Energy Smart Appliances standards programme – PAS 1878 and PAS 1879 development stage

Roadmap for PAS implementation and next steps

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Important notice

This research paper has been prepared for general information purposes relating to its subject matter only. It is not intended to be advice on any particular course of action. For more information on its subject matter specifically, or on Standards and other services offered by the British Standards Institution more generally, please contact katherine.hunter@bsigroup.com.

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Executive summary

In May 2021, following extensive engagement with a wide stakeholder community over a period of twenty-four months, BSI published PAS 1878[1] and PAS 1879[2].

These PASs are intended as key enablers of demand side response (DSR) and will contribute to a more flexible and secure energy system. They will allow consumers to offer their energy smart appliances into services that can modify their operational cycle depending on the capacity of the electricity network or the availability of electricity on the grid. These standards will assist with developing the new market structures that the energy system is entering; consumers can be protected from new risks, including cyber security risks, and be encouraged to be more involved. For example, by enabling interoperability through standardization, consumers can have a free choice of appliances from different manufacturers that are able to communicate effectively and provide DSR services through any service provider the consumer has contracted with.

Whilst an important development, the publication of the two PASs is just the first step towards establishing good practice for a DSR-enabled, flexible and secure energy system and there is a need to set out a follow-on programme of work to build upon the PASs and further enhance their impact on the market.

To facilitate this exercise, BSI has conducted a series of stakeholder interviews and workshops which addressed a number of topics.

1. How to embed the two PASs developed within the programme in the wider national and international standardization framework to support ongoing management and adoption.
2. Identify options to develop a testing and certification regime and other requirements of DSR as they are developed.
3. How to promote the convergence, where appropriate, of formal standards for energy smart appliances (ESA) and Smart EV chargepoints.
4. Consideration of wider standardization activities that should be part of a post-programme standards landscape.

This report builds on the feedback received from stakeholders and sets out a series of standardization activities required to support the early implementation of PAS 1878/9, exploring how they can be internationalized and developed beyond their initial limited scope and integrated into the wider energy system.

To achieve this, it is recommended from Autumn 2021, a follow-on programme of activities is initiated to realize the benefits of DSR enabled by ESA. This programme should build on the current ESA Standards Programme, continue for an initial period of two years and where possible, utilize existing communities, national and international for its implementation.

Normally, industry will adopt standards because they provide a commercial benefit or, in certain instances, when government recommends a particular standard as a route to compliance with regulations. Government has announced[3] that, using its powers under the AEV Act[4], in 2021 it will legislate for minimum smart charger device level requirements. It will not mandate compliance with PAS 1878, but the legislation will be compatible with PAS 1878. There will be a second phase of legislation updating the device level requirements

1 PAS 1878:2021, *Energy smart appliances – System functionality and architecture – Specification* https://shop.bsigroup.com/ProductDetail?pid=000000000030396626

2 PAS 1879:2021, *Energy smart appliances – Demand side response operation – Code of practice* https://shop.bsigroup.com/ProductDetail?pid=000000000030396625

3 Electric Vehicle Smart Charging, *Government Response to the 2019 Consultation on Electric Vehicle Smart Charging*, HM Government, July 2021.

4 Great Britain. Automated and Electric Vehicles Act 2018. London: The Stationery Office.

and extending beyond the devices themselves to the entities which control them, such as the DSR service providers. The smart metering system remains government's lead option for delivering smart charging, but stakeholders are encouraged to share views, and the option of mandating compliance with PAS 1878/9 will be considered in this second phase. It follows that industry may well adopt the PASs with a view to possible future policy decisions. However, there are also good commercial reasons for industry to use PAS 1878/9 as this will provide consumers with the freedom to choose appliances from different manufacturers that can be used to access DSR services offered by multiple service providers. This report therefore sets out recommendations to encourage industry to adopt and further develop the PASs. Furthermore, PAS 1878 should be promoted to companies offering DSR services as an enabling element of this new service.

The principal recommendations detailed in the report are as follows.

1. a. Establish an Industrial Sponsorship Group (ISG) to promote the use and uptake of PAS 1878/9. This group would be responsible for the overarching roll out of ESAs across the UK, considering the commercial and societal requirements for the deployment of ESAs and alignment with adjacent sectors on the energy demand and supply side. It would oversee the work of delegated working groups which should include, as a priority, consideration of the approaches for conformity and assurance of ESAs to standards.
   b. An internationalization plan, options and course of action will be discussed and developed by BSI in collaboration with all key parties, including BEIS, the proposed ISG, and with key involvement from BSI committees.
2. a. There should be one or more demonstrations of DSR services based on PAS 1878/9 as a showcase for other countries to see the benefits of this approach. Additionally, there should be a review of international DSR activities to identify groups to beneficially collaborate with.
   b. Via the relevant BSI technical committee (TC), engage with CLC TC 205 WG 18 to promote alignment of future developments of prEN 50491-12-2 with PAS 1878.
3. PAS 1878 applies to a wide range of appliances. EV charging, heat pumps and storage should be the primary focus for the initial development work.
4. a. BSI L/13 Smart Energy Coordination Committee should work with other relevant BSI Committees to promote the PASs within relevant international standardization activities.
   b. The ISG should ensure that there is close cooperation between its own work and that of other relevant UK activities and initiatives.
5. A Technical Working Group (TWG) should be established by the ISG to identify potential enhancements to the PASs and support their further development through future revisions of the PASs.
6. Impactful consumer awareness raising activities should be identified and undertaken. As part of that effort, the development and roll out of a labelling scheme for PAS 1878 compliant ESAs could be considered. Such a scheme should be aligned to wider approaches developed for conformity and assurance of ESAs to standards.
7. The need for UK experts to take part in international standards development must be recognized and funded.

Each of these recommendations and the specific tasks within them will require collaboration with the relevant product standards committees. Further, in the future, ESAs should be more fully integrated into smart home standards, which will largely be developed in international groups.

Alongside working on standardization, the full use of PAS 1878/9 will involve close integration with groups developing other aspects of the transitioning energy system, such as the EV Energy Task Force (EVET). Such

groups have wider scopes than the PASs cover, but flexibility will be a key component of the roll out of EVs, electric heat and expansion of renewable generation. The use of the PASs to deliver this flexibility should be promoted to create a consistent, interoperable DSR system.

The report sets out a wide range of activities that follow from these recommendations. These recommended activities are proposed as inputs to the L/13, and the ISG and TWG who should carry out a planning and prioritization exercise if these recommendations are adopted.

1 Introduction

The increasing use of electricity for heating and transport and the move to less flexible generation such as wind and PV creates a need for more flexible loads. Control of these flexible loads can be used to reduce the need to reinforce power networks and can increase the use of renewable generation. To achieve this, a load management system has to be established, connecting signals from distribution network operators (DNOs) and energy suppliers via demand side response service providers (DSRSPs) to ESAs that can modify their demand pattern on command from the DSRSP.

The current standardization programme sponsored by BEIS is widely recognized as a major step forward in realizing ESA deployment in the UK; principally through two standards that create a minimum specification for an ESA (PAS 1878) and a code of practice for the demand side response (DSR) environment in which the ESA can operate (PAS 1879). The scopes of PAS 1878/9 are reproduced in Figure 1.

PAS 1878:2021, *Energy smart appliances. System functionality and architecture. Specification*

This PAS specifies requirements and criteria that an electrical appliance needs to meet in order to perform and be classified as an energy smart appliance (ESA). It defines the attributes, the functionalities and performance criteria for an ESA. This PAS is intended to be used by manufacturers of ESAs and CEMs. Other actors who might have an interest in this PAS are maintainers of ESAs, manufacturers and maintainers of interfacing products, software developers and service providers.

PAS 1879:2021, *Energy smart appliances. Demand side response operation. Code of practice*

This PAS sets out a common definition of demand side response (DSR) services for actors operating within the consumer energy supply chain and provides recommendations to support the operation of energy smart appliances (ESA). The consumer-focused approach outlined in this PAS can coexist with other forms of balancing or DSR. This PAS is aimed at those organizations responsible for providing and delivering energy services to domestic (e.g. individual households) or small business (i.e. SME) premises.

Figure 1 – Standards developed by the ESA programme

PAS 1878 sets out that "...an energy smart appliance is one which is able to respond automatically to price and/or other signals and, as part of that response, to modulate its electricity consumption and/or production".

The move to such a flexible energy system plan is an important part of the Government's wider Smart Systems and Flexibility Plan[5] and is a core component of BEIS/Ofgem's future-facing work to enable the energy system transition. A key objective of the plan is that consumers are more directly involved in managing demand in the electricity system through smart appliances that react to the availability of electricity on the grid in determining their operational cycle.

By using standards to assist with the market structure that the energy system is entering, consumers can be protected from new risks, including cyber-attacks, and be encouraged to be more involved. For example,

5 Transitioning to a net zero energy system: Smart systems and flexibility plan 2021, https://www.gov.uk/government/publications/transitioning-to-a-net-zero-energy-system-smart-systems-and-flexibility-plan-2021

by enabling interoperability through standardization, consumers can have a free choice of appliances from different manufacturers that are able to communicate effectively and provide DSR services through any service provider the consumer has contracted with.

To assist in understanding the report, Figure 2 below shows a simple view of the PAS 1878/9 architecture and lists several terms that have different names in the standards developed by IEC TC 205 WG 18.

The ESA system comprises a number of functional components that are able to be implemented in a variety of different forms. Groups developing ESA systems (notably IEC TC 205 WG 18) have given different names to these functional components and it is useful to list these to show their equivalence. Although not directly comparable technically, these are useful to indicate where relevant activities are underway. The figure below (taken from PAS 1878) shows the basic architecture assumed in PAS 1878/9 for reference through the report.

PAS 1878/9	IEC TC 205 WG 18
CEM	CEM
ESA Gateway (ESAG)	Resource Manager
On-premises router/gateway, mobile data modem on ESA or CEM etc.	Energy Management Gateway
Interface A	S1 interface
Interface B	Manufacturer interface
Internal CEM interface (optional)	S2 interface
ESA	SA

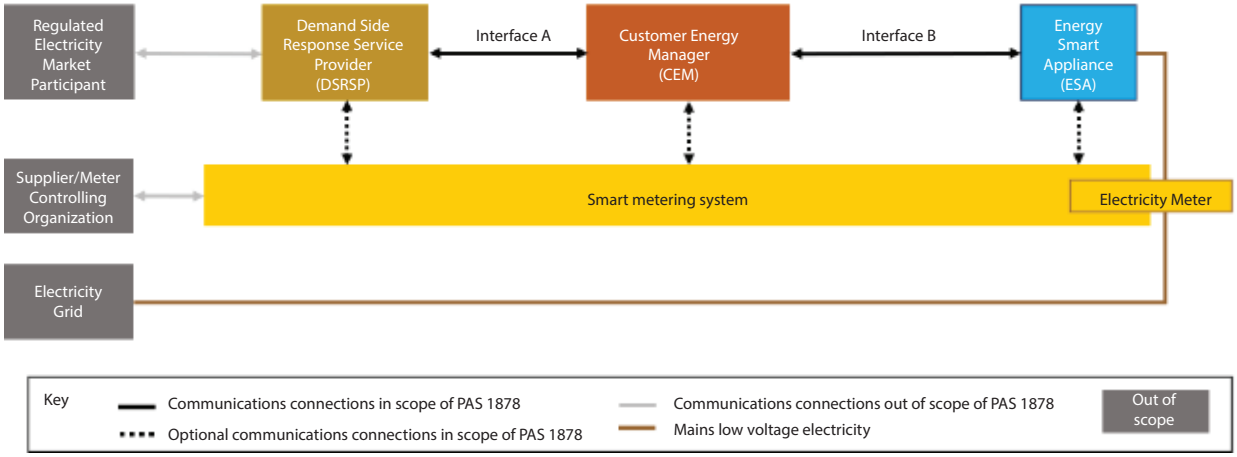

Figure 2 – Logical DSR architecture and communications described by PAS 1878

ESA and DSR are nascent and evolving topics. PAS 1878/9 represent the most significant activity to date that provides guidance as to how smart flexible energy could work. However, they should both be considered as a platform to build upon going forwards as our energy system becomes more flexible. The development of the PASs involved extensive engagement with a wide variety of stakeholders and the consensus from those working on the ESA programme was that it should be considered as a starting point rather than the end point of ESA roll out in the UK.

For this reason, BSI conducted a series of interviews and held three workshops to gather the views of stakeholders on what should be done to support the dissemination and uptake of the PASs.

Specifically, four topics were examined.

1. How to embed PAS 1878/9 in the wider national and international standardization framework to support ongoing management and uptake.

2. Identify options to develop a testing and certification regime providing assurance of conformity to PAS 1878.
3. How to promote the convergence, where appropriate, of formal standards for ESAs and Smart EV chargepoints.
4. Consideration of wider standardization activities that should be part of a post-programme standards landscape.

Further to this, there are several ongoing international initiatives developing flexible energy systems and it would be desirable to integrate the PASs with this activity, possibly reflected in future revisions of the two standards.

2 Building from the ESA Standards Programme

This report specifies activities to be undertaken post completion of the ESA Standards Programme and how they can be accomplished through a series of recommendations.

Roadmap Scope

Items in scope:

- For topics identified as necessary, but out of scope of the two PASs, consider options for how further standards could be established. (Chapter 3)
- For the PASs developed as part of the programme, how to cement their alignment with national and international standardization activities. (Chapter 3)
- Development plans of standards that extend beyond the minimum provisions set out in PAS 1878/9. (Chapter 4)
- Consider options for how a demonstration of compliance to PAS 1878 could be established. (Chapter 5)
- Consider wider standardization issues that manifest themselves as an issue to the successful implementation of DSR. (Chapter 6 and 7)

Items out of scope:

- Policy and regulation related to DSR and ESA, including carbon-reduction plans.
- Specific business models underpinning DSR.
- Topics not specific to DSR and ESA.

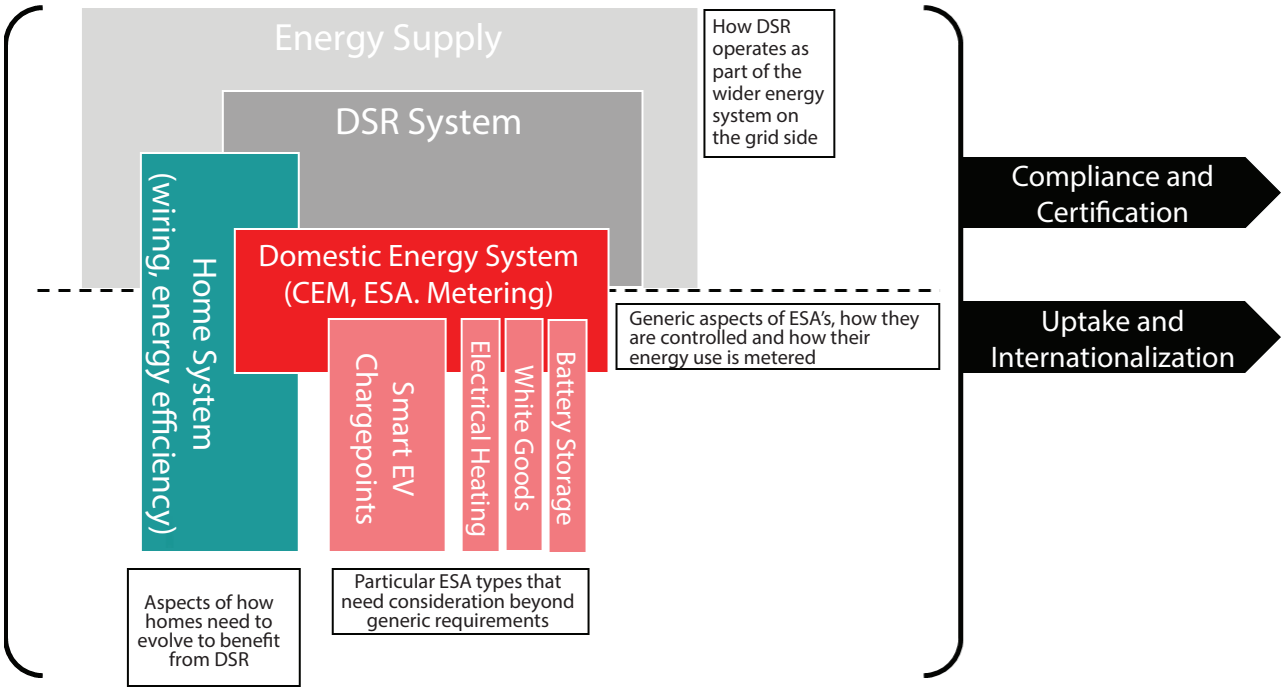

Figure 3 – Conceptual view of the topics considered in the roadmap

Key challenges to be addressed, solutions and recommendations

Proposing the adoption and internationalization of PAS 1878/9 gives rise to a number of challenges which are examined below, along with consideration of how these challenges can be overcome.

BEIS and OZEV are continuing to develop policy for smart appliances[6], smart charging[7] and flexibility providers[8]; in order to deliver benefits to consumers and the energy system, while protecting against risks from the emerging smart energy system. This includes developing an appropriate regulatory and technical environment for such devices, systems and actors. Therefore, going forward, it will be important that industry engage with policy development and are aware of evolving regulatory requirements.

Promoting the adoption of the PASs by Industry

Challenge: The use of standards is normally voluntary for industry; they are used because industry believes that they offer them a benefit. In some cases, government can choose to recommend a particular standard as a route to demonstrate compliance with regulation. Government has announced that it will not mandate that smart EV chargers are compliant with PAS 1878 when it legislates using AEV Act powers in 2021, but that any legislation will be compatible with PAS 1878[9]. A second, future stage of legislation will consider requiring the smart metering system be used to deliver smart charging, other options are also under consideration including requiring compliance with PAS 1878/9. Against this regulatory background, the key to encouraging wide uptake of PAS 1878/9 is to ensure industry fully understand the benefit the PASs will bring to them and their customers. There are some challenges to this happening as set out below along with recommendations for meeting these challenges.

Solution: To maximize the uptake of the PASs it is strongly recommended that an industrial grouping of major stakeholders is brought together with a view to using, developing and supporting the internationalization of the PASs. The most likely stakeholders to be open to this approach will be companies looking to develop energy and flexibility services. For them, the availability of ESAs with a common functionality and secure communications pathway could be a foundational component of their business. Once such a grouping is established, ESA manufacturers would be confident of a market for PAS 1878 compliant products and would bring them forward. Further, with sufficient commercial interest, companies could make available the technical resource to develop the PASs and associated compliance methods and standards. Many likely stakeholders would be international companies, so there would be a natural drive to bring the PASs into international use.

It follows that alongside the extensive list of work set out in the rest of this report, a vital immediate step will be to promote the PASs to the key stakeholder groups at a senior level and build a grouping of supporters who can take ownership of much of this dissemination and promotion work.

Recommendation 1a: Establish an Industrial Sponsorship Group (ISG) to promote the use and uptake of PAS 1878/9. This group would be responsible for the overarching roll out of ESAs across the UK, considering the commercial and societal requirements for the deployment of ESAs and alignment with adjacent sectors on

6 Consultation outcome: Proposals regarding setting standards for smart appliances, https://www.gov.uk/government/consultations/proposals-regarding-setting-standards-for-smart-appliances

7 Consultation outcome: Electric vehicle smart charging (Phase 1), https://www.gov.uk/government/consultations/electric-vehicle-smart-charging

8 Transitioning to a net zero energy system Smart Systems and Flexibility Plan 2021, BEIS, July 2021. Consultation outcome: Electric vehicle smart charging, section on Phase 2, https://www.gov.uk/government/consultations/electric-vehicle-smart-charging

9 Electric Vehicle Smart Charging, Government Response to the 2019 Consultation on Electric Vehicle Smart Charging, HM Government, July 2021

the energy demand and supply side. It would oversee the work of related technical working groups (TWG), which should include, as a priority, consideration of the approaches for conformity and assurance of ESAs to standards.

Recommendation 1b: An internationalization plan, options and course of action will be discussed and developed by BSI in collaboration with all key parties, including BEIS, the proposed ISG and TWG, and with key involvement from BSI committees.

There are parallel developments in DSR standardization

Challenge: The development of residential flexibility markets is widely recognized around the world as an essential step in decarbonizing heat and transport, and there are a number of solutions that have been or are being developed. The PASs will need to establish their place within this field.

Solution: Potential users of the PASs should be persuaded that they provide a good basis for initiating a mainstream and interoperable flexibility services market and that they are an important step forward. Existing forms of DSR generally support load management via such measures as the temporary reduction of chiller thermostat set points. The widescale introduction of devices such as electrical storage, EVs, thermal storage and heat pumps, where loads can potentially be shifted across a period of hours, creates a need for a more complex form of DSR and this is what PAS 1878/9 provide support for. It will be important to explain to other standardization groups that the PASs are essentially extensions of existing protocols and are, as much as is possible, aligned with current developments.

Specifically, CLC TC 205 WG 18 is developing prEN 50491-12-2, which will provide a comprehensive suite of load management tools of which PAS 1878 is a subset. There is an opportunity to offer PAS 1878/9 as an immediate solution for international markets that share the need for flexibility while being consistent with the longer-term objectives of CLC TC 205 WG 18. By collaborating with the CLC TC 205 WG 18 it should be possible to ensure that PAS 1878 compliant ESAs are forward compatible with future versions of prEN 50491-12-2. In addition, a practical implementation of PAS 1878/9 in the UK would allow testing of the PASs and would be of interest to other groups working in this area as they would find evidence relevant to their own concepts and it is recommended that such a project is carried out. Such a project would require input from a variety of contributors to equip consumers with PAS 1878 compliant ESAs, and a DSO and DSRSP to initiate and act on service requests respectively consistent with PAS 1879. This would also likely require a regulatory sandbox to permit its operation. The ISG could coordinate such a project but would probably need the support of government to deliver all elements of it.

Recommendation 2a: There should be one or more demonstrations of DSR based on PAS 1878/9 as a showcase for other countries to see the benefits of this approach. Additionally, there should be a review of international DSR activities to identify groups to beneficially collaborate with.

Recommendation 2b: Via the relevant BSI technical committee, engage with CLC TC 205 WG 18 to promote alignment of future developments of prEN 50491-12-2 with PAS 1878.

The PASs fall across a wide range of stakeholders and standardization areas

Challenge: There are a wide variety of industry groups that need to adopt elements of the PASs. PAS 1878 primarily addresses the ESA, which will be manufactured by appliance manufacturers as well as chargepoint and heat pump manufacturers, etc. Often, these appliances will already be smart for a variety of purposes, such as user convenience. They might be compliant with one of the smart home protocols, such as ZigBee, and it is likely that ESA functionality will need to be added to an existing smart home protocol.

Solution: A focus on newer forms of ESAs, such as EV chargers, will face less resistance. Getting industry agreement to the adoption of PAS 1878 will be easier for newer ESAs as they have less well-developed markets, are generally recognized as presenting a greater challenge to power network capacity and should attract higher payments for flexibility services. Given government's target of 600,000 annual heat pump installations by 2028, electric heat pumps will follow behind smart charging and will need similar solutions. Battery storage devices are also being developed, as standalone or Vehicle 2 Grid (V2G) and again are well suited to management via PAS 1878/9.

Recommendation 3: PAS 1878 applies to a wide range of appliances. EV charging, heat pumps and storage should be the primary focus for the initial development work around PAS 1878/9.

DSR schemes are being developed for specific forms of ESA

Challenge: It is possible to develop different flexibility solutions for each new form of load, such as an EV charger, rather than a common solution as provided by PAS 1878/9. This will have an impact on consumers as they might have more than one flexibility system to learn and use, and, further, the cost reduction delivered by flexibility solutions will have to be shared across multiple solutions, reducing customer rewards.

This is a challenge for standardization, as product committees, such as IEC TC 69, are focused on developing standards for their products, in this case EVs, and each product committee will need to be persuaded of the benefits of a common flexibility platform and supported in developing common systems. This is no less a challenge in the UK where there are a number of activities underway, such as the EV Energy Taskforce and the ENA Open Networks projects.

Solution: IEC SyC SE, mirrored by L/13 in BSI, is intended to coordinate standards for wider systems and connect the work of individual product committees. The PASs can be promoted as a common DSR solution for all ESAs to IEC SyC SE via L/13. This will ease the important task of ensuring that the correct stakeholders are engaged. The widescale adoption of PAS 1878/9 and suitably enabled ESAs will be attractive to DSRSPs that are seeking to establish a general flexibility market in the UK and beyond. These are commercial and regulatory considerations and beyond the scope of standardization. What can be said is that there are existing standardization structures available to support a systems approach and it will be important for PAS 1878/9 to be promoted into their activities. Further, the UK can become a showcase for such common approaches by ensuring effective integration between the relevant UK initiatives.

Recommendation 4a: BSI L/13 Smart Energy Coordination Committee should work with other relevant BSI Committees to promote the PASs within relevant international standardization activities.

Recommendation 4b: The ISG should ensure that there is close cooperation between its own work and that of other relevant UK activities and initiatives.

Flexibility services and ESAs are a subject of rapid innovation

Challenge: There is a rapid evolution of ESAs and flexibility services and it is essential not to allow standardization to slow down or prevent innovation. However, appropriate standardization can assist and accelerate the development of new markets by providing building blocks that innovation can build on. PAS 1878/9 provide a minimum specification for ESAs and one that allows standards-based and interoperable flexibility services to be offered.

Solution: There are many aspects of PAS 1878, in particular, that can be taken forwards, such as the role of the CEM, the interface B and the role of a resource manager (RM)/ESAG and enabling a whole-house energy

management solution, e.g. through Home Energy Management System (HEMS) integration. Ideally, all of this would evolve within international standardization based on PAS 1878/9.

Recommendation 5: A Technical Working Group (TWG) should be established by the ISG to identify potential enhancements to the PASs and support their development.

DSR must be understood and accepted by consumers

Challenge: Many aspects of DSR will be new to consumers and its adoption should be explained and simplified whilst it should also be clear to consumers how they benefit from the service.

Solution: The proposed industrial grouping should work independently, or with government, to educate consumers on these new services and how they benefit consumers. Additionally, the industrial grouping could develop a label for PAS 1878 compliant ESAs that would be easily understood by consumers and allow them to purchase appliances with a clear understanding of their usability with these new services.

Recommendation 6: Impactful consumer awareness raising activities should be identified and undertaken. As part of that effort, the development and roll out of a labelling scheme for PAS 1878 compliant ESAs could be considered. Such a scheme should be aligned to wider approaches developed for conformity and assurance of ESAs.

Resourcing

Challenge: Delivery of these recommendations will require increased participation by UK experts in international standards committees and the funding of this work will have to be addressed, making experts available and funding travel to international meetings (albeit COVID-19 has reduced the number of face to face meetings) is a significant barrier to involvement in international standards development.

Solution: A benefit of securing the active support of industry via the ISG is that PAS 1878/9 will be seen as the basis for commercial development and investment and these funds will be found more readily.

Recommendation 7: The need for UK experts to take part in international standards development must be recognized and funded.

Summary

PAS 1878/9 are the result of a major programme of work with widespread stakeholder involvement and they offer a solution to the need for greater flexibility as new energy loads are introduced. Despite this, there are significant challenges facing their take up and development, solutions to which have been set out above. The remainder of the report examines in detail each of the specific topics considered in the workshops and expands upon the recommendations set out above.

3 Management of the PASs and international standardization

PAS 1878/9 will be managed post-programme by BSI as the UK National Standards Body

Ongoing and active management of the PASs is important to ensure relevancy of the standards, especially if PAS 1878 is to be used for certification and assurance schemes.

- BSI's management activities for the PASs include:
  - Hosting of the publications in its standards catalogue.
  - Aligning the PASs with activities of standing standards committees.
  - Responsibility for accuracy of the PASs, including issuing corrigenda if found necessary.
  - Coordinating review and update of the PASs.
- BSI will review the PASs to ensure they remain current. A PAS can be reviewed for update at any time, but a review is mandatory after two years (~April 2023). Outcomes of a review can include:
  - Keeping the PAS "as is".
  - Using the PAS as input to other standardization such as an ISO/IEC standard.
  - Establishing a programme of work to update the PAS.
  - Withdrawing the PAS.
- A review is undertaken by BSI in consultation with the Sponsor (BEIS) and can involve members of the original steering group.
- A review of the content of the PASs should take account of the gaps identified in this document.

Table 1 lists the principal standards and associated UK, and International Technical Committees relevant to PAS 1878/9 and relevant actions for those committees.

Table 1 – PAS 1878/9 scope and actions linked to relevant BSI and International committees

	Topic	Relevant standards/committee	Action
1.1	CEM	IST/6/-/12 (CLC TC 205 WG 18) **IEC 63345** - PEL/23 - IEC TC 23 SC 23K) IOT/001 **ISO/IEC 27001-2-19** - IST/033 - JTC1/SC 27 ETSI EN 303 645[10]	• Based on the CEM requirements included in PAS 1878, propose a new standard via CLC TC 205 WG 18 to provide a "minimum level" framework specification and expand on the role of the CEM • Consideration of the CEM as a cloud service
1.2	ESA	CPL/59 - IEC TC 59 - CLC TC 59X IST/6/-/12	• All smart home protocols bodies should be checked to ensure support of PAS 1878 profile signals within their protocols • Stakeholders should be surveyed to understand which protocols to prioritize
1.3	DSR	**EN 61850-7-420** - PEL/57 -IEC TC 57 L/13 - IEC SyC SE **IEEE 1547.3-200**7	• Communication of signals between DSO and DSRSP for residential flexibility is not currently covered by standards. UK developments in this area should be promoted to international bodies and IEC SyC SE
1.4	Electric vehicle charging	**ISO 15118** - PEL/69 - ISO/TC 22/SC 31 **IEC 63110**- PEL/69 - IEC TC 69	• Examine the communication between the EV and the smart chargepoint in terms of compatibility with PAS 1878/9 functionality. How does the CP/EV behave as an ESA? • Examine compatibility between PAS 1878/9 EV charging solution and IEC 63110 implementation
1.5	Battery storage	IST/6/-/12 - TC 205 PEL/21 - TC 21	• Extensions of specific requirements to support PAS 1878
1.6	Heat pump operation	CPL/61/4 - IEC TC 61/SC 61 D	• Extensions of specific requirements to support PAS 1878

BSI will work with stakeholders to promote uptake and advance the internationalization of PAS 1878

BSI are promoting and distributing PAS 1878/9 through its existing channels. However further promotional activities are recommended and could include:

- Development of an information package/material to provide a technical overview of PAS 1878 and the benefits associated with its use, as well as practical implementation guidance around salient aspects of the PAS (and PAS-enabled ESA manufacture and use).
- Engaging with industry via webinars and other events, supporting PR and marketing activities, as well as 1-on-1 meetings with industry stakeholders.
- Wider promotional activities (e.g. speaking slots and trade interviews).
- Case studies.
- Social media activity.
- Cross-promotional activities, events, etc. – in tandem with BEIS, OZEV, and wider government and industry partners.
- Dissemination and promotional activities via the proposed task forces and new groups.

Where possible, BSI will coordinate approaches to promote the PAS with CEN/ISO/IEC as outlined in Table 2 below. Establishing this plan is complex as it requires coordination across several committees in an evolving area.

10 ETSI EN 303 645, V2.1.1:2020, https://www.etsi.org/deliver/etsi_en/303600_303699/303645/02.01.01_60/en_303645v020101p.pdf

Table 2 – PAS internationalization

	Topic	Relevant standards/committees	Action
2.1	Establish a PAS post-publication plan for international uptake	BSI's L/13 committee will be the primary group coordinating UK post-publication activities of the PAS. Key international committees include IEC SyC SE, CLC 205 and IEC TC 57 plus also IEC SEG 9 depending on its future role. Aside from UK activities, there exist national German DSR standards based on EEBus. L/13 should also look at activity around the world, such as US (OpenADR), Japan (EchoNet).	• An internationalization plan, options and course of action will be discussed and developed by BSI in collaboration with all key parties, including BEIS, the proposed ISG and TWG, and with key involvement from BSI committees. *NOTE 1 There is currently no committee with direct remit for ESAs in the integrated manner presented in PAS 1878 and hence active consultation with existing committees will be required. This could require the establishment of a new WG.* *NOTE 2 Any activity to move PAS 1878 onto the international stage would be expected to take a minimum of 24 months.* *NOTE 3 Key aspects of the ESA system, the CEM and S1 interface are also without standards development activities. It needs to be considered if a revision or international uptake of PAS 1878 would benefit from having these in place.*
2.2	Establish the role of the PASs in the international standards development roadmap	L/13 - IEC SyC SE WG2 and JWG 3	• IEC SyC Energy WG2 and JWG3 are developing the next iteration of their Development Plan. L/13, which shadows SyC Energy, will be required to comment on the Development Plan and can use this opportunity to advise IEC SyC SE of the publication of the PASs and set out where we believe they could contribute to the Development Plan.
2.3	Wider environment	SmartThings Project Connected Homes Amazon/Apple/Google	• The TWG should carry out a review of relevant international DSR projects outside of the standards community to ensure that they identify projects that they could collaborate with. • Smart home protocols are often managed outside of international standards and acceptance, and compatibility with these protocols will be important for supporting ESA flexibility services. • Consumers are increasingly familiar with operating their smart home devices via services such as Amazon's Alexa and Apple's Siri. Consideration should be given to how these might be applied to PAS 1878/9 operations and implications for cyber security.
2.4	International Activity	Mission Innovation 2.0[11] – Mission on Power. This is an international collaboration addressing flexibility and data. The UK is leading Pillar 3 – Data and Digitalisation.	• The TWG should connect to the Pillar 3 team to gain insight into other relevant activities around the world and, where relevant, connect with them.

11 Mission Innovation 2.0 – Mission on Power, http://mission-innovation.net/about-mi/overview/

4 Addressing additional standardization gaps identified in the development of PAS 1878/9

PAS 1878 provides a minimum specification for an ESA and several of the items that were out of scope for the PAS are in consideration for future standardization activities as they mature. We expect the content of PAS 1878 to evolve over the next few years.

This report seeks to capture the key topics where recommendations could not be specified at the time of drafting PAS 1878 but should be considered in future revisions.

There are a range of topics that should be considered for future revisions of PAS 1878/9 or potential new standards

The publication of PAS 1878/9 will provide an initial framework for flexibility services and this framework can then be built upon to identify and address standardization gaps. From the workshops, four key areas of standardization gaps were identified that would need to be addressed to support and improve the roll out of ESAs.

1. Standards related to the generic aspects of an ESA system (CEM, ESA, etc.).
2. Standards related to ESA appliance types, notably smart EV charging and electrical heating.
3. Standards related to homes and buildings in which the ESA is deployed.
4. Standards related to the DSR market.

There are aspects of the ESA system that will require an agreed specification in the future

The ESA system includes the components in the home such as the appliance and CEM and the interface to the DSRSP. In the course of developing PAS 1878, aspects of the ESA system could not be specified as they have yet to reach good practice. These specifications we would expect to be developed as standards in their own right and subsequently referred to in a PAS 1878 update.

Table 3 – Standardization gaps

	Topic	Relevant standards/activities	Action
3.1	ESA (product) maintenance through its lifecycle covering software updates and second-hand market	• PAS 1878 now covers registration, deregistration and software updates. Second-user market should be implicit with this. • As connected products, ESA devices will be subject to UK regulation that is currently being developed by the Department for Culture, Media and Sport (DCMS)[12] regarding cyber security unless exempted. DCMS is excluding smart meters, as they are well covered by existing regulations and could apply this to ESAs on the same grounds although this could result in some devices falling under multiple regulatory regimes.	• Consider nuances of second-user market as topic for PAS revision, based on experience of PAS 1878 in use. • BSI to track DCMS development of the Consumer Connected Products legislation and align with the requirements for ESAs. • Note draft ISO 37100 Consumer Protection: Privacy by design for consumer goods and services, which would include ESAs in its scope.
3.2	CEM specification	• CLC TC 205/WG18: No programme proposed for development of a CEM. Hence any CEM specification not expected before 2023. • **prEN 50491-12-2** - CLC TC 205/WG18. Programme proposed for development of a Resource Manager (consistent with the concept of an ESAG). This might be published before 2023. • CLC TC 205/WG20 could consider cyber security aspects of devices such as the CEM.	• This could be an activity that could be initiated by the UK. • This is an activity to be undertaken. There is no plan currently for this, earliest for a CEM would be 2023.
3.3	Control signal from DSO to DSRSP Control signal from energy supplier?	• PEL/57, ENA Open Networks Project • ½ hour settlement for support of dynamic pricing. Elexon	• A variety of protocols are used for various balancing products, for residential flexibility it would assist if there were common services and associated protocols. Such services are being developed by the ENA as part of their Open Networks project. Once developed this should be offered to SyC Energy and IEC TC 57 to establish a standardized process for networks to manage DSR resources. • Application of dynamic tariffs based on ½ hour settlement processes should be examined.

12 Government response to the call for views on consumer connected product cyber security legislation, April 2021
13 Open ADR Alliance, https://www.openadr.org/

	Topic	Relevant standards/activities	Action
3.4	Interface A (DSRSP to CEM)	• IEC PC 118 (mirrored in BSI by L/13) developed the IEC standards for OpenADR but was closed down following the completion of that work and ongoing work is via the OpenADR Alliance[13] • IEC TC 57/JWG25: Could consider specification for S1 (consistent with interface A). However, should consider implementations other than just OpenADR • EEBus • CLC TC 205 • **IEC 62056** DLMS COSEM series - IEC TC13 WG14	• OpenADR has been chosen as a protocol for Interface A although other protocols are allowed. UK users will need to register their interest directly with the OpenADR Alliance. This connection could be made individually by UK manufacturers or by a grouping of industrial parties. • This group could propose the development of an extension of OpenADR to specifically support the PAS 1878/9 use cases. • In the future and based on working experience of the use of PAS 1878/9 there might be a review of the Interface A protocol. Consideration should be given to a process to update interface A or how an additional interface could be introduced. • Engage with EEBus organization to explore option of extending specification to explicitly include interface A functionality. • DLMS/COSEM is being developed to support DSR use cases and was considered as a candidate for Interface A in PAS 1878 but rejected in favour of OpenADR. Progress with DLMS/COSEM should be monitored and its suitability for Interface A reviewed when it is available.
3.5	Interface B (CEM to ESA)	• CLC 205/WG18: Standard for S2 interface to be published mid-2021. S2 is consistent with Interface B in PAS 1878, however it only specifies the data model and not the security model to be used.	• Once **EN 50491-12-2** is published the compatibility of PAS 1878 should be established and promoted.
3.6	CEM Aggregation: Each ESA is logically associated with one CEM. Operationally it would make sense for CEMS to operate in aggregation rather than individually.	• CLC 205/WG18: Any work on CEM aggregation would be pending or part of a CEM specification.	• Consider use cases for PAS revision for CEM to connect to > 1 appliance. Currently not mandatory that it is 1:1, but options for parent:child and peer:peer. • Based on PAS 1878 Annex B.1, consider CEM specializations such as HEMS. • Consider CEM taking over operation of an ESA with an integrated CEM.
3.7	Common methodology for flexibility signals from the DNOs to the DSRSPs.	• Open Networks	• This work is ongoing and outside of the standards arena but should be adopted in UK standards and internationalized.

(*continued*)

Table 3 – (*continued*)

	Topic	Relevant standards/activities	Action
3.8	Coordination of DNOs in their DSR requests to ensure national system requirements.	• ENA Open Networks/ESO	• Consider for revision of PAS 1879.
3.9	Metering baseline (demand v supply). Current approaches do not work and any method needs to be low cost to be viable and operational across a portfolio of appliances.	• P375: "Metering behind the Boundary Point"[14]: Settlement of Secondary BM Units using metering behind the site Boundary Point.	• Consider for revision of PAS 1879. • Consider for revision of PAS 1878 to appraise the impact/benefit of ubiquitous metering baseline and what this would mean for the ESA system. • Should be included in future IEC SyC Energy Development Plan[15].
3.10	Security of communications between the ESO/DNO and DSRSP and trust modelling of basic application of PAS 1878/9 and with more complex designs with multiple ESAs and CEMs	• **IEC 27001-2-19** - IST/33 - ISO/IEC JTC 1/SC 27 • **IEC 62443** - GEL 65 - IEC TC 65	• A risk analysis of the end to end security of ESA enabled flexibility should be carried out with input from stakeholders and NCSC. Appropriate risk mitigation approaches for a core set of flexibility models can then be identified. • Review of certificate management.
3.11	Consumer interaction with CEM/ESA.		• Consumers will be able to interact with the CEM and ESA and there should be consideration of codes of practice. This is probably not a suitable area for standardization.

14 Nicoll, I, *P375: Metering behind the Boundary Point*, Elexon, 2020.
15 IEC SyC Energy Development Plan, https://syc-se.iec.ch/home/organisation/development-plan/

5 An appropriate mechanism needs to be established to demonstrate compliance to PAS 1878

Establish a government–industry advisory group to define the mechanisms to confirm claims of conformity of an ESA to PAS 1878

The ESA programme strategic advisory group recommended that a distinct group be established to advance approaches for demonstrating and assuring compliance to PAS 1878.

- It was felt that certification and conformity should not be left entirely to the market to develop a solution.
- It was felt that a mix of assured compliance and self-declaration could be used to balance conformance requirements to market acceptability.

Wider consultation as part of the development of this roadmap identified the following additional topics for consideration in developing a scheme. An overarching view was that a scheme or similar for demonstrating compliance needs to balance the costs of compliance with the benefits:

- If the compliance level is too high, this will impact the cost of ESA and deter consumers.
- If compliance level is too low it will not build trust in the market and could threaten the security of energy supply.
- If the compliance required is too prescriptive across all aspects of ESAs it will stifle innovation.
- If the compliance required is too lax across all aspects of ESAs it will limit interoperability.

The development of a label for compliant ESAs and CEMs would allow customers to recognize appropriate components and would also focus this area of activity on what is necessary to provide this assurance to customers. If the recommended industrial grouping is established, then it could delegate this task to a technical task force. This task force could, over time, become a standing group, with responsibility for future technical iterations of labelling, aligned with future standards.

A range of factors that should be considered by any approach to demonstrate compliance of an ESA to PAS 1878

The strategic advisory group concluded that the CEM is the key starting point for compliance as this is a key new feature of an ESA distinct from other types of electrical appliance.

- The CEM is a core component of the ESA and crucial to interoperability, and security.
- CEM is where potential issues might develop. As appliances get smarter, CEM compatibility is essential.
- CEM should be considered as a distinct ESA component from a compliance perspective.
- OpenADR is a recommended protocol and currently provides some testing for compliance. However, PAS 1878 includes extensions of OpenADR and these will require new test procedures to be developed.
- Cyber security approach to the CEM, ESA and the ESA broader system. The ESA and CEM will be in scope of ETSI EN 303 645 and a gap analysis of EN 303 645 and PAS 1878 should be conducted to identify what compliance testing is currently supported by the standard and what will need to be developed.

Table 4 – Standards relevant to compliance

	Topic	Relevant standards	Action
4.1	Smart metering: There is extensive experience and established systems from the Smart Metering programme that can be learnt from. The time and effort spent on this will not need to be repeated for ESAs	• Various smart metering standards for information transfer and security. • Established approaches for conformity assessment.	• Smart metering team should be a consideration of any programme to develop a compliance or certification scheme. • Engage with smart DCC (data communications company) to capture lessons learnt on smart meter development and roll out programme as part of a continuous improvement effort.
4.2	CEM in the cloud (service) v CEM as a device (product) might require different schemes, albeit with some common elements	• **ISO/IEC 17789:2014** • Many industry schemes for cloud service assurance (e.g. Microsoft, Amazon) • Input should be requested from IST/33, Information security, cyber security and privacy protection.	• A reference standard for CEM functionality needs to be considered before deployment and hence compliance can be considered. PAS 1878 provides a basis for this. • Tests that are neutral to system implementation can be developed to check correct functioning of CEM/ESA functional blocks (local or cloud based).
4.3	Type testing of ESAs allows grid side actors to facilitate rapid uptake if classes of ESAs can be trusted	• Current industry (grid side) approaches to type testing assets connected to the grid, including how conformity is exposed to demonstrate trusted connections.	• Consider how the certification/compliance of ESAs is to be exposed grid side and any segmentation in the classes/levels of compliance.
4.4	Cyber security/privacy is critical and can be based on existing practices used for SMET. Interoperability is the other aspect crucial for the ESA. Grid Security is more of a grid side issue	• SMET Cyber Security conformity assessment. • Cyber security of DSR and DERMS is being considered in IEC SyC Energy Development Plan[15]. • **IEEE 1547.3** is in development. • **ETSI EN 303 645** will apply and DCMS policy being developed for consumer connected devices will also have ESAs and CEMs in scope (but not smart meters).	• See 2.1 • In order to identify compliance needs and methods, a cyber security risk assessment should be carried out on a general ESA based flexibility scheme. This should be used to identify key, common components that would require product certification. • The coverage of the ESA and CEM in existing product regulations and those in development should be examined and a gap analysis between these and the outcome of any cyber security risk assessment carried out. • Other standards that can provide guidance on testing should be considered, such as **ANSI CTA2088, *Baseline Cybersecurity Standard for Devices and Device Systems.***
4.5	CEM needs 3rd party certification, but "traditional connected appliances" – appliance connected to a smart phone could/should use existing approaches such as CA marking	• Existing approaches to self-declared conformity assessment used by manufacturers currently. • Revision to the Radio Equipment Directive will be relevant and should be examined for possible input.	• Consider the segmentation of ESA and CEM.
4.6	Consider existing approaches for compliance and certification of devices similar to ESAs	• EU JRC and VDE used for EEBus compliance testing by APPLiA • BSI Assurance have kitemark scheme for IoT devices • **ETSI EN 303 645** • **ANSI CTA-2088**	• Consider advantages and disadvantages for existing schemes when appraising an option for ESAs.
4.7	Develop consumer label		• Establish a programme to develop a consumer label for ESAs and CEMs that assure compliance with PAS 1878 and interoperable capability.

6 Contribution to the wider picture of activities advancing the roll out of ESAs

Establish a government–industry initiative to coordinate the advancement of ESAs in the UK and internationally

There is a need to establish an industry-led sponsorship group (ISG) to take ownership of developing the market for PAS 1878/9 compliant ESAs as recommended in Section 2.2.1. This ISG would act as a leadership group for the TWG. In the absence of such a grouping, a similar structure to the EV Energy Task Force (EVET) could be adopted. Indeed, as elements of this work overlap with EVET activity such as smart charging, it might be possible to share this work across the groups or, at least, set up close liaison between the groups. This is illustrated in Figure 4, which shows that a number of energy and product domains face their own challenges to which a DSR solution based on PAS 1878/9 would be a resolution. The ISG should seek to ensure that PAS 1878/9 is used as a consistent offering across these domains.

Oversight groups should have a wider role than just standardization. The scope of the EVET is "to ensure that the GB energy system is ready for and able to facilitate and exploit the mass take up of electric vehicles" and is much wider than smart charging. Similarly, the ISG could form part of a wider activity addressing the development of flexibility services.

- The ISG should start from where the ESA programme concludes.
- The ISG should be aligned to the EVET and wider energy developments. Achieving net zero requires the delivery of many simultaneous and interconnected tasks. The ISG would be an important element in establishing a residential flexibility market. It would intersect with the EVET around smart charging and liaise with other industry bodies such as Energy Data Task force (EDT) and the Electrotechnical Standardization Strategic Advisory Council (ESSAC).
- The smart meter roll out provides a partial template and it is recommended that the lessons from the smart meter roll out are captured to inform the approach to the ESA roll out.

Similarly to EV charging, any group established to encourage the adoption of the PASs will need to deliver concerted action across a wide range of stakeholder groups. These are listed below along with appropriate industry associations. Associations in bold are represented on BSI L/13 and engaged with standards development, although it is likely that all parties will need to increase their contribution towards standardization work. The availability of sufficient technical resource will be greater the more the PASs are used for commercial purposes. It might be necessary for seed funding to establish the various groups, but it will be a mark of the success of the initiative that the cost is taken up largely by industry.

PAS 1878/9 are important components of a number of major elements of decarbonizing energy and affect a wide range of stakeholders who have their own specific requirements that will need to be aligned.

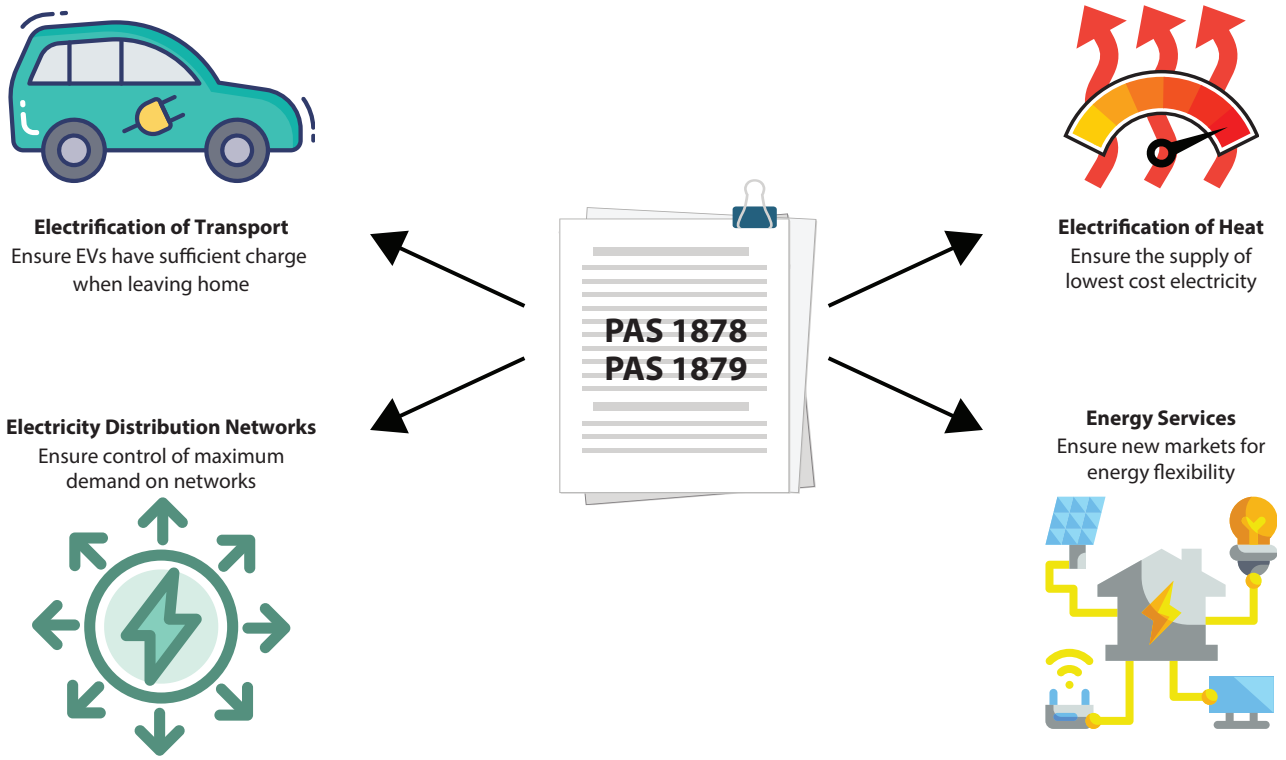

Figure 4 – Role of PAS 1878/9 in delivering energy flexibility

Table 5 – Stakeholders for the uptake and roll out of ESAs

Scope	Stakeholder group	Stakeholder organization
ESAs	Appliance manufacturers	**AMDEA**, APPLiA
	EVSE manufacturers	**BEAMA**, REA, **Energy UK**, **SMMT**
	EV manufacturers	SMMT, Automotive Council
	HP manufacturers	HPA, **BEAMA**
	DSRSPs	ADE, REA, **Energy UK**
	Consumer bodies	Citizen's Advice
	Innovation	**ESC**, Innovate UK
CEM	IoT	**TechUK, AMDEA, BEAMA**
	HEMs	**TechUK, BEAMA**
	Smart homes	**TechUK, BEAMA**
	DSRSPs	ADE**, BEAMA**, REA, **Energy UK**, **SMMT**
	Electricity suppliers	**Energy UK**
	Smart meter manufacturers	**BEAMA**
	Consumer bodies	Citizen's Advice
	Innovation	**ESC**, Innovate UK
DSR	ESO	ESO (Power Responsive)
	DNOs	**ENA** (Open Networks)
	Energy suppliers	**Energy UK**
	DSRSPs	ADE, **Energy UK,** REA, **SMMT, BEAMA**
	EV manufacturers	**SMMT,** Automotive Council
	Smart meter manufacturers	**BEAMA**
	Consumer bodies	Citizen's Advice

The stakeholders have a wide variety of commercial interests and objectives, but all have an interest in the establishment of a functioning residential flexibility market underpinned by energy smart appliances and secure and resilient control systems. It should also be noted that there are a number of parallel initiatives to PAS 1878/9 around the world at various stages of development. It should be an objective of the UK to collaborate with as many of these initiatives as possible, in order to build a widely based international consensus around the use of key components of PAS 1878/9 to deliver flexibility markets around the world.

Most of the parallel developments are based on international standards, although often with a focus on national or regional requirements. This means that BSI L/13, working through IEC SyC Energy, and BSI TCs working through their international ISO and IEC committees, are in a position to access and collaborate across these projects.

Convergence of ESAs and smart EV chargepoints

Providing adequate charging infrastructure for future EVs will be a multifaceted programme with many different charging scenarios. These will include forecourt charging as well as charging for vehicle fleets, at depots, at retail and workplace parking, and individual on-street and off-street parking. Provision of charging infrastructure is being considered by the EV Energy Task Force[16].

These different scenarios can be distinguished on grounds of scale and potential for flexibility. In general, PAS 1878 is most suited for large volume applications where there is a need for an aggregator and where the availability of flexibility is likely (sufficient to support a commercial offering). As the earliest of the new loads addressed by PAS 1878/9, it is vital to their wider adoption that the PASs are included in the development of the appropriate charging scenarios and those developing PAS 1878/9 should work closely with the EVET group.

There are also groups developing international standards for various aspects of EV charging and it will be important to ensure that these provide the necessary support for the PASs. These standards typically focus on the needs of EVs and do not take a wider view of the flexibility provision. This is an issue recognized by IEC SyC SE and it is working to connect standardization activity across different product and system areas. BSI L/13 can use this route to highlight that the PASs can bring EV chargers into alignment with other appliances.

The roll out of a national public charging infrastructure in response to the Government's 10-point plan means alignment with ESA and all smart EV chargepoints will need ongoing consideration. It is important to note that the basic concepts of flexibility services are the same at all sizes, implementation depends on the market; residential flexibility needs low cost, scalable solutions such as supported by PAS 1878/9, whereas larger projects may fall into different balancing and flexibility markets.

16 EV Energy Taskforce, https://www.zemo.org.uk/work-with-us/energy-infrastructure/projects/EVP20-1-EV-Energy-Taskforce.htm

Table 6 – Standards relevant to the wider aspects of ESA

	Topic	Relevant standards	Action
6.1	EVET: Initiative supporting the roll out of the UK electric vehicle charging infrastructure (see Table 9).	Aligned with BSI L/13 and PAS 1878	• EVET should be considered as the primary initiative going forward to consider alignment between ESAs and all smart EV chargepoints.
6.2	Superchargers (>11 kV). Superchargers will always be different to domestic charges. They will require a dedicated connection and often needed to supply "immediately", hence limited flex options, but could be used in conjunction with storage. It is very unlikely that a supercharger would be managed as an ESA.	Standards for superchargers on the grid?	• Assessment of how advances in super charger technology will impact the extent/ need for domestic charging. This is less of an issue for ESAs, but for the wider roll out of smart EV chargepoints. • Monitor for any evidence that PAS 1878/9 are being used for superchargers and investigate as part of the review of the PASs
6.3	Smartness in vehicle. Aspects of smart for charging come from the car. For example, the charger does not know the state of charge of the car and therefore how much energy is required is not available to the ESA. The car controls the smart chargepoint.	**ISO 15118-20**	• Assessment of how vehicle charging standards are developing common approaches for communication of charging demand from vehicle to charger. • Smart charging can be implemented differently to other ESAs as the EV provides an alternative communication path. EVET should consider options for different implementations, including consideration of the consumer experience. • Appraise differences between domestic and commercial EV charging solutions.

There is a need for ongoing standards convergence for ESA and electrical heating

The decarbonization of heat is a major policy driver and a revolution in new approaches is anticipated in the coming decade, driven in part by the Government's ambition of 600,000 heat pumps installations per year by 2028 as set out in the 10-point plan. As this technology is evolving it is recommended to track standards related to advances in heat pump and electrical heating technology to ensure alignment with standards related to ESA and DSR.

Table 7 – Standards relevant to electric heating

	Topic	Relevant standards	Action
7.1	Electrical heating: Decarbonization of domestic heating is creating a revolution in new approaches to electrical heating such as heat pumps. This is relatively new technology and is set to evolve over the coming years.	**IEC 60335 series** - CPL/61/4 - IEC SC 61 D PEL/72 - IEC TC 72	• Establish roadmap for heat pump technology, possibly adopting a similar model to EVET for smart chargepoints. • WG3, System Integration, of the proposed National Centre for the Decarbonisation of Heat could cover this. *NOTE BEAMA is running a cross-sectoral working group, covering manufacturers of heat pumps, heating controls and smart building technologies. The focus is on smart grid controls for heat pumps.*
7.2	There are other options for residential heating such as district heating and hydrogen[17]. These might also benefit from being able to manage ESAs.	BSI heat networks activity	• Liaise with other development work on residential heating.

17 BSI UK Heat Networks, https://www.bsigroup.com/en-GB/industries-and-sectors/energy-and-utilities/uk-heat-networks/

There is a need to consider how standards related to the home and buildings can impact the benefit of ESAs

The ESA programme is targeted at increasing the flexibility of energy consumption in domestic buildings. Additional factors related to the domestic building might be required to improve energy efficiency through the use of ESAs. There will also be homes that have heat pumps and EV smart chargers plus their existing load, where there will be concern about management of total building power demand. ESAs connected to HEMS controllers and a smart meter should be able to manage the maximum demand and this should be examined.

Table 8 – Standards relevant to domestic buildings

	Topic	Relevant standards	Action
8.1	Links between smart energy and wiring regulations. Existing domestic wiring regulations are not designed with flexible energy systems in mind.	**BS 7671** SMETS[18]	• Liaise with the IET to examine work programme related to the wiring regulations. • Consider necessary changes to current regulations. • Investigate use of smart meters and ESAs to manage building electrical demand.
8.2	DC wiring in houses. Homes using back-up batteries could supply DC directly from batteries to many home appliances.	**BS 7671**	• IEC published a report on LVDC[19] that examines this topic in detail, and this should be reviewed for relevance and routes to follow up.
8.3	Future Home Standards[20] for new builds with DSR in mind. For example, "PV and battery storage" ready.	The Future Homes Standard[20] Part L Building Regulations[21] Part P Building Regulations[22]	• Consideration is being given to including EV chargepoints in new buildings. This requirement will be set out in the Building Regulations and these should be reviewed for links to support future flexibility.
8.4	Links between home energy architecture and DSR. The topology and components in a home network may determine the need for different DSR offers. For example, a home that has battery storage as part of its energy network is a different DSR proposition to one that does not.	None	• PAS 1878 B.5 sets out a possible integrated CEM-HEMS architecture and L/13 should promote this approach to other standardization groups. At the very least they should ensure that standards are compatible with PAS 1878.
8.5	There is a Distribution Code proposal G100 to manage the demand of large residential import devices.	G100	• Liaise with the ENA to understand possible application of PAS 1878/9 to operation of G100.

18 Consultation outcome: Smart metering equipment technical specifications: Second version (SMETS), https://www.gov.uk/government/consultations/smart-metering-equipment-technical-specifications-second-version

19 http://pubweb2.iec.ch/technologyreport/pdf/IEC_TR-LVDC.pdf

20 The Future Homes Standard: Changes to Part L and Part F of the Building Regulations for new dwellings, https://www.gov.uk/government/consultations/the-future-homes-standard-changes-to-part-l-and-part-f-of-the-building-regulations-for-new-dwellings

21 HMSO, Building Regulations 2010 Approved document L1A conservation of fuel and power in new dwellings, 2013 edition with 2016 amendments and L1B, conservation of fuel and power in existing dwellings, 2010 edition (incorporating 2010, 2011, 2013, 2016 and 2018 amendments), London: The Stationery Office. https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/697629/L1B_secure-1.pdf

22 DCLG, Building Regulations 2010 Approved document P, 2013 edition, London: NBS. https://www.niceic.com/Niceic.com/media/Schemes/Part-P-Approved-Document-2013-England.pdf

There is a need to consider the DSR market in more detail to support the uptake and benefit of ESAs

The PAS development process identified topics that are not directly related to the ESA eco system but impact the uptake and benefits of DSR and smart energy supply. There is no need for specific actions at this time as there will are more pressing issues to address but for each of these it would be helpful to identify relevant stakeholder groups and ensure that the ISG reaches out to these when it is established.

Table 9 – Standards relevant to DSR market

	Topic	Relevant standards	Action
9.1	Guidance document on how to bring an ESA product to market. PAS 1878 provides a minimum speciation for an ESA; however, guidance would be useful to inform the development cycle of an ESA, culminating in market release.	**PAS 277** and other standards for product launch	• A guidance document should be written when the technical and compliance structures are better developed. This would form part of a public website promoting PAS 1878/9 enabled ESAs and flexibility case studies. • This would include consideration of further standards/guides to support building to PAS 1878.
9.2	Fundamentals/limits of DSR to affect the energy system. Design metrics to support the type of DSR offers that ESAs could respond to. Maybe dependent on local distribution topology.	Open Network Project/ ENA[23]	• TWG to identify and connect with relevant stakeholders.
9.3	Transition to future energy systems and "Energy as a service". Appraisal of DSR in the context of a future smart energy grid and what this means for ESAs.	IEC SyC SE Development Plan 2021[15]	• TWG to identify and connect with relevant stakeholders.
9.4	Community use cases, e.g. gated communities, rural communities, communities with no parking spaces. Appraisal on ESA inclusivity. This is the consumer equivalent of 2.		• TWG to identify and connect with relevant stakeholders.

23 Energy Networks Association, Open Network Project: 2021 Project Initiation Document, https://www.energynetworks.org/assets/images/ON21-2021%20Project%20Initiation%20Document%20FINAL.pdf

7 Supporting activities

Standards activities

There are a range of standards activities that can support the roll out of ESAs. These are summarized in Table 10. Particular attention is drawn to the activities of IEC SyC Smart Energy, which is discussed in more detail below.

Table 10 – Standards relevant to DSR market

	Activity	Standards	Relevant dates	Input to ESA
10.1	**CLC TC 205: Home and Building Electronic Systems (HBES)** Standards for all aspects of home and building electronic systems to ensure integration of a wide spectrum of control applications.	**prEN 50491-12-2** - CLC TC 205/ WG 18	Summer 2021	S2 Interface (CEM > DSRSP)
10.2	**BSI CPL/59 > IEC TC59 Performance of household and similar electrical appliances** UK input into IEC TC 59. SC 59C, SC 59L and SC 59K and CLC TC 59X on methods of measurement of characteristics which are of importance to determine the performance of household electrical appliances and are of interest to the consumer.	EEBus SPINE CENELEC[24] **prEN 50631-1** SAREF[25] **ETSI TS 103 264**	Currently at Committee stage. Publication expected end 2022	Input needed if EEBus issued for PAS 1878
10.3	**IEC Systems Committee on Smart Energy** (IEC SyC SE) Standardization in the field of Smart Energy in order to provide systems level standardization, coordination and guidance in the areas of smart grid and smart energy, including interaction in the areas of heat and gas	**IEC SRD 63199** Top priority standards development status in the domain of smart energy	An updated report is in development and should be published end of 2021	Ensure report accommodates the PAS development.
10.4	**ISO/IEC JTC/1 SC25 WG1: Home electronic systems** ("similar to CLC/TC 205") Standards for home and building electronic systems in residential and commercial environments to support interworking devices (IoT-related) and applications such as energy management, environmental control, lighting and security	**ISO/IEC 15067-3-51**	Due for publication Dec 2022	TC relevant to the development of home electronic system standards, which is where home energy systems would fall.

24 EEBus SPINE CENELEC, https://www.eebus.org/our-work/

25 The Smart Applications Reference ontology (SAREF), https://saref.etsi.org/core/v3.1.1/

Table 10 – (*continued*)

	Activity	Standards	Relevant dates	Input to ESA
10.6	**BSI L/13: Smart Energy Systems coordination** Coordinating smart grids and energy systems information across relevant BSI committees and other sources as a horizontal "systems" committee	L/13 shadows IEC SyC SE and seldom produces standards but acts to connect TC and identify "system" aspects of standards requirements		L/13 should take ownership of the standardization roadmap delivered by this report and oversee its delivery.
10.7	**BSI PEL/13 > IEC TC 13: Electricity Meters** UK input to the work of IEC/TC 13 - Equipment for electrical energy measurement and load control and CLC/TC13 -Equipment for electrical energy measurement and load control	**DLMS COSEM IEC 62056** series of standards - IEC TC 13 WG14 and jointly with IEC TC 57 via JWG/16.		IEC TC 13 WG14 covers the DLMS/ COSEM specification and this work should be investigated for suitability for including in PAS 1878 as an interface A candidate.
10.8	**BSI IST/33 (Information security, cybersecurity and privacy protection)** UK input into ISO/IEC JTC 1/SC 27; recommending action to be taken on issues relevant to ISO/ IEC JTC1 that concern the planning and coordination of security, cyber security and privacy protection work			IST/33 covers a wide range of cyber security standards and should be briefed on the challenges raised by ESAs with a view to connecting with relevant international standardization activities.
10.9	**BSI PEL/69 (Electric Road Vehicles)** > IEC TC 69 UK input to the work of IEC/TC 69, ISO/TC 22/SC 37, and CEN/TC 301	**EN ISO 15118-20**	Scheduled publication date 18/10/2021	Functionality of information exchange between the EV and EVSA and how this would support PAS 1878/9. Flex provision should be examined.
		IEC 63110-2 ED1	Spring 2022	**IEC 63110-2** is likely to be used widely to support EV charging and its compatibility with PAS 1878/9 should be explored and, if possible, promoted.
		IEC 63382 ED1	Spring 2024	UK input to this project is required to ensure suitability to UK operation, and compatibility to PAS 1878/9 implementation.

(*continued*)

Table 10 – (*continued*)

	Activity	Standards	Relevant dates	Input to ESA
10.10	**BSI PEL/57 - Power systems management and associated information exchange** > IEC/TC 57 and CLC/SR 57 UK input to IEC/TC 57 and CLC/SR 57 for telecontrol, tele protection and associated telecommunications equipment, and systems such as power line carrier, used in the planning, operation and maintenance of electric power systems together with ripple control receivers.	• **IEC 62746-10-1 OpenADR 2.0** • **IEC 62746-10-3** • Profile of OASIS EI 1.0[26]		PEL/57 (and IEC TC 57) is the key committee for developing grid side standards. Greater input for the UK is needed, especially if we are to promote standards based on PAS 1879 and UK balancing services.
10.11	**PAS ESA standards steering group**	PAS 1878	Published May 2021 Revision Summer 2023	
		PAS 1879	Published May 2021 Revision Summer 2023	
10.12	**EchoNet** – Development of EchoNet 2.0 to adapt to IoT capabilities	**IEC 62394 -** BSI EPL 100 - IEC TC 100 **ISO/IEC 14543-4-3 -** BSI IST/6/-/12 - ISO/IEC JTC 1/SC 25	Well established smart energy ecosystem. Lacking flexibility profiles.	Should be approached about adopting demand profiling elements of PAS 1878.
10.13	**OpenADR**	**IEC 62746-10-1 OpenADR 2.0** **IEC 62746-10-3** Profile of OASIS EI 1.0[27]		IEC 62746-10-1 was developed by IEC PC 118 which is no longer active. Further development of OpenADR would require re-establishment of PC 118 or direct engagement with the Open ADR Alliance.

IEC SyC Smart Energy

The challenge facing the internationalization of PAS 1878/9 is the broad range of standardization topic areas that they encompass. This is a challenge for all standardization work in the field of DSR, and IEC has established the Systems Committee Smart Energy (SyC SE) to coordinate activity in this area. The role of SyC SE is not to develop product standards but "...to provide overall systems level value, support and guidance to the TCs and other standard development groups, both inside and outside the IEC". Within BSI, L/13 mirrors SyC SE and takes a similar role across BSI TCs.

SyC SE has been active for a number of years and has developed a comprehensive series of tools for the adoption and management of smart grid standards in international markets, most notably the Smart Energy Grid Reference Architecture (SGAM). SyC SE is currently developing an updated roadmap for standards development based on the findings of IEC SRD 63199 Ed1, *Top priority standards development status in the domain of smart energy*. This roadmap is expected to include proposed activity around DSR, EV charging,

26 Profile of OASIS EI 1.0, http://docs.oasis-open.org/energyinterop/ei/v1.0/energyinterop-v1.0.html

integration of V2G, heat pumps, thermal storage, DERMS and cyber security needs for DSR. These are all relevant to the scope of PAS 1878/9 and it is vital that both PASs are included in the development of this framework as bringing them into international standards after alternative standards have been developed will be difficult. An advantage of working via SyC SE is that the group has worked to develop maps of relevant standards and their related technical committees, and these can be used to identify which BSI technical committees should be involved in future work.

The UK has not been a leading participant in SyC SE and industry input has tended to come from other countries. With the development of the PASs the UK is now in a position where there is likely to be a great deal of relevant innovation that will come from the UK and it will be important to increase UK involvement in SyC SE (and associated product and system TCs).

Relevant documents published by IEC SyC Smart Energy are:

- IEC SRD 63199, Top priority standards development status in the domain of smart energy (which sets out IEC SyC Energy's views on areas that require more work).
- IEC SRD 63268 Ed 1, Energy and Data Interfaces of Users Connected to the Smart Grid with Other Smart Grid Stakeholders – Standardization Landscape (which contains a comprehensive list of related standards).

SEG 9 Future structure of standardization of smart homes/buildings

A challenge that this roadmap must address is that much of the relevant activities fall within the smart homes domain, and there is no IEC/CLC Committee that has oversight of this domain. In 2016, IEC set up ahG 66 to review this area and, from this emerged System Evaluation Group 9, Smart Homes and Buildings. This group covered a wider remit than energy, covering all "smart" topics within home and buildings. It involved a variety of committees (IEC TC 72, IEC TC 79, IEC TC 100, IEC SyC AAL, ISO/IEC JTC 1/SC 25, ISO TC 205). SEG 9 was set up with a limited duration and in March 2021 held a series of workshops to get feedback on whether: it has met its original aims and can be closed down, should be made permanent or a SyC Smart Homes and Buildings set up. The outcome of the workshop was inconclusive and further work is underway to produce a final recommendation for the July 2021 IEC SMB meeting. It is likely that some form of Joint Activity Group (JAG) will be established and it will be important for the UK to be represented on this as part of the roadmap activity. The list below sets out the areas that the workshop participants identified as important.

- Facilitate cooperation between TCs.
- Able to create substructures under this structure.
- Accelerate and prioritize standards development on specific items.
- Avoid conflicts/overlaps/duplication of work.
- Gap analysis of specific items.
- Bring interoperability across systems and products including protocols and data semantics.
- Accelerate and prioritize standards development at a high level.
- Carry out high level gap analysis.
- Accessibility/openness to organizations external to IEC.

Clearly, much of this is relevant to the wider adoption of the PASs and the UK should track the progress of the developing JAG, and ensure it's involvement on it. The roadmap will need to be updated as this area emerges.

Projects and initiatives

In addition to specific standardization activities, there are several groups that are considering topics relevant to the roll out of ESAs, creating the knowledge and understanding on which standards can be based. These are summarized in Table 11.

Table 11 – Projects and initiatives relevant to PAS 1878/9

	Activity	Standards	Relevant dates	Input to ESA roll out
11.1	BEIS/OFGEM Smart Systems Flexibility Plan		Forward work plan July 2021.	Actions for government, regulator and industry to undertake to support ESA uptake.
11.2	Smart Metering programme	Mandated Half Hourly Settlement (MHHS) will have important implications for tariff-based flexibility. The smart metering system remains government's lead option for delivering smart charging and we can expect relevant development work from the smart metering programme. There are a number of smart charging trials using smart metering underway.	Residential Smart Tariff. A new four-year smart meter policy framework will commence on 1 January 2022. Ongoing	Tariff information available over HAN and through DCC is standardized (SMETS[18], DUIS) Smart charging trials based on smart metering will provide important learning for PAS 1878/9
11.3	ENA Open Networks	Developing common balancing products for DNOs	To be published in 2021	Open Networks are working on these topics in 2021 relevant to PAS 1878/9: • Commercial arrangements – Standard agreement • Primacy rules for service conflicts • Non-DSO services • Baseline methodologies • Curtailment information The outputs of these studies should be reviewed and the need for changes to PAS 1878/9 considered.
11.4	ESO Power Responsive Group	Stakeholder group for the full range of network balancing services	Ongoing	Support the development of a coherent suite of balancing services across all size ranges.
11.5	EVET	• Considering the full range of standards for smart EV chargepoints in the context of interoperability, cyber security, grid stability and data privacy. • **EN ISO 15118-1:2019** • OCPP v2.0.1[27] • DUIS v1.0[28]		EVET is considering the four principles by BEIS and PAS 1878/9 to ascertain how they support the full spectrum of duration EV chargepoints.
11.6	BEAMA CEM Suppliers		Published December 2020	

(*continued*)

27 Open Charge Point Protocol v2.0.1, https://www.openchargealliance.org/protocols/ocpp-201/

28 DUIS v1.1 Draft SEC Subsidiary Document Submitted to Secretary of State on 18th November 2015 DCC PUBLIC APPENDIX XXX – DCC USER INTERFACE SPECIFICATION

Table 10 – (*continued*)

	Activity	Standards	Relevant dates	Input to ESA roll out
11.7	OpenADR	• **IEC 62746-10-1 OpenADR 2.0**[29] • **IEC 62746-10-3** • Profile of OASIS EI 1.0[27]		The UK should formally connect to the OpenADR Alliance as it is specified in the PAS.
11.8	EEBus	**CLC EN50631-1-2017**	Under review	Links with CLC TC 205, APPLiA, etc. Mirrored CPL/59.
11.9	OCPP	OCPP v2.0.1[28]	Published	OCPP activity should be monitored, especially regarding charging scenarios other than those covered by PAS 1878/9.
11.10	Market-wide half hourly settlement	Introduction of half hourly metering across the electricity market	Programme due to complete 2025	Implications for PAS 1878/9 applications with the widescale introduction of ½ hourly metering and settlement for residential consumers should be considered.

29 OpenADR Alliance 2.0, https://www.openadr.org/specification

Annex 1 Roadmap development

The roadmap was developed using the following process:

1. Consultation with organizations who have been involved in the ESA programme
2. Input of what was learnt during the standard development process
3. Outputs from the public consultations of PAS 1878/9
4. Capture of topics that might need addressing but out of scope of the PASs
5. Creation of document circulated to consultees for review
6. Wider stakeholder workshop
7. Creation of final document based on comments

The roadmap consultation considered four areas:

1. **Embed the two PAS developed by the programme in the wider national and international standardization framework to support ongoing management and adoption**
   a. What national and international standards organizations and committees would be the most relevant?
   b. What relationships with other committees are important to consider?
   c. What industry standards groups have international reach?
2. **Identify options to develop a testing and certification regime providing assurance of conformity to PAS 1878**
   a What approaches to testing and certification of ESAs are appropriate? E.g. Self-declaration – cf. CE/CA marking, 3rd Party certification schemes – Assured or not
   b. What lifecycle stages of an ESA need particular consideration to ensure compliance to PAS 1878?
   c. Are there existing approaches (e.g. testing and certification schemes) that could be used in whole or in part for ESAs?
3. **Implement ongoing convergence where appropriate of formal standards for ESAs and smart EV chargepoints**
   a. What convergence are you are aware of for standards for ESAs and smart EV chargepoints?
   b. What convergence activities are needed?
4. **Consider wider standardization activities that should be part of a post-programme standards landscape**
   a. What is happening in areas that might have a bearing on the standardization of ESAs and DSR? Could be technical, economic, social or political factors?

Annex 2 Validation Workshops

BSI held three validation workshops to validate the initial findings and research carried out for the development of the Energy Smart Appliances standards programme – PAS 1878 and PAS 1879 development stage - Roadmap for PAS implementation and next steps.

1) ESA Roadmap Workshop session 1 – 05.02.2021

The first workshop focused on standards needs and standards development gaps including EV and ESA convergence. Discussion topics included:

- PAS 1878: Consolidating ESA standards.
- Extending ESA functionality.
- Topics 8-12: DSR Functionality.

The session was attended by 20 industry, government, and standards stakeholders.

2) ESA Roadmap Workshop session 2 – 09.02.2021

The second workshop focused on compliance and assurance. Discussion topics included:

- Conformity Assessment in the ESA System.
- Approaches to Conformity Assessment.
- How can these minimum levels of ESA performance best be assessed?

The session was attended by 19 industry, government, and standards stakeholders.

3) ESA Roadmap Workshop session 3 – 10.02.2021

The third workshop focused on ESA's in the wider market. Discussion topics included:

- Uptake and promotion – who should be involved?
- Internationalization of the PASs.
- Factors that could facilitate the uptake of DSR.

The session was attended by 15 industry, government, and standards stakeholders.

Annex 3 Committees

Table 12 – List of full standard committee names

Committee	Title
CLC TC 205	Home and Building Electronic Systems (HBES)
IST/6	Data communications
BSI L/13 (L/13)	Smart Energy Coordination Committee
ISO TC 205	Building environment design
IEC TC 69	Electrical power/energy transfer systems for electrically propelled road vehicles and industrial trucks
IEC SyC SE	Smart energy
PEL/23	Electrical accessories
IEC TC 23 SC 23K	Electrical Energy Efficiency products
IOT/1	Internet of things
IST/33	Information security, cybersecurity and privacy protection
ISO/IEC JTC 1/SC 27	Information security, cybersecurity and privacy protection
CPL/59	Performance of household electrical appliances
IEC TC 59	Performance of household and similar electrical appliances
CLC TC 59X	Performance of household and similar electrical appliances
PEL/57	Power systems management and associated information exchange
IEC TC 57	Power systems management and associated information exchange
PEL/69	Electric vehicles
ISO/TC 22/SC 31	Data communication
IST/6/-/12	Home Electronic Systems
PEL/21	Secondary cells and batteries
CPL/61/4	Room air-conditioners
IEC TC 61/SC 61 D	Appliances for air-conditioning for household and similar purposes
IEC TC 57	Power systems management and associated information exchange
IEC SEG 9	Smart Home/Office Building Systems
JWG 3	IEC Smart Energy Roadmap
IEC PC 118	Smart grid user interface
IEC TC 57/JWG25	Communications for monitoring and control of wind power plants
IEC TC13 WG14	Data exchange for meter reading, tariff and load control
GEL 65	Measurement and control
IEC TC 65	Industrial-process measurement, control and automation
IST/33	Information security, cybersecurity and privacy protection
IEC SC 61 D	Appliances for air-conditioning for household and similar purposes
CPL/72	Electrical control devices for household equipment and appliances
IEC TC 72	Automatic electrical controls
SC 59C	Electrical heating appliances for household and similar purposes
SC 59L	Small household appliances
SC 59K	Performance of household and similar electrical cooking appliances
ISO/IEC JTC/1 SC25	Interconnection of information technology equipment
PEL/13	Electricity meters
IEC TC 13	Electrical energy measurement and control
CLC/TC 13	Electrical energy measurement and control

(*continued*)

Table 12 – (*continued*)

Committee	Title
BSI IST/33	Information security, cybersecurity and privacy protection
ISO/TC 22/SC 37	Electrically propelled vehicles
CEN/TC 301	Electrically propelled road vehicles
IEC/TC 57	Power systems management and associated information exchange
CLC/SR 57	Power systems management and associated information exchange
BSI EPL 100 -IEC TC 100	Audio visual equipment
BSI IST/6/-/12 - ISO/IEC JTC 1/SC 25	Home Electronic Systems
IEC SyC SE	System Committee Smart Energy
ahG/66	Smart Home/Office Building Systems (now disbanded)
IEC TC 72	Automatic electrical controls
IEC TC 79	Alarm and electronic security systems
IEC TC 100	Audio, video and multimedia systems and equipment
IEC SyC AAL	IEC System Committee Active Assisted Living
ISO/IEC JTC 1/SC 25	Interconnection of information technology equipment

Annex 4 Standards

Table 13 – List of standards

Identifier	Title
ANSI CTA 2088	*Baseline Cybersecurity Standard for Devices and Device Systems*
BS 7671	*Requirements for Electrical Installations – IET Wiring Regulations*
CLC EN 50631-1:2017	*Household appliances network and grid connectivity – General Requirements, Generic Data Modelling and Neutral Messages*
EN 61850-7-420	*Communication networks and systems for power utility automation – Part 7-420: Basic communication structure – Distributed energy resources logical nodes*
EN ISO 15118-1:2019	*Road vehicles – Vehicle grid communication interface – Part 1: General information and use-case definition*
EN ISO 15118-20	*Road vehicles – Vehicle to grid communication interface – Part 20: 2nd generation network and application protocol requirements*
ETSI EN 303 645	*Cyber security for Consumer Internet of Things: Baseline requirements*
ETSI TS 103 264	*Smart appliances – Reference Ontology and oneM2M Mapping*
DLMS COSEM IEC 62056	*Automatic Meter Reading*
Engineering Recommendation G100	*Engineering Recommendation G100 Issue 1 Amendment 2 2018 Technical Requirements for Customer Export Limiting Schemes*
IEEE 1547.3-2007	*Guide for Monitoring, Information Exchange, and Control of Distributed Resources Interconnected with Electric Power Systems*
ISO/IEC 27001: 2013 ISO/IEC 27002: 2013 ISO/IEC 27019: 2017	*Information Technology — Security Techniques — Information Security Management Systems — Requirements* *Information Technology — Security Techniques — Code of Practice for Information Security Controls* *Information Technology — Security Techniques — Information Security Controls for the Energy Utility Industry*
IEC 60335	*Household and similar electrical appliances*
IEC 62056	*Electricity metering – Data exchange for meter reading, tariff and load control – Part 21: Direct local data exchange*
IEC 62394	*Service diagnostic interface for consumer electronics products and networks – Implementation for echonet*
IEC 62443	*Security for industrial automation and control systems*
IEC 62746-10-1	*Systems interface between customer energy management system and the power management system – Part 10-1: Open automated demand response*
IEC 62746-10-3	*Systems interface between customer energy management system and the power management system – Part 10-3: Open automated demand response – Adapting smart grid user interfaces to the IEC common information model*
IEC 63110-2 ED1	*Protocol for Management of Electric Vehicles charging and discharging infrastructures – Part 2: Technical protocol specifications and requirements*
IEC 63345	*Energy efficiency systems – Simple external customer display*
IEC 63382 ED1	*Management of Distributed Energy Storage Systems based on Electrically Chargeable Vehicles (ECV-DESS) – Part 1: Definitions, Requirements and Use Cases – Part 2: Data models Protocols, Messages – Part 3: Conformance tests*
IEC SRD 63199	*Top priority standards development status in the domain of smart energy*
IEC SRD 63268 2020	*Energy and data interfaces of users connected to the smart grid with other smart grid stakeholders – Standardization landscape*
IEEE 1547.3	*Guide for Cybersecurity of Distributed Energy Resources Interconnected with Electric Power Systems*
ISO 15118 Series	*Road vehicles - Vehicle to grid communication interface*
ISO/DIS 15118-20	*Road vehicles – Vehicle to grid communication interface – Part 20: 2nd generation network and application protocol requirements*

(*continued*)

Table 13 – (*continued*)

Identifier	Title
ISO 37100	*Sustainable cities and communities – Vocabulary*
ISO/IEC 14543-4-3	*Information technology – Home Electronic Systems (HES) architecture – Part 4-3: Application layer interface to lower communications layers for network enhances control devices of HES Class 1*
ISO/IEC 15067-3-51	*Framework of an On-Premises Narrow AI Engine for an Energy Management System using Energy Management Agents*
ISO/IEC 17789:2014	*Information technology — Cloud computing — Reference architecture*
PAS 1878:2021	*Energy smart appliances – System functionality and architecture – Specification*
PAS 1879:2021	*Energy smart appliances – Demand side response operation – Code of practice*
PAS 277	*Health and wellness apps – Quality criteria across the life cycle – Code of practice*
prEN 50491-12-2	*General requirements for Home and Building Electronic Systems (HBES) and Building Automation and Control Systems – Part 12-2: Smart grid – Application Specification – Interface and framework for customer – Interface between the Home/Building CEM*
prEN 50631-1	*Household appliances network and grid connectivity – Part 1: General requirements, generic data modelling and neutral messages*

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