

Progress Report for Technical Monitoring and Evaluation for Swansea Bay City Deal Homes As Power Stations Project

Reporting period: December 2022 – November 2023

Report produced by:

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1 Overview of activity

The contract for the technical monitoring and evaluation for Swansea Bay City Deal Homes as Power Stations project (“HAPS Technical M&E”) was awarded to Cardiff University on 28th November 2022. The contract commenced on 1st December 2022 and will run until 30th November 2027. In December 2022 Professor Jo Patterson and Dr Emmanouil Perisoglou completed the formalisation of the contract and begun mobilising the project.

The job descriptions for the Research Associate and Project Officer roles were written and advertised publicly in January 2023. Dr Juan Fernandez Goycoolea (full time) started in the role of Research Associate and Esther Tallent in the role of Project Officer (2.5 days per week) on 1st April 2023. Professor Jo Patterson and Dr Manos Perisoglou will continue to be involved in the project as indicated in Figure 1 below. All HAPS Technical M&E team members have completed a basic DBS check, following online guidance from UK Government on which type of DBS check is suitable for the role. The DBS check was carried out by an external company that provides Cardiff University staff with a self-service DBS checking system called “Online Disclosures”.

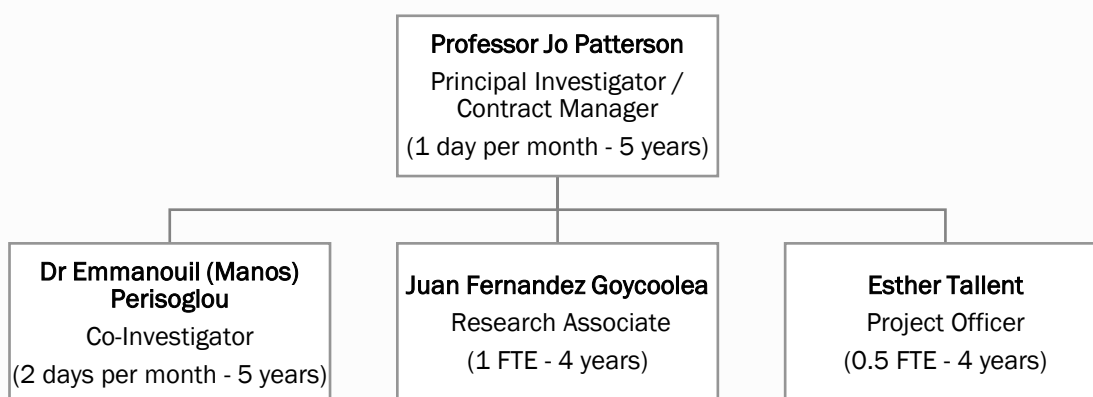


Figure 1: HAPS Technical M&E Team Structure

The HAPS Technical M&E team have focused on preparing and planning for project delivery ensuring they are familiar with the contract requirements and University requirements. This has included:

- identifying the proportion of retrofits and new builds to be monitored (see Figure 2);
- creating a timeline of activity for the different levels of monitoring (see Figure 3);
- understanding how data for each parameter within each level will be monitored;
- checking that existing monitoring equipment is operational, calibrated and stock is sufficient;
- selecting, purchasing and testing new monitoring devices;
- creating documentation and completing the University’s ethical review of the monitoring approach for each level of monitoring;
- creating consent documents for the homes that will be monitored;
- developing resident questionnaires for each level of monitoring;
- creating a method to capture, store and use data throughout the project;
- understanding the requirements for research data to be published in open data repository at the end of the project, and the need to capture consent at the outset;

- sharing knowledge with the HAPS Project Management team at a visit to the LCBE retrofit demonstration homes;
- attending all HAPS project Board Meetings;
- attending HAPS events such as the launch of the Duracell battery for home storage event at the National Botanic Garden of Wales on 30th November 2023;
- supporting the preparation of the successful application for the Strategic Partnership Fund to carry out two whole house demonstration retrofits with Tai Tarian;
- advising the HAPS Project Management team on the Monitoring and Evaluation approach and requirements;
- suggesting representatives to join the HAPS FIF evaluation panel;
- supporting the development of the application forms and guidance documents for the HAPS Financial Incentives Fund (FIF);
- participating in the Technical Evaluation of round 1 of FIF applications with Professor Jo Patterson leading the review of the retrofit applications.

The activities undertaken have demonstrated the HAPS Technical M&E teams commitment to the development and success of the HAPS programme as a whole. This supportive approach is how the HAPS Technical M&E team intend to continue working in future to enhance the impact of the HAPS programme across the region and beyond.

2 HAPS Technical Monitoring and Evaluation programme

The HAPS Technical M&E programme has been designed to gather data to evaluate delivery of the five overarching aims of the HAPS project as stated in the Proposal call documentation:

- technology performance,
- environmental conditions,
- fuel costs and poverty,
- energy savings,
- residents' behaviour,
- residents' health and well-being.

The HAPS Technical M&E programme will combine technically recorded numerical values of building performance such as temperature or energy consumption and user responses including comfort levels and household information. Building performance monitoring will involve a combination of long-term continuous monitoring such as regular measurements of indoor temperature and humidity, and short-term one-off data collection techniques such as air tightness and heat loss tests.

The HAPS Technical M&E programme has been structured to include three levels of monitoring to collect increasing depths of detail for the homes in each level. This sampling approach was included within the HAPS Technical M&E proposal and is based on the experience of Cardiff University's Low Carbon Built Environment (LCBE) team in implementing residential monitoring and evaluation programmes across South Wales. It also draws on the references of the sampling approaches implemented by the IEA Task 40 guide and recommended by the BS40101 Building Performance Evaluation standard. Flexibility when planning the HAPS Technical M&E approach was vital as the FIF recipients, the homes and the technology combinations were unknown. The HAPS

Technical M&E funding would not allow in depth technical monitoring of all 10,300 homes across the HAPS programme. An approach that is believed by the HAPS Technical M&E team to utilise the available funding to obtain the most appropriate and valuable level of data will be applied. The three HAPS Technical M&E levels are defined as basic, moderate and comprehensive, have been summarised in Table 1.

Table 1: Breakdown of sampling levels, data collection methods and source of information

Level	Data collection methods			
	Existing building parameters	Residents experience	Indoor conditions monitoring	Energy consumption monitoring
Basic	SAP data, info provided by FIF recipient	Short survey - online or paper-based	User satisfaction reported in short survey	A minimum of annual meter readings provided by resident
Moderate	SAP data, info provided by FIF recipient, PRESS tool	Extended online or paper-based survey	User satisfaction reported in short survey and basic monitoring (1 point per unit)	A minimum of annual meter readings provided by resident. Ideally billing data will be provided.
Comprehensive	SAP data, info provided by FIF recipient, PRESS tool, one-off tests (fabric and MVHR)	Extended face-to-face survey or interview	User satisfaction and detailed monitoring (min. 2 points per unit)	Detailed electricity and heat metering (8+ points per unit)

Figure 2. below specifies the expected proportional distribution of homes across levels and types of projects (retrofit or new builds). However, final numbers will be subject to the projects funded through the HAPS FIF and resident cooperation with the programme. Sampling quotas will be decided after each intake of projects.

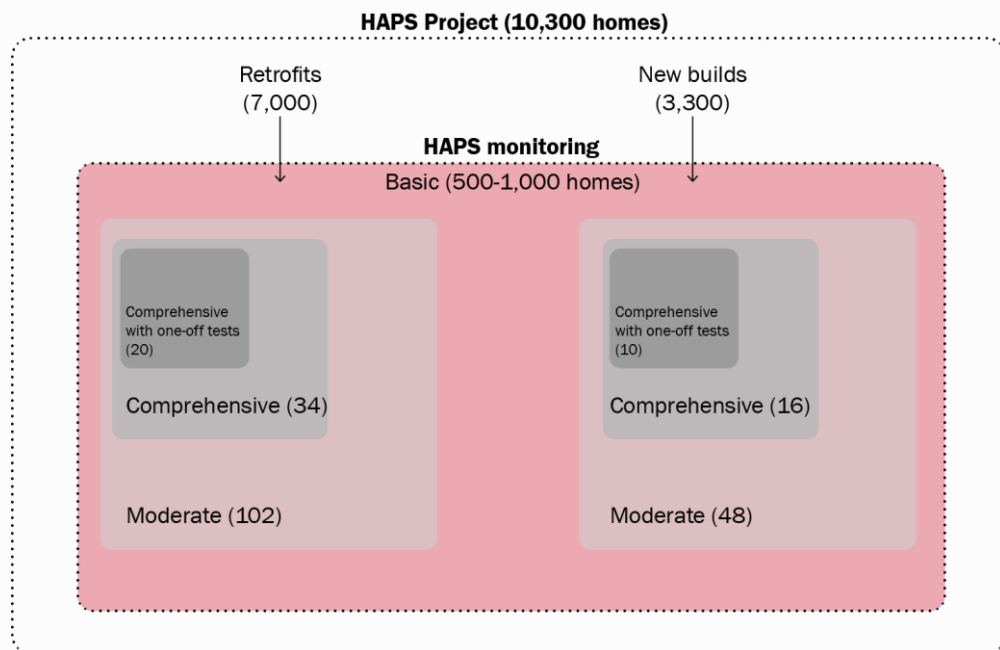


Figure 2: Breakdown of homes to be monitored within the HAPS Technical M&E programme

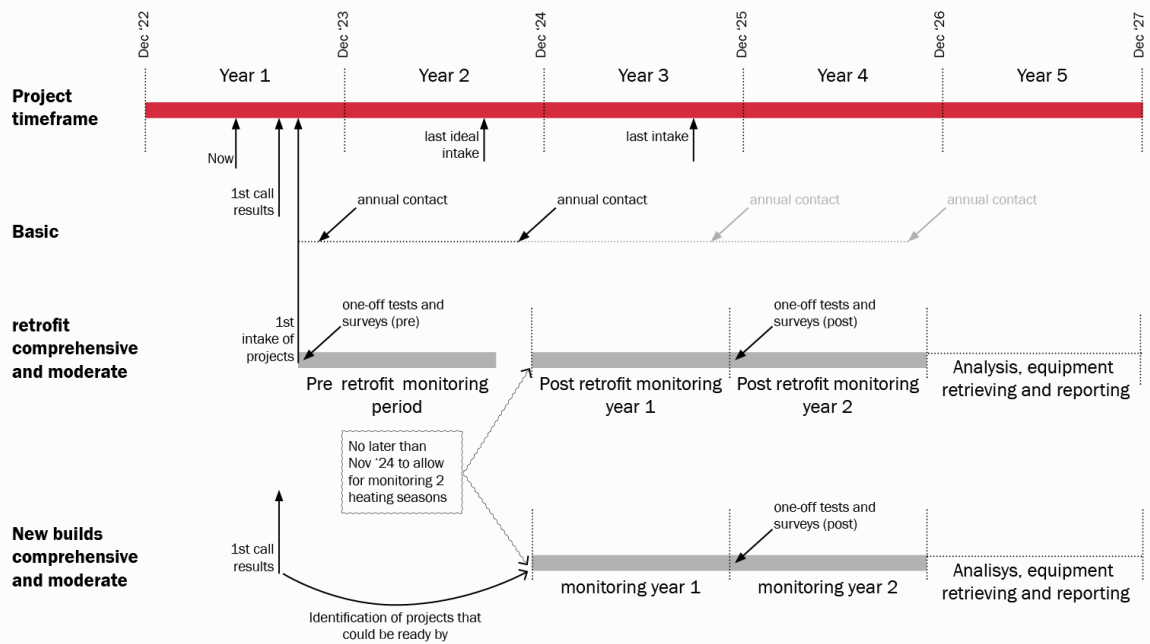
The HAPS Technical M&E programme has been structured to run for up to five years, ending in November 2027.

At least one year of pre-retrofit monitoring should be carried out to include at least one heating season to provide before works information. This will allow the HAPS Technical M&E team to accurately assess the impact of the improvements in terms of final energy demand, indoor environmental conditions, and other aspects such as fuel poverty. It is suggested that monitoring periods should start no later than November each year to ensure full heating seasons are included.

Where possible two years of post-works monitoring should be carried out for both retrofits and new builds. This will allow the accuracy of measurements to be maximised and to compensate for any possible data losses, anomalies or issues with the systems. To achieve two years of post-works monitoring installations by FIF projects would need to be complete by November 2024. This will be encouraged and used as part of the selection process when choosing projects to monitor to the comprehensive and moderate levels. However, a minimum one year of post-works monitoring including one heating season is essential.

Considering these requirements, Figure 3 illustrates the timeline of the HAPS Technical M&E programme indicating the annual intake of M&E projects. It highlights that the sampling and monitoring of retrofitted homes should be prioritised during the first year to allow for the one-year pre-retrofit and two years post-retrofit monitoring. Monitoring for the retrofitted homes sampled within the comprehensive level should ideally start in November 2023. The timeline for new build homes is more flexible, however, Figure 3 highlights that to include a two-year monitoring period the sampled new build projects should ideally be finished and occupied with monitoring equipment in place by November 2024.

Due to the FIF application process and evaluation timing, it will not be possible to complete a full year of pre-works monitoring for some of the retrofit projects and two years monitoring post-works will be challenging to capture and analyse before December 2027. The HAPS Technical M&E team will prioritise working with FIF retrofit projects to collect as much pre-works monitoring data as possible. After this the focus will be on working with the FIF new build projects to ascertain the expected completion date of each unit so that as many as possible can be monitored for at least one year post-works and ideally longer for some.



Comprehensive and moderate total: 150 homes

Figure 3: Workflow timeline for different levels of technical monitoring

3 Technical monitoring case studies

3.1 Existing Low Carbon Built Environment (LCBE) projects

The LCBE team are monitoring a number of domestic properties as part of other ongoing and completed projects. This includes retrofit and new build case-studies whose outcomes are of value to the HAPS project either due to their location, in the Swansea Bay City Deal region area, and/or due to the whole house energy systems approach that has been applied. These projects present a learning opportunity for the HAPS Technical M&E programme and were included in the HAPS Technical M&E proposal submitted by the LCBE team. The key outcomes of these projects are available on the Cardiff University website and project factsheets are available in hard copy or as pdf.

The HAPS Technical M&E team will continue to monitor these homes. Further involvement with these projects will require the cooperation and consent of the project partners and occupants and a review of the monitoring equipment functionality. Collaboration agreements are currently being prepared to enable this to continue. Information about these projects is displayed in Table 2. Two of these projects, containing 9 homes, are within the Swansea Bay City Deal region and can therefore be considered as part of the HAPS programme.

Table 2: Ongoing monitoring projects general information

Completed	Type	Location	Units	House type	Tenure	Technologies installed
2015	New Build	Bridgend	1	Detached	Private	Solar panels, battery, air source heat pump, transpired solar collector and mechanical ventilation with heat recovery.
2014	Retrofit	Rhondda Cynon Taff	1	Mid-terrace	Social housing	Solar panels and battery.
2018	Retrofit	Rhondda Cynon Taff	1	End-terrace	Social housing	Solar panels, battery, transpired solar collector and mechanical ventilation with heat recovery.
2020	Retrofit	Swansea	6	Bungalow	Social housing	Solar panels, battery, ground source heat pump, mechanical ventilation with heat recovery.
2021	Retrofit	Neath Port Talbot	3	Terrace and Semi-detached	Private	Solar panels, battery, air source heat pump with oil and mechanical ventilation with heat recovery or positive input ventilation.
2021	Retrofit	Ceredigion	6	Semi-detached	Social housing	Solar panels, battery, air source heat pump, and mechanical ventilation with heat recovery or positive input ventilation.
2022	Retrofit	Bridgend	1	End-terrace	Social housing	Solar panels, battery, air source heat pump, mechanical ventilation with heat recovery.

Highlights from the whole house energy retrofit of six off-gas bungalows in Swansea are:

- The comfort of the homes has improved significantly. The internal temperature is consistent with the thermostat set by the resident. The humidity levels and supply of fresh air are managed by the mechanical ventilation with heat recovery (MVHR) system.
- The amount of energy used by the homes reduced by 72% and most of this was provided by the solar panels directly or via the battery. A large amount of excess energy generated by the solar panels was exported to the national grid. This results in both lower energy bills for residents and reduced carbon emissions.
- The home's Energy Performance Certificate (EPC) rating improved from as low as G (12) before the retrofit to A (95-100) after the retrofit.

Further details can be found here:

<https://www.cardiff.ac.uk/architecture/research/projects/low-carbon-built-environment-project/whole-house-energy-retrofit-of-six-1970s-off-gas-bungalow-retrofits-in-swansea>

3.2 Tai Tarian Sandfields project

The HAPS Project Management team identified a potential opportunity for the Tai Tarian County Flats project located in Sandfields in Port Talbot to be included within the HAPS Technical M&E programme. Tai Tarian are implementing a re-development project involving retrofit and new build properties, using different insulation materials and technologies in different phases of the development.

In July 2023 the HAPS Technical M&E team met with Tai Tarian and visited the site to explore the potential for monitoring these homes as a pilot study. The first phase of the development was nearing completion at the time and already had some monitoring

equipment installed. This presented the opportunity for the HAPS Technical M&E programme to explore how to work with existing monitoring systems and complement them with additional equipment to ensure that all parameters that need to be measured for the HAPS Technical M&E programme could be achieved. The second phase, which was due to start, presented the opportunity to observe the construction phase and install appropriate monitoring equipment as well as to monitor the properties post-retrofit or post-construction for two years. The third phase which was yet to start, presented the opportunity to gather pre-retrofit data ahead of any works starting in addition to observing the construction and post-retrofit stage. After the visit the HAPS Technical M&E team created a detailed monitoring plan, a fact-finding list of questions, a list of pre-monitoring requirements and a list of equipment to purchase specific to this site.

The HAPS Technical M&E team met again with Tai Tarian in early September to present the proposed monitoring plan and to discuss the technical requirements in more detail. There was a positive discussion and response. The FIF application process was open at the time, and this was communicated to Tai Tarian. However, Tai Tarian did not submit an application. No further communication was received from Tai Tarian so the technical M&E opportunity has not been taken up.

4 HAPS Technical M&E project delivery plan

Following submissions and independent evaluation, the successful FIF applicants were notified on November 24th 2023, and application details were shared with the HAPS Technical M&E team. The information in the application forms has been reviewed to gain an understanding of each of the projects and to consider the potential M&E approach for each site, including suitability for moderate and/or comprehensive monitoring. Some organisations have been successful with applications for both new build and retrofit projects. The successful projects include:

- 7 new build sites comprising 142 properties across 3 different organisations;
- 9 retrofit sites comprising 219 properties across 7 organisations.

The HAPS Technical M&E team have confirmed with the HAPS Project Management team that there is a need for a Collaboration Agreement to be signed between the organisations receiving the FIF and the University, to clarify the University's role and the requirements for monitoring works. The University will provide a Collaboration Agreement to the HAPS Project Management team for this purpose. The Collaboration Agreement will be issued to the organisations alongside the HAPS FIF funding agreement with NPTCBC. The HAPS Technical M&E team has emphasised the need to meet with all successful FIF projects urgently to begin implementation. The retrofit projects should be prioritised to attempt to capture data from the current heating season.

An inception meeting with the HAPS Project Management team, the HAPS Technical M&E team and all of the successful FIF retrofit projects has been set for 30th January 2024 in Baglan. After this, the HAPS Technical M&E team will engage directly with the FIF project teams to prepare a detailed monitoring plan to be implemented inline with their delivery plans. The HAPS Project Management team will secure the funding agreements and collaboration agreements required to enable the implementation.

5 Social and community benefits

5.1 Educational opportunities, graduate placements, community initiatives and secondment opportunities

Cardiff University have just launched a placement/secondment scheme under its Harmonised IAA programme. There is a possibility for an application to be submitted by the team to secure funding to enable a placement or secondment which will need to demonstrate impact.

As already demonstrated with the funding leveraged, the HAPS Technical M&E team will identify funding sources as they arise and look out for calls to create paid-for placements. Prof Jo Patterson is the Director of Research within the Welsh School of Architecture, is part of the Net Zero Innovation Institute Management Board, a board member of the Place Based Impact Accelerator with Swansea Council and the deputy Chair of the Wales Innovation Network Net Zero strategic group and as such will be made aware of relevant calls and funding sources that could be used to support the delivery of HAPS.

5.2 Recruitment opportunities

In line with Cardiff University's HR processes the Research Associate and Project Officer roles for the HAPS Technical M&E team were initially advertised internally to redeployment candidates (existing members of staff with less than 6 months remaining on their contract). The Project Officer role was fulfilled through this route. There were no suitable redeployment candidates for the Research Associate role and so this role was advertised externally and fulfilled by a recent PhD graduate from the University.

5.3 Information sharing networks and training sessions

During the reporting period the HAPS Technical M&E team have attended a variety of information sharing network activities and shared information about the role within the HAPS project. These include:

Date	Event title	Attended by	Which sector are the attendees from?
24/04/23	Wales Innovation Network launch	Prof. Jo Patterson	Net Zero from across Wales – Jo is now Cardiff Uni Rep and Deputy Chair of the WIN NZ Strategic Committee
26/04/23	Tai 2023 Conference	Presentation given by Prof. Jo Patterson	200+ attendees Housing sector, RSL's, Local Authorities, Welsh Government.
05/05/23	GW4 anniversary event	Prof. Jo Patterson	Senior leaders of Bath, Bristol, Cardiff, and Exeter Universities.
12/07/23	WG Local Area Energy Planning Workshop on domestic retrofit	Prof. Jo Patterson	Housing sector, RSL's, Local Authorities, Welsh Government.

05/09/23	Association for Public Service Excellence (APSE) Energy Event - Swansea	Presentation given by Prof. Jo Patterson	40+ Local Authority staff from housing sector
08/08/23	Filming for BBC news	Prof. Jo Patterson interviewed	Public
17/10/23	Secretary of State for Wales and Wales Innovation Network event for research and Innovation in Wales.	Prof. Jo Patterson and Manos Perisoglou attended and had a stand promoting outcomes	Welsh and UK Government representatives
14/11/23	Housing Decarbonisation - Community of Practice Event	Prof. Jo Patterson key speaker at this event - PRESS tool	Housing sector, RSL's, Local Authorities, Welsh Government
29/11/23	British Academy Policy Insight Workshop	Dr Manos Perisoglou	Cross sector environment and sustainability professions with social science research
06/12/23	CABE Conference - Built Environment LIVE 2023, two-day live technical symposium and exhibition.	Prof. Jo Patterson presented with Q&A Retrofit of Domestic and Non-Domestic Buildings	Construction, technical, trades, building safety and building engineers

As Co-Director and key partners in the Arts and Humanities Research Council funded project Transforming Housing and Homes for Future Generations, opportunities to promote the Homes As Power stations programme are frequent, both within the consortium which includes 50 partners from 7 organisations as well as a much wider stakeholder audience interested in retrofit and the general improvement of housing stock.

5.4 Supply Chain Opportunities

As noted in the overview section, the HAPS Technical M&E team attended launch of the Duracell battery for home storage event at the National Botanic Garden of Wales on 30th November 2023.

Now that the HAPS FIF projects have now been identified there will be scope to identify Supply Chain opportunities and the HAPS Technical M&E team will work closely with Neath Port Talbot Council to support and develop these.

6 Investment leveraged

During the reporting period, the Cardiff University Low Carbon Built Environment team have been successful in bidding for and securing new project funding through:

- HAPS retrofit Shared Prosperity Fund demonstration homes**
 This project will run from January to December 2024 using Shared Prosperity funding secured via NPTCBC to create two demonstration homes with Tai Tarian. The project will showcase the process of retrofit including modelling and monitoring, and showcase the retrofit solutions available.
- Transforming Housing and Homes for Future Generations**
 This project will run from October 2023 and September 2025. In total the project funding is £4.6million across 50+ consortium members from Cardiff, Bath, Bristol and Exeter Universities, Swansea Council, Mikhail Riches, So Modular, We Can Make, Wood knowledge Wales, and the Alliance for Sustainable Building Products (ASBP).

The project aims to create a new multi-partner, transdisciplinary, design ecosystem to transform housing for future generations using bio-based and non-extractive materials, together with renewable energy supply and storage. Prof Jo Patterson is Co-Director.

- **Embedding good practice into social housing to enable progress towards Net Zero high quality homes**
One Research Associate will be funded initially for 12 months to develop a retrofit strategy with Trivallis Housing Association.
- **Investigating the benefits and challenges experienced by owner-occupiers who are undergoing a whole house retrofit to stimulate large scale uptake**
One Research Associate and one Research Assistant for (part of the time) will be funded through the Place Based Impact Accelerator Account Project Net Zero Buildings led by Swansea University.

7 Finance update

7.1 Budget

The HAPS Technical M&E team have conducted quarterly informal budget reviews this year. Staff have been recruited and charged to the project as outlined in the original proposal. There has been a review of the existing stock of monitoring equipment available to the HAPS Technical M&E team and some new (upgraded) equipment has been purchased for testing prior to implementation. There has been significantly less purchased than anticipated due to the delays in confirming the FIF projects. Purchasing of monitoring equipment will now take place within the next six months to allow timely installation. The HAPS Technical M&E team will continue to conduct quarterly budget reviews to capture forecast costs and ensure that the current underspend is used appropriately.

7.2 Invoicing

Cardiff University have issued an invoice for the first 12 months of project delivery. The intention is to invoice every six months in future.

8 Risk Register

The Technical M & E risk register is included in an excel document. In addition, each project that has successfully applied for the HAPS FIF has submitted a risk register for each application / scheme. There will be a requirement to update these as the projects progress.



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