most important drivers to heat pump market development?

Most of the respondents from Ireland, Spain and other European countries except for Austria think a supportive policy framework would work as a driver for heat pump market development whereas most of the Austrian experts think awareness raising is a key driver for that market development. See Figure 1 ▼ for a more detailed survey response to this question:

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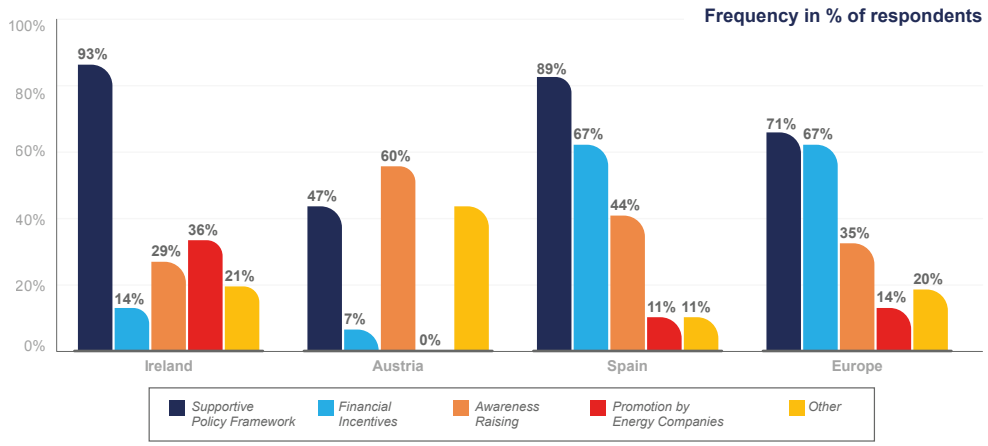

Figure 1. *Most important drivers for heat pump market development*

What are the most important barriers to heat pump market development?

On this question, experts across Europe have varied opinions. Experts from Austria and Spain consider high-cost installation or lack of financial incentives to be the main barrier to the development of the heat pump market, whereas Irish and other European experts (except Austrian and Spanish) consider a lack of qualified and experienced planners, designers and installers as the main barrier preventing the development of the market. Some other prevailing barriers identified are low customer awareness and insufficient regulations requiring fossil fuels transition. See Figure 2 ▼ for a detailed survey response to this question.

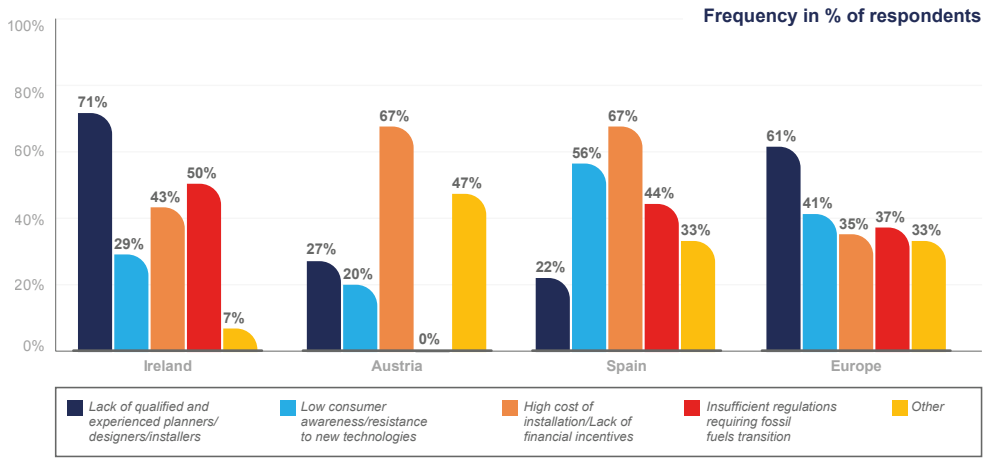

Figure 2. *Most important barriers to heat pump market development*

What are the most important actions to scale up the heat pump market?

Experts from all three pilot countries differed on the actions considered important to scale up the heat pump market. For Irish experts, it is increasing skills across the heat pump value chain (design, installation, operation, and maintenance), for Austrian experts, it is increasing end-user awareness, while for Spanish experts it is implementing regulations requiring fossil fuel transition to renewables. Experts from other European countries consider increasing skills across the heat pump value chain could scale up the market. See Figure 3 ▼ for a detailed survey response to this question.

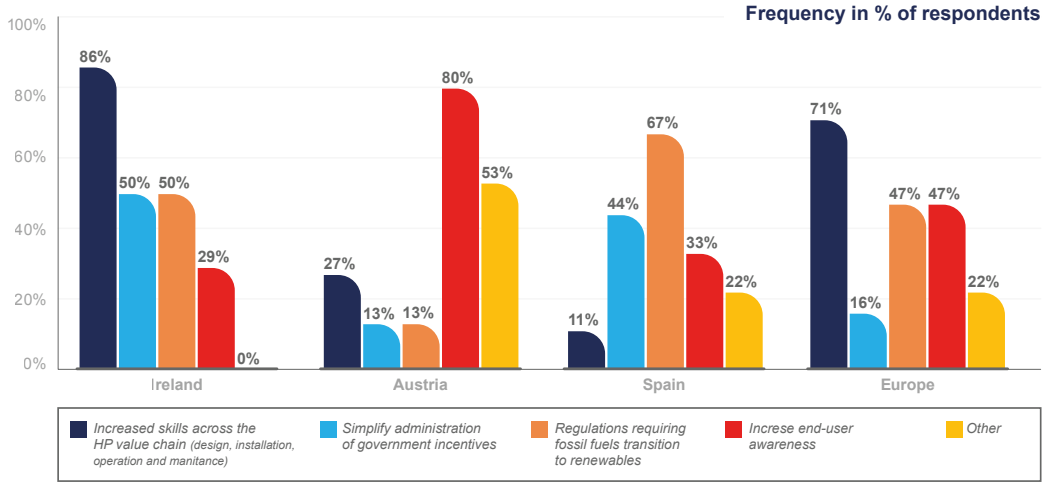

Figure 3. *Most important actions to scale up the heat pump market*

Finally, the policy and legislation review were conducted by undertaking a series of actions like desktop research and online/face-to-face interview. To summarise:

- **15 policies** (2 in Spain, 2 in Ireland, 2 in Italy, 3 in Upper Austria, 3 across Europe, and 3 at an international level (Canada, China and the USA),
- **4 legislations** (2 Europe-wide and 2 at an international level (Japan and USA),
- **16 current incentives** were reviewed (1 in Spain, 3 in Ireland, 1 in Italy, 3 in Austria, 3 across Europe, and 5 at an international level (2 in Canada, 2 in Australia and 1 in the USA),
- **6 interviews** were organised with policymakers and public procurement-related organisations.

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Below are the findings of the policy and legislation review:

- Some countries (like Austria, Belgium, Ireland, and Spain) have already well-established policy structures in place to encourage the deployment of heat pumps in residential and non-residential buildings.
- At a European and international levels, there is still clear room for improvement and development in the procurement of heat pumps in terms of operational, technical, and financial measures.
- At European and, to some extent international level, incentives are focused on encouraging the training of personnel for the acquisition and awareness of the use of heat pumps.
- On the other hand, at a national level, incentives are more focused on financial support to increase the number of heat pumps installed in all types of buildings.
- Financial incentives can also play a major role in the development of the heat pump market, as they are a key enabler for overcoming challenges such as the high cost of a heat pump installation, boosting the sustainability in buildings, giving special support for vulnerable groups, as well as to improve the positive effects on energy efficiency improvements and environmental sustainability.

While performing all the aforementioned actions for overcoming barriers, a register of heat pump experts was created to support the project through testing and validating the regional implementation plans. This register of experts was not limited to Europe as it included as well professionals worldwide. Currently, due to the data protection laws applicable in Europe (General Data Protection Rules, GDPR), this register is only accessible to the project members. Table 1 presents a summary of this heat pump register.

Number of heat pump experts in each domain

Region	Research	Manufacturer	Planning/Design/Distribution/ Installation/Maintenance	Energy Company	Public body	Others
Ireland	6	10	28	1	9	10
Spain	9	14	18	1	6	8
Austria	15	15	37	3	4	18
Italy	6	13	3	2	0	5
EU Wide	62	94	5	5	3	56
Outside EU	0	1	0	0	0	2
Total	**98**	**147**	**91**	**12**	**22**	**99**
Grand Total	**469**					

Summary of heat pump experts' register

4 | Competency framework

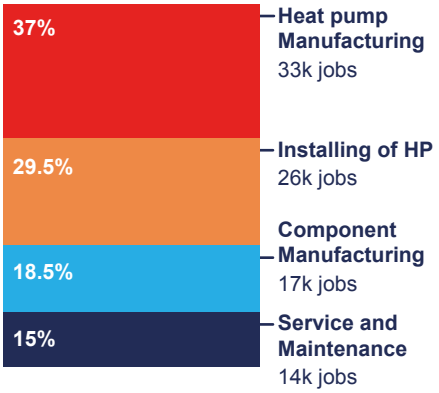
The competency framework draws initial inspiration from other projects in the field (EU-funded projects under the research and innovation programme Horizon 2020 e.g., BUSLeague), other previous reports and data gathering of this HP4All initiative used in other organisations/sectors (e.g., the Organisation for Economic Cooperation and Development) and data gathering mechanisms such as interviews and panel discussions during the events led by the European Heat Pump Association (EHPA). Building upon the 16-month process from the completion of the draft structure, as well as the large data gathering (from research, likeminded project collaboration, expert inputs and others), it serves as a starting point for discussion, validation and as an instrument for gathering relevant stakeholder feedback.

Its findings are especially relevant, given the recent push towards the mass deployment of heat pumps and the employment and economic benefits that are already created inside the EU by the industry, as the European manufacturers of heat pumps and components are world leaders in this technology.

One of the examples is the EHPA Market Report (2021), which showcases that manufacturers are now offering integrated solutions equipped with interfaces, thus providing ever-increased efficiency catering to nearly all application fields. Based on the average sales prices of the different systems, the total value of the 2020 market volume is almost 10.98 billion € (including. VAT). Likewise, based on the different average costs per system, the turnover shares per type are split up as follows: heating-only air/water heat pumps represent 36%, reversible air/air with heating function 27%, and heating-only ground/water systems 16% of total turnover. The rest is comprised of reversible air/water (15%), sanitary hot water heat pumps (5%) and exhaust air (1%).

Finally, based on the calculation of national VAT rates, the total VAT generated by heat pump sales raises to 1.77 billion € approximately.

From a labour perspective, the heat pump sector employs a well-educated workforce in the areas of research and development, components and heat pump manufacturing, installers (including drillers) and service & maintenance. Considering the number of working hours needed to install the different types of heat pumps and based on expert estimates on turnover per employee, the total number of staff in the European heat



Staff percentage working for the European heat pump industry

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pump industry is estimated at 89,784 people, approximately 37% of those being active in heat pump manufacturing.

It is difficult to pinpoint the minimum competency of heat pump designers and installers, as the building regulation, incentives and education systems are different for each region. To this end the HP4All project collated information from each pilot region on the technical competencies of heat pump designers and installers in the competency and skills framework to see what common themes could be seen.

1. In Austria, there is no distinction made between an Installer or a designer, heating installers are a skilled trade called “Installation and building technicians”, who provide both installation work, maintenance and building technicians plan / design of the systems.

2. On the other hand, heat pump designers are mainly either engineers or highly technical tradespeople with additional training on heat pumps. Common competencies of designers are:

   a. Heat pump fundamentals – refrigeration cycle, components, building standards, performance of heat pumps.

   b. Design aspects – Location selection for indoor and outdoor units, heat loss assessment of a building, site constraints.

   c. Design criteria – for hot water and heating systems, heat requirement and output.

   d. Understanding and producing electrical and mechanical schematics for planning and feasibility.

3. Heat pump Installers are mainly plumbers but can be other trades, with additional training on heat pumps. Common competencies of installers are:

   a. Heat pump fundamentals – refrigeration cycle, components, building standards, performance of heat pumps.

   b. Assembly, maintenance and repair including an understanding of pipework type, insulation, jointing & cutting methods.

   c. Complying with current regulations and regulations, safety and environmental regulations.

4 Ground source heat pump Installers/designers have, in addition to the competencies above, extra training on:

   a Handling of heat transfer fluids.

   b Compliance with environmental protection

5 Electrical connections are required to be installed and commissioned by a registered electrician.

6 A registered F-gas engineer / installer professional/ company is required to connect the outdoor unit and the indoor unit, charge, refill, maintain and certify the refrigerant system.

As such, the competency framework can be found below. It uses colours to identify the job families of the value chain, as well as competency clusters that group the core competencies. This report is followed by definitions and key indicators.

Installers
(Technical and customer focused)

Positions in this bracket involve technical and customer focused competencies that are the mainstay of the company's services

Typical positions:

Installer, Maintainer, Decommissioner and Advisor

Chief Installers
(Organisational and customer/team focused)

Positions in this bracket involve organisational and customer focused competencies that are the mainstay of the company's adaptability and improvement

Typical positions:

Team leader, Project Manager, Change Manager ans Specialist

Corporate
(Management and administration)

Positions in this bracket involve business and organisational competencies that ensure the company's growth

Typical positions:

General Manager, Director, Owner / Founder, HR Manager

HP4All Competency framework

Segmenting job positions into families along the value chain of an organisation or sector determines (depending on the size of the organisation) whether it has the necessary abilities and capabilities to achieve the maximum impact/efficiency. This segmentation can be used to set the requirements for each position in the organisation, to view potential skills needed for each level, to provide learning/ training opportunities, and to design structured career development programmes based on organisational and market needs.

As such three main segmentations have been made (above), being aware that these intertwine in individuals and/or teams and that (given the size of the organisation, previous learnings, location, technical legal requirements, market fluctuations etc) a professional working in the heat pumps sector would need most of them to participate in a competitive market. The core competencies clusters are highlighted below.

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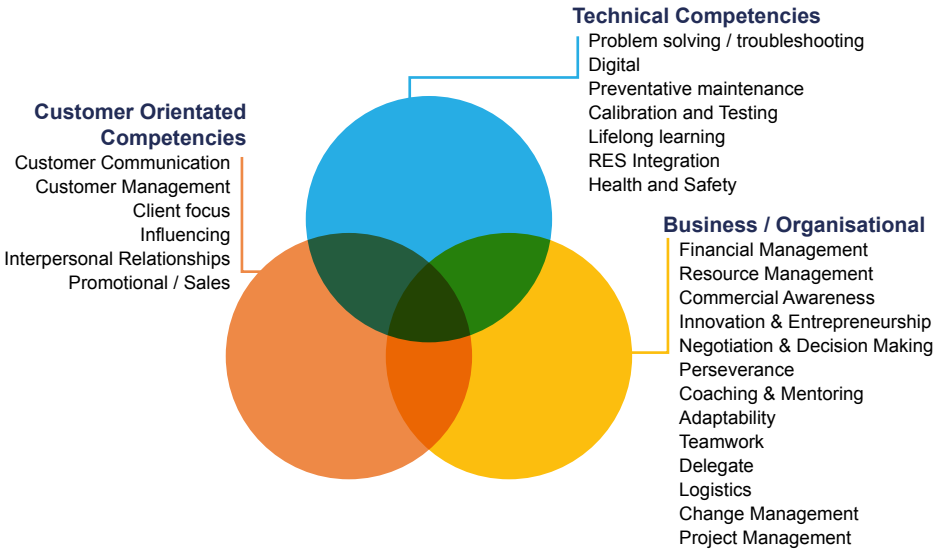

Heat pump core competencies clusters

The competency framework details all 26 of the competencies and behaviours expected at different levels which reflect the variance in complexity, scope, and responsibility across professional responsibilities. Taking into consideration small companies, the need for lifelong learning and improvement at all levels, effective decision-making based on an understanding of all levels, and competition, it is assumed that professionals possess not only the competencies of their cluster but also a combination of competencies from the other clusters. An example belonging to Digital Technical competence would be: Digital competencies refer to the knowledge, skills, and abilities that individuals need to effectively use digital technologies, the internet, and its resources. Examples of digital competencies: Basic computer literacy, Hardware selection (e.g., assisting others to troubleshoot basic software and hardware issues), and digital communication skills. While more complex ones can include Building Information Modelling (BIM) general knowledge or BIM for energy efficiency. Each has its key-level indicators.

Further work with training providers on the competency framework validation needs to be pursued; closer alignment with National Heat Pump Associations (members of EHPA) in training, qualifications and mutual recognition is needed (indeed this was suggested by the National Heat Pump representatives). The addition of other clusters can be considered (e.g., value chain logistics, manufacturing including robotics and 3D printing, research and development) as per a complete value chain approach; collaboration with likeminded projects was pursued, however, new relevant projects that can be built upon are steadily appearing; Direct inputs and examples of manufacturer-provided training have been included in the report, but

further work is needed to fully appreciate the wealth of capabilities offered directly by these companies; EHPA does not currently have Heat Pump National Associations in all countries of Europe, and as more are created and grow, a better picture of variables and needs can be achieved.

The competency framework needs to be tested and validated, this comes after it is public and complete, while parts of it have already been endorsed by dozens of stakeholders that have contributed to the data gathering via interviews, surveys, events, and meetings. Once the competency framework is endorsed and stakeholders become acquainted with the framework, further work focusing on more specific aspects can be pursued and be more easily recognised as well.

5 | Benchmarking Tool

The heat pump benchmarking tool has been developed to help homeowners to create awareness regarding expected annual energy consumption and energy cost for space and water heating delivered by heat pumps within their building. The tool also acts as a decision-making instrument for heat pump installation by encouraging homeowners to install heat pumps within their buildings.

Since all the pilot countries of the HP4All project (Austria, Ireland, and Spain) have different target sectors and pilot activities, three different tools have been developed to satisfy the needs of each pilot country and their respective pilot activities as, likewise, the target audiences for each of the tools are different from each other. The tool has been integrated within the HP4All Knowledge Hub, which will further provide end-users with awareness and knowledge of heat pumps. Below is the design approach being adopted for each of the pilot countries.

Ireland

The target audience for the tool in Ireland is homeowners or users who have already installed a heat pump or plan to install one during the renovation of an old house or the construction of a new one. The Benchmarking tool developed for Ireland will help homeowners in decision-making when considering the installation of a heat pump by providing them with estimated annual energy costs for running a heat pump in their residential setting.

The backbone of the heat pump Benchmarking tool for Ireland is the integration of the SEAI BER database[1] available as a National Building Energy Rating Certificate

1 https://ndber.seai.ie/BERResearchTool/ber/search.aspx

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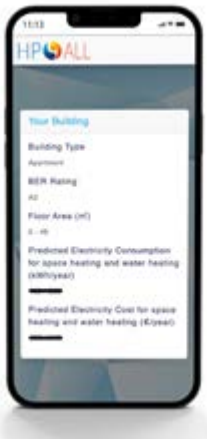
(BER) research tool. Thanks to this, the HP4All tool predicts the average annual energy consumption and energy cost. The Irish benchmarking database represents the average annual electricity consumption for space heating and water heating for all types of buildings ranging from A1 to C3 energy ratings having a heat pump installed. The annual electricity consumption found in this database is based on the average electricity consumption (for space heating and water heating) of all the buildings in Ireland registered in the SEAI BER database presenting all possible combinations of houses based on users' input parameter i.e., type of building, energy rating and area range.

The Irish Heat Pump Benchmarking Tool, developed in English, can be found at http://HP4All.ierc.info/development/index.php

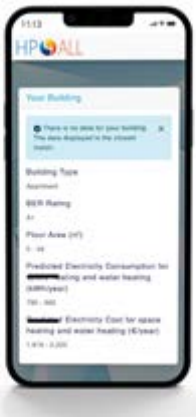
Below Figure 4 ► is a screenshot of the user input page on the Irish tool, on the page where the user needs to provide information about its concrete building.

Figure 4. *User input page of heat pump Benchmarking Tool for Ireland*

Figure 5 ▼ shows the screenshot of an output, where the tool provides a summary of user inputs and then predicts annual electricity consumption (kWh/year) and annual electrical cost (€/year) for running a heat pump to provide both space and water heating.



User output page of heat pump Benchmarking tool for Ireland



User output page of heat pump Benchmarking Tool for Ireland when no data is available for the user's building

Austria

The heat pump Benchmarking tool designed for Austria assesses the real-life annual performance factor of residential heat pump installations. It determines the in situ Coefficient of Performance of a system and offers a general indication of the performance level compared to other systems of the same type (air source or ground source heat pumps). The tool is primarily targeted at end-users of residential heat pump installations who would like to assess the efficiency and real-life or in-situ performance of their systems. The result is presented on a coloured scale (green to red), indicating the level of performance compared to other systems of the same type.

The Austrian Heat Pump Benchmarking Tool, developed in German, can be found at https://www.energiesparverband.at/energiespartipps/heizen-warmwasser.

Below the screenshot of the user input and output page of the tool can be found.

Input page of the Austrian Benchmarking tool

Result page for an air source heat pump in the Austrian Benchmarking tool

Result page for a ground source heat pump in the Austrian Benchmarking tool

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Spain

The heat pump benchmarking tool for Spain follows a similar approach as Ireland. The target audience for the Spanish tool includes public building owners/tenants, who are planning to install heat pumps within their buildings. Since heat pump operation (energy demand and Coefficient of Performance-COP) largely depends on climatic conditions and Spain has three different climatic zones, the impact of climate on the heat pump operation needs to be considered in the calculations performed by the tool. To consider the impact of climate change/ seasonal variation the tool needs to calculate the Seasonal Performance Factor (SPF) for the heat pump. This is calculated using the following Equation:

$$\text{SPF} = \text{Nominal COP} \times \text{WF} \times \text{CF}$$

Equation 1: SPF of Heat Pump in Spain

Where COP is the measure of heat pump operational efficiency and Nominal COP is the one calculated at standard lab conditions. COP nominal value stems from official lab tests outcomes according to the applicable regulation for every technology (UNE-EN 14511: 2012, UNE-EN 15316: 2010, UNE-EN 16147, etc.), temperature conditions corresponding to the climate zone and heat pump application (heating, solar hot water etc.).

WF (Weight Factor) and CF (Corrective Factor) are the multiplying factors accounting for the impact of climate. WF considers the climate zone (A, B, C, D and E) in which the heat pump has been installed. This value is defined by the Spanish Technical Building Code (CTE in its Spanish acronym) and has been calculated by a purely technical methodology and documentation[2]. WF value also differs for different technology of heat pumps. CF outweighs differences between actual, operational, and testing temperatures at which COP is calculated for different technology of the heat pump on a lab scale.

Spanish Energy Agency IDAE provided a Building Energy Efficiency database for old buildings (built before 2007)[3] and for new buildings (built on or after 2007)[4]. This database provides the average annual thermal heating demand (space heating and domestic hot water) for individual households and blocks of buildings for each province of Spain. Then using thermal heating demand fetched from the database and SPF value the tool calculates electrical heating demand for the user's residential building.

2 https://www.caloryfrio.com/calefaccion/zonas-climaticas-espana-segun-cte.html
3 https://www.idae.es/uploads/documentos/documentos_11261_EscalaCalifEnerg_EdifExistentes_2011_accesible_c762988d.pdf
4 https://www.idae.es/sites/default/files/documentos/publicaciones_idae/documentos_calener_07_escala_calif_energetica_a2009_a_5c0316ea.pdf

The Spanish Heat Pump Benchmarking Tool, developed in Spanish, can be found at http://HP4All.ierc.info/development_spn/index.php

The screenshots of the user input and output pages of the tool are shown in Figure 6 & 7 ▼

Figure 6. *Input page of the Spanish Benchmarking Tooll*

Figure 7. *Output page of the Spanish Benchmarking Tool*

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6 | Experience with HP4All package implementation in 3 pilot regions

Several action plans have been developed for each of the three HP4All pilot regions (Upper Austria, Ireland, and Andalusia/Spain) and HP4All has carried out their implementation. The regional reports offer a brief background of the heat pump market at the start of the HP4All project, define the pilots in terms of their scope and key objectives, and present the target groups and stakeholders engaged, activities carried out, tools used, communication strategy, and main outcomes.

The pilot regions aim to address different heat pump market sectors, applications, and technology solutions. Each pilot region took specific approaches to the rollout of targeted activities and materials, and the development and promotion of heat pump skills depending on different market scenarios in each country.

Irish Pilot

The Technological University of the Shannon (TUS) has been working with nine local authorities by providing their local staff with heat pump and procurement training, as well as by running local promotional events to improve the knowledge of these professionals that are directly responsible for new-builds, retrofits and heat pump installation. TUS trained 120 local authorities' staff that were working on the planning, procurement and design of social housing units with heat pumps. The training provided not only a good understanding of heat pump design, installation, maintenance, and homeowner handover. but also engaged in procurement and tendering, with a particular focus on skills, certification, and qualifications to bear in mind when addressing public tendering processes. Throughout these nine local authorities mentioned above, the planned number of heat pump installations that would be completed up until the end of 2023 was 1,386.

From conversations with contractors, or both on-site or training at a facility was deemed that out of scope, time and missed opportunity of income were the main barriers. In order to combat all those, short online training was created and circulated to local authorities, their contractors and heating and cooling professionals. In this sense, there is a total of 14 installer training webinars attended by 282 professionals. TUS also ran an eight-part homeowner webinar series lasting 20 minutes with short learning content for homeowners. In this case, there were 119 attendees in total. Apart from the direct attendees, all training and materials were made openly available on the HP4All website (www.HP4All.eu), as well as on the TUS Research, Development, and Innovation YouTube page.

Likewise, HP4All also engaged with several training providers, policy makers (Sustainable Energy Authority Of Ireland Retrofit grants), specifiers, consulting

engineers and installation companies to learn more about their perspective on the matter with the aim of highlighting the strengths and weaknesses of the current approach in relation to its effect on operating efficiency and the level of understanding of these systems enjoyed by their end-users. From these conversations the learning outcomes of the online training were created and rolled out.

HP4All actively engaged with all actors in the supply chain and with end users to develop an understanding of the key weaknesses in project delivery mechanisms and develop together education and training materials. As independent broker, HP4All could engage with the suppliers of large heat pumps through the contact with the Heat Pump Association of Ireland. From these conversations, the issues that surround the large-scale heat pump deployment are, on the one hand, that architects and consulting engineers do not have the knowledge in order to consult with designers and, on the other, that mechanical and electrical installation contractors do not have the expertise to carry out the works. This leads to large-scale heat pump installations being primarily done by refrigeration and air conditioning companies and some heat pump suppliers that cannot keep up with the growth of the market.

The deployment of non-domestic heat pumps also faces significant challenges in public buildings. Heat pumps are supplied with comprehensive control systems that are capable of managing a wide range of equipment within the setting of small to medium non-domestic buildings. These control systems are often under-utilised or worse, over-ridden by inappropriate or incorrect integration with Building Management Systems or hydraulic arrangements that may also involve fossil fuel boilers. The task is further complicated when projects require public procurement as the design documentation cannot specify any particular manufacturer or installation company.

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Upper Austrian Pilot

The Upper Austrian pilot activities have aimed, among others, at developing the market for mid-/large-scale heat pump applications (commercial and industrial) in the region. The overall scope of the pilot was to provide options for phasing out fossil-fuels in companies through the up-take of other renewable energies, such as heat pumps. Material was developed and activities were organised to overcome current challenges, namely low levels of awareness of promising application possibilities among planners and users, and the lack of required skills by planners and installers. Additionally, some activities focused at supporting heat pump innovations and the upskilling and demand for skills in the residential sector.

As regional energy agency, the OÖ Energiesparverband (ESV)

is a trusted source of information on sustainable energy and the energy transition. With its wide portfolio of services for households, actors in the residential sector and companies, it is well-placed to work across the heat pump value chain (from manufacturers to end-users). Its extensive experience in market transformation and with information campaigns, training and energy advice was strategically used to support the objectives of the HP4All pilot.

Numerous awareness raising and training activities were organised to increase knowledge and skills along the heat pump value chain. In addition to adding heat pump content to its current information services, ESV developed new events (e.g. its Energy Academy), cooperated with organisations in the heat pump sector, and looked for and utilised synergies with already existing events. The initial targets of the pilot activities (five events and 200 people trained) were significantly surpassed. Over 780 people (mostly professionals along the heat pump value chain, and end-users in companies) attended the around 15 events organised, out of which

285 people were trained. Likewise, over 10,000 private building owners received information on sustainable heating systems at ESV's stands at three tradeshows.

Moreover, ESV produced high-quality materials to support the objectives of the pilot:

- The novel Renewable Process Heat Guide fills a large need by offering information on mid-/large-scale heat pump applications. It contains comprehensive heat pump information, attractive case studies on renewable process heat, and guidance on energy efficiency in companies. 3,000 copies were produced. This guide will be a key material for supporting further development of the market for mid-/large-scale heat pump applications in Upper Austria beyond the HP4All project.
- The ESV's Residential Heat Pump Guide was reviewed and updated in the context of HP4All. It was also made available both on the ESV website and on the HP4All's Knowledge Hub. Likewise, 6,000 copies were printed and distributed.
- 12 best practice case studies (partly included in the heat pump guides) were developed and published, including eight case studies on heat pumps in residential buildings primarily targeted towards end-users in the residential and non-residential sectors, planners, and installers.

Andalusian/Spanish Pilot

The main goal of the Spanish pilot was twofold:

1. To untap the potential of the public sector as an outstanding driving demand force as a public promoter and as a key market influencer through legislative, administrative, and financial initiatives.
2. To increase heat pump manufacturers competitiveness through a robust public sector influenced (launching customer) demand.

To this end, engagement with the public and manufacturing sectors was conducted at the following events:

- ISVIS Congress: The first Congress on Innovation and Sustainability in Social Housing was organised by the Housing and Rehabilitation Agency of Andalusia (AVRA) with the objective to explore new or alternative design, technology, and management ways to improve energy efficiency and sustainability in the publicly promoted housing stock.HP4All was presented at ISVIS 2021 with a dedicated session.
- Efficient energy supply in buildings. Needs and opportunities: This event was specifically organised by Technological Corporation of Andalusia (CTA) with a view of bringing together representatives from the whole

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heat pump value chain and public administrations to be briefed on the technological challenges and opportunities offered by heat pumps. The event focused on two aspects:

- Technical requirements and objectives to be met by heat pump installations.
- Best available technologies and equipment, and how to have a reliable first idea among possible alternatives to demand or install, especially the most innovative and effective.

- Cleaner heating & cooling technologies in non-residential applications: CTA, together with the utility IBERDROLA and the Andalusian Association of heating & cooling equipment manufacturers (AFAR) convened this event to highlight the advancement of more energy-efficient, decarbonised solutions for non-residential applications notably heat pumps, including synergies thereof with other alternatives (e.g. biomass) in cases of difficult electrification -i.e thermally driven heat pumps- , as well as various case studies in industry, tertiary buildings and public services.
- Rehabiliving Forum: is the most important annual forum on energy efficient rehabilitation and installations in Andalusia. It aims to bring together, the most advanced technologies for building heating, cooling, and renovation.
- Second Spanish Heat Pump Forum: CTA co-organised with the Andalusian (AFAR) and national (AFEC) heating & cooling equipment manufacturers associations the event II Heat Pump Forum: Opportunity for training and employment. HP4All had, once more, a specific session to highlight its contribution to employment and skills.

7 | HP4All Policy recommendations to foster heat pump skills

Against the backdrop of the hardships and global energy market disruption caused by Russia's invasion of Ukraine and in order to curb the climate crisis, the European Commision presented on the 18th May 2022 the REPowerEU (RPEU) Plan Communication, a comprehensive package of measures to address massive energy savings, wide diversification of energy supplies, and accelerated roll-out of renewable energy in households, industry and power generation, particularly heat pumps. The ambitious objectives set forth by this RPEU Plan mean that, by 2030, that the number of heat pumps related workers in the EU (manufacturing, installation, maintenance) be increased by 50%, and that out of the existing workers, at least 50% will also need to be reskilled to work with heat pump technologies (electric, hybrid, thermal). This is an enormous challenge as heat pump installations require twice as much time as boilers, according to the European Heating Industry (EHI).

For this reason, the RPEU initiative deserves particular attention to establish a large-scale skills partnership to maintain and regain technological and industrial leadership in key areas and to support the workforce.

Labour and skills shortages in the building energy renovation sector are one of the main obstacles that need to be seriously addressed to successfully implement the REPowerEU Initiative and related ones such as the Fit-for-55 Package, the Green Deal and the Renovation Wave.

Although it was launched in a rather different geopolitical context, the EU-funded HP4All project scope and goals intended to help cover these shortcomings, to ensure a more robust skills and labour market domain in the heat pump value chain. As a result, legislation and policy recommendations stemming from HP4All came out timely.

This group of mutually reinforcing measures encompasses proposals for legislative and administrative adjustments to foster labour market consolidation schemes (e.g., updated competency frameworks and requirements for skilled workers in procurement and dedicated training schemes for installation & maintenance professionals), incentives (based on success stories) and ambitious private and officially supported dissemination & communication packages.

The main recommendations coming out of the HP4All implementation are:

1 | To carry out an intensive EU-wide marketing and awareness-raising campaign to ensure social recognition and visibility of energy & building renovation professionals with increasing and more complex skills. Put installers at the heart of it, due to their strategic role, without neglecting other stakeholders.

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2 To adopt legal and market measures to improve labour conditions, avoiding temporality and fostering long-lasting careers, gender balance, attractiveness to youth and workers from other declining sectors, and integration of vulnerable collectives to labour market niches and talent pools.

3 To address an overarching EU scheme for the legal reinforcement of energy rehabilitation training & skills curricula, with Member states and Regions addressing the optimal implementation specialization scheme and roadmap.

4 To draw up EU-wide minimum content guidelines for specialised training programme contents, either formal or informal, to avoid gaps. Continuous training for upskilling workers that are already in the sector must be made compulsory alongside providing opportunities for people outside of the sector to re-skill and join the sector workforce.

5 To advance and favour more agile Vocational, Education and Training certification schemes that can be mutually recognised and repeated by other member states, with simplified procedures for application and certification all the while using common reference frameworks so that good quality heat pump workers are ensured.

6 To reinforce sustainable energy skills in school curricula (Apprenticeships, Secondary Level Education and Primary Education) ensuring that the opportunities for employment in the sustainability, energy and climate sectors are presented to future generations.

7 To boost installation service quality assurance mechanisms.

8 To introduce more strict manufacturing & installation solvency and implementation criteria in related public procurement, as well as more demanding quality/price ratio targets. This ratio is explicitly mentioned in the EU Directives on public procurement, and it is a very good opportunity to pre-empt quality versus price-only driven contracts.

9 To promote energy advice and energy renovation project management as a job enrichment opportunity / new market niche/specialisation itinerary, with appropriate financial support. One-Stop-Shops, clearinghouses and call centres can be used for this purpose, with appropriate and coordinated support from EU, national and regional funds, and private investment. This service would include training and signposting to certified, trusted professionals as is currently the case in some Member States.

10 | To reinforce and provide specific visibility and prioritisation to energy rehabilitation education and training schemes and packages within the Structural Funds Regulations, particularly the European Social Fund (ESF+).

11 | To put in place adequate coordination mechanisms (e.g., a Heat Pump Accelerator or an EU wide Public Private Partnership) to ensure complementarities and synergies at all administrative levels (EU, state, regional, local) and bring in all stakeholders throughout the whole value chain, implementing fully or partially these recommendations depending on the context.

These recommendations take stock of two complementary situations:

- The situation of skills training for renovation at the EU level and best practice examples that could be scaled up or replicated to boost the workforce for renovation across the EU as described in REPowerEU, May 2022.
- The interactive dialogue between the HP4All project and the entire HP value chain throughout the project duration (Sep-21 to present), both the supply side (manufacturers, engineers, designers, installers, trainers) and the demand side (building owners and end users from all sectors -residential, industry and tertiary).

8 | Good practices in the dissemination and communication of the HP4All Package

The main objective of HP4All's dissemination strategy was to ensure that the project's outcomes (concepts, scientific results, methodologies, validated work, problem awareness) were consequently disseminated to appropriate target communities. Contributors to HP4All's development, evaluation, market uptake and exploitation were identified and motivated to proactively participate from the very beginning.

HP4All followed a multi-step and multi-channel approach to the dissemination strategy to reach and engage different stakeholders and target groups with adjusted information for needs and interests. Awareness was raised among all possible project beneficiaries.

As so, the dissemination plan's objectives were:

- Revolve around leveraging the demand for energy skills in the building sector for heat pumps.

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- Demonstrate at workshops and pilots the lessons learnt on the project and the capabilities of the technologies to the target stakeholders for exposure and capitalise on the interest.
- Show the societal impact, and project outcome impacts on services, employment, and the economy.
- Strengthen internal communication within value chain stakeholders.
- Conduct an intense communication and dissemination campaign.

From the start, several key stakeholders were detected by consortium partners, including relevant associations, trade media and similar projects addressing similar challenges.

Through its technical work, HP4All has generated a significant volume of information with interest to different stakeholders in the Heat Pumps and Buildings value chains, as well as others.

Therefore, it was necessary to identify what outputs and messages could be provided from the activities developed throughout the project. These key messages to be disseminated were supported by different tools/channels including printed materials, online platforms, publications, events, and others.

Different tools and channels were used to disseminate and communicate the activities carried out by HP4All and its results. Each tool and channel was used appropriately to address different target groups at different stages of the project implementation, thereby increasing the efficiency of the Dissemination Plan.

These channels included a project website, articles targeted at both a lay and a technical audience, press releases, e-newsletters, scientific papers and leaflets, social media presence, and participation in workshops/conferences.

Any dissemination activities and publications in the project, including the project website, specified that the project received funding from the European Union's Horizon 2020 programme, as well as displayed the European emblem.

The communication activities within the project were both periodic (management group meetings, newsletters, project group meetings and reporting to the European Commission) and online (SharePoint established by the coordination).

Communication activities with stakeholders outside the project group were based on the dissemination plan originally established at the beginning of the project. The journal articles were primarily intended to communicate the recent findings to the scientific and academic communities. However, the project was also published in trade journals and magazines important to the industry to disseminate new relevant solutions to other possible end users. Project presentations at technical conferences were intended to reach the same audience.

A recognisable project identity was developed to build a visual brand and ultimately offer a package of templates that will facilitate the building of notoriety progressively through the project. This included creating a project logo and an accompanying style guide, consistently used for the project website and all other communication templates, such as PowerPoint, Word, posters, and EC Reports.

Project partners attended sector-related events, conferences, and workshops, to meet target groups, other stakeholders, public authorities, and the scientific community and to raise awareness about the project objectives and results. These events provided access to target audiences at local, national, European, and international levels.

The HP4All consortium partners are from different disciplines; therefore, they disseminated project results to diverse scientific forums.

The industrial sector communities were also informed of HP4All's achievements at international conferences and trade shows. HP4All partners also provided information through posters, presentations at other sessions and the distribution of flyers.

Every effort was made to communicate the work of the consortium via the media, publications, conference presentations, trade fairs and workshops, as well as through the Commission and industry bodies. The results of the project have been disseminated via reports, scientific papers, and articles. Whenever a translation was needed, it was carried out to better fit the different pilot region's needs.

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9 | Resources

Project website

HP4All developed an up-to-date and user-friendly project website (https://HP4All.eu/) as a primary source of information for external parties, providing updates on project activities and achievements to all target audiences. The website aimed to inform the scientific community and associated industries about project developments, but also to present the project's achievements and novel pilot lines to the public.

All partners contributed to the website by providing relevant project information in accessible language (laymen's terms).

The project website contains:

- Latest news about the project's progress and results
- Details about the project partners
- Electronic materials (newsletter, infographics, articles)
- Events and contact information

The project website was set up and will be managed, maintained and hosted for the duration of the project and a further 2 years after the completion of the project.

Social media

The project has a social media presence on Twitter (https://twitter.com/heatpumps4all) and LinkedIn (https://www.linkedin.com/company/HP4All) to ensure wider dissemination to different age groups and target audiences. Social media was used as a tool to announce project developments, but most importantly drive traffic to the project website.

Twitter and LinkedIn accounts were established at the very beginning of the project start and content related to HP4All was posted regularly to increase outreach. Once the project had video material, a YouTube. Channel was created and over there several videos, as well as webinars and workshops were uploaded there.

Newsletters and press releases

Electronic newsletters were prepared every 6 months, and included project updates, announcements, interviews, and other information related to HP4All, to be distributed to stakeholders and partner networks and posted on the project website. Moreover, project updates appeared in partners' respective newsletters, which were distributed electronically to their contacts within their specific industry.

Press releases were also published to announce newsworthy developments during the project. They were written in English and sent to the European press and national journalists in translated versions, with the help of the project partners.

Knowledge Hub

HP4All has developed a set of tools and resources for use by the different stakeholders which has been tested and validated in different markets through regional implementation Austria, Spain, and Ireland. The intention that these resources, which have been tailored the needs of each market, will drive market change, influence end-user decisions, and accelerate the uptake of innovations and emerging technologies in the heat pump market.

Different stakeholders and actors in the heat pump value chain have developed resource materials, information and tools which are designed to increase the knowledge of end users. HP4All has collated the range of information available and through categorisation and analysis of resources available, populated a Knowledge Hub which has been made available as a digital resource in each pilot region. Where specific gaps were identified, the HP4All team has developed specific information and guidance. The resources compiled focus primarily on the critical importance of skills and knowledge across the supply chain and enable different end users (residential homeowners, non-residential building owners, facility managers, procurement officers etc.) to access resources relevant to them.

HP4All pilot leaders have been responsible for collating and assessing contents, resources, and materials relevant to support a high-quality design and installation

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of solutions addressing financial, technical, environmental, and social aspects. The Knowledge Hub has been developed specifically for the region-specific end-users with resources such as:

- Procurement guidance focusing on specific demands in terms of skills/ knowledge of providers.
- Contract development (Energy Supply, EPC, O&M) and associated skills/knowledge demands
- Improving the value (economic/environmental) of your building through the integration of HPs
- Key factors to demand in terms of installation and commissioning.
- Providing advice on performance expectations and monitoring options
- Environmental performance including noise, low GHG refrigerants.
- Smart Grid Solutions and Innovations e.g., HP & PV solutions, HP & Smart Grid Communications etc;
- Emerging technologies and innovations etc.

It was decided to access each pilot region knowledge hub, the user will need to click on the pilot regions flag. This will allow for easy replication for other regions. Selecting a country flag will allow the user to access their respective country's knowledge hub. Another reason for this choice was to allow each knowledge hub to be tailored to the region's specific needs.

Knowledge Hub Landing page

To access the knowledge hub, firstly you must click on a flag in the top right of the website. Once the flag is selected clicking on the knowledge hub should bring the user to the specific Knowledge Hub.

The format of the knowledge hub saw four major categories available on the landing page. These include:

1. **Non-Residential.** Any resources found for non-residential buildings with heat pumps.
2. **Residential**. Any resources found for residential buildings with heat pumps.
3. **Workshops**. Any workshops or webinars that HP4All organised or participated in the project are listed here.
4. **Benchmarking Tool.** This relays the knowledge hub user to the country-specific benchmarking tool.