ReFLEX Orkney

Project Support Workshop Report

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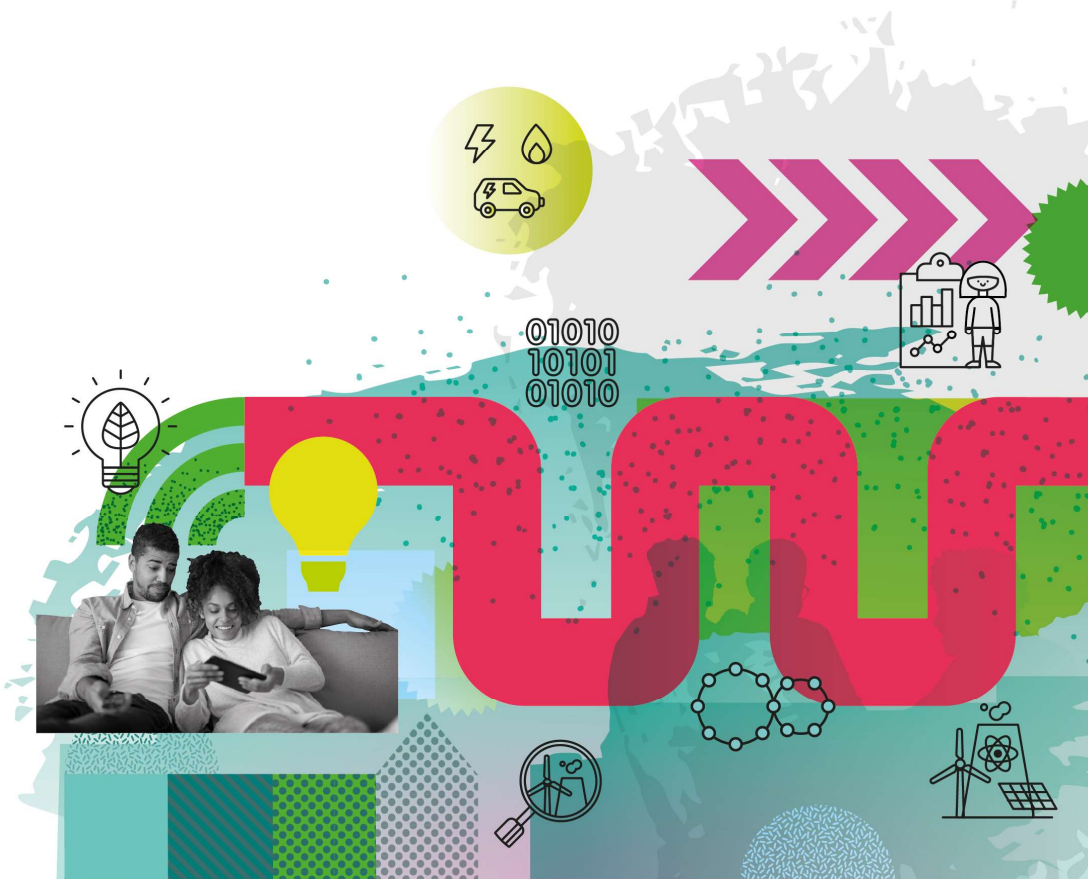
November 2019



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1. Introduction

1.1. Background

The Energy Revolution Integration Service (ERIS) is part of the Energy Systems Catapult (ESC or ESCAT), an independent, technology-agnostic organisation, focused on creating demand pull for energy systems innovation by removing barriers and opening new markets. It exists to respond to the integration challenge, to break down the siloed thinking that stands in the way of sustainable new smart local energy markets and to support the Prospering from the Energy Revolution (PFER) projects.

Following discussions held at the ERIS PFER working group on the 9th and 10th October 2019, a workshop was scoped and agreed with the ReFLEX team in order to:

- Elicit and examine stakeholders, their needs, and their interactions with the solution
- Derive and examine key solution requirements
- Understand solution view and awareness of aspect relationships to develop high-level architecture

This workshop took place under existing ERIS core support and was held on the 30th October at the Orkney Research and Innovation Campus (ORIC) in Stromness, Orkney Islands.

1.2. Purpose

The purpose of this document is to present the outputs and finding of the workshop and propose a way forward for the ReFLEX project.

1.3. Scope

This document describes the activities, outputs, learnings and recommendations from the workshop. Any potential concerns for the ReFLEX project that have been identified during the creation of this report are also recorded.

It is expected that this report will support the creation of the ReFLEX solution Basis of Design (BoD) that is understood and agreed by project members. The BoD is expected to be maintained throughout the life of the project.

The document may also help the ReFLEX project plan and deliver an appropriate systems engineering approach, including the use of Model Based Systems Engineering (MBSE). The ESC has held preliminary discussions with members of the ReFLEX team as to how it could support such activities.

1.4. Attendees

Name	Company
Neil Kermode	EMEC
Matthew Finn	EMEC
Graeme Booth	DOOSAN Babcock
Matt Davidson	DOOSAN Babcock
Mark Hamilton	SOLO Energy
Ger Finneran	SOLO Energy
Alexander Afjool	Community Energy Scotland (CES)
Luke Fraser	Orkney Island Council
Steven Bruce	Orkney Island Council
Chris Page	Aquatera
Lars Harro	Aquatera
Eibhlin Lee	CES
Dan Cook	Technopolis
Laura Watts	Edinburgh University
Benoit Couraud	Heriot Watt University (HWU), via telephone
Kevin Ball	Energy Systems Catapult (ESC)
Anna Stegman	ESC
Jonathan Friend	ESC
Madeline Antill	Consultant to ESC

2. Workshop

2.1. Format

ESC facilitated three engagement exercises that involved all participants in an interactive session:

- Exercise 1 – Review and update Stakeholder Needs: ReFLEX project partners
  - Capture what each project partner can contribute to ReFLEX
  - Capture what each project partner wants to achieve from ReFLEX

- Exercise 2 – Review and update Stakeholder Needs: other stakeholders
  - Review user requirements and stakeholders list recorded in the draft Basis of Design (group #1)
  - Use post-its to identify and group multiple stakeholders relating to ReFLEX (group #2)

- Exercise 3 – Energy System View/Architecture and Aspects of Integration
  - Show relationships and interfaces between stakeholders
  - Populate the type and flow of relationship between stakeholders
  - Identify the system boundary.

The original meeting agenda was not completely followed due to a change in priorities on the day to make best use of time and resources.

ESC also demonstrated several tool-based engineering model examples to highlight the benefits and overall purpose of applying MBSE approach within the project, as part of a systems engineering management and process framework. These are not covered in this document.

2.2. Exercise 1

2.2.1. Summary

Attendees in the room were divided into two groups, which included a member from each project partner where possible. Heriot-Watt supported by telephone. The exercise consisted of each individual recording for ReFLEX the:

- Offering from that project partner
- Needs of that project partner.

This was followed by a group discussion on each to allow members to gain a deeper understanding of what had been written.

2.2.2. Outputs

The outputs from the exercise have been included in Appendix 1 – Exercise 1 Outputs.

2.2.3. Learnings

Each project member could describe their offering and needs clearly. Although there were some clarification questions during the group discussion, there was consensus and understanding of each perspective. Where two outputs were produced for a project partner (as a result of the split groups), these were largely consistent. This implies that each project partner has a well-defined and

clearly understood purpose, and the consortium is well established and comfortable with each partner's contributions.

2.2.4. Recommendations / Way forward

Each project partner should review in detail the other outputs and check for potential conflicts or challenges that could arise e.g. due to competing business models or mismatched expectations.

The project management team should assess the outputs as a whole and ensure they align with the project's vision/mission. Any conflicts or challenges should be discussed between the relevant partners and a way forward agreed.

Each project partner should consolidate and finalise their company's perspective (from the two versions, where available), so there is a single, agreed position for that company. The ReFLEX 'exploitation document' that was referred to during the workshop may then need to be refreshed.

Stakeholder requirements should be derived and added to the others assessed and captured in Exercise 2.

2.3. Exercise 2

2.3.1. Summary

Attendees remained in groups in order to identify and assess new and existing stakeholders

Group#1 were tasked to review the current user list and requirements recorded in the draft Basis of Design. Each user was assessed in sequence and additional users and requirements were recorded.

Group#2 were tasked to use post-its to identify stakeholders that the group assessed were involved the project. Stakeholders were then moved into specific categories.

2.3.2. Outputs

The outputs from the exercise have been included in Appendix 2 – Exercise 2 Outputs.

2.3.3. Learnings

The two lists created by the two groups contained many of the same stakeholders, which suggests the project has a good understanding of its key stakeholders and how they relate to the ReFLEX system. However, some differences were apparent.

Additional stakeholders were identified that were not on the original list in the draft BoD, and some types of stakeholder did not naturally fit into any of the existing categories or transcended categories e.g. Air BnB guest.

'Affordability' was raised as a requirement for the solution, rather than 'cheaper'. This is an important distinction and one that will be important for both messaging and system implementation.

The stakeholders identified are largely those who use ReFLEX or are part of its development system. Other impacted stakeholders may be missing.

2.3.4. Recommendations / Way forward

Each project partner should review the stakeholders and requirements identified and propose any further changes.

The engineering management team should consolidate and update the stakeholder lists from exercises 1 and 2 to a form a final, approved list from the exercises.

The engineering management team should consider if there are other stakeholders missing from the list. Consider stakeholders within the areas of:

- Users e.g. homeowners, vehicle users
- Operators e.g. control system operators, EV charging station maintainers
- Decision maker e.g. project board, customer, financer
- Parties to the agreement e.g. energy supplier, DNO, electricity distribution system, transmission system
- Regulatory bodies e.g. Ofgem, system operator
- Development agencies e.g. Scottish Enterprise
- Support organisations e.g. equipment maintainers, spares providers
- Society at large (within the context of the proposed solution) e.g. naturalists, walkers, media

The engineering management team should analyse the finalised stakeholder list and derive or update any associated requirements. The ESC has provided a template for stakeholder requirements that could be used. Use cases could also be used to understand stakeholder interactions with the ReFLEX system to refine and derive additional requirements.

The engineering management team should assess the stakeholder requirements and their impact on the ReFLEX solution architecture and design. It is recommended that ReFLEX system requirements are created to inform the BoD. The ESC has provided a template for system requirements that could be used. Consider system requirements within the areas of:

- Function
- Performance
- Interface
- Physical
- Electrical
- Safety
- Human Factors
- Electromagnetic Compatibility (EMC)
- Availability, Reliability and Maintainability (ARM)
- Operability
- Supportability
- Communications
- Security
- Risks
- Constraints

The difference between an affordable consumer proposition and a cheaper one should be understood, and a project-wide position agreed to allow clear communications and manage expectations, as well as inform the system design, implementation and validation.

2.4. Exercise 3

2.4.1. Summary

All attendees were combined back into a single group and tasked to develop a high-level architecture of the ReFLEX System of Interest (SoI) using the project partner templates from Exercise 1, including key interfaces within and external to the system. Interfaces considered included property exchanges of physical e.g. heat, power; logical e.g. data; and value e.g. money, knowledge. A discussion was held around using the Aspects of Integration framework to help identify missing interfaces, check for completeness and understand system integration issues and risks, although the task itself was not undertaken.

2.4.2. Outputs

The outputs from the exercise have been included in Appendix 3 – Exercise 3 Outputs.

2.4.3. Learnings

Each project partner was able to identify the key interfaces between their organisation and others, including key exchanges, suggesting a good understanding at component level of the contribution to the overall ReFLEX system. Discussions on interfaces were focussed on clarity rather than discrepancies.

Some interfaces only appear partially complete, with one-way transfers and nothing in return. This suggests there is a missing value exchange that is not currently captured. Interfaces currently show the key value exchange and it is likely that others are missing, especially those relating to non-technical or financial exchanges.

There was some discussion on non-project partner entities and energy projects, and whether they were within the system boundary or outside of it. Some were placed on the edge, suggesting a key interface but not necessarily part of the core solution.

The need for a system design authority or development function was identified to oversee the design and implementation of the overall solution.

2.4.4. Recommendations / Way forward

The solution architecture and design, including interfaces, should be further developed by the system design authority, with the participation and agreement of all project partners. This will include clearly defining the system boundary (what is in, what is out, what is a dependency and what is an opportunity). This may result in conflicts with existing or planned subsystem (element, component) designs or products, which will need to be managed.

The project should consider the use of Aspects of Integration to assess the system interfaces for completeness and ensure that all relevant exchanges of interface have been identified. This can also help identify risks and issues relevant to the system that have been overlooked or not considered from a system perspective. A description of each aspect is provided in Appendix 4 – Aspects of Integration. The ESC can support the completion of this assessment, subject to agreement.

The planned BoD document should be owned by the system design authority and include the traceability from the stakeholder analyses undertaken, through to the ReFLEX system requirements, and the proposed system architecture and design. The BoD baseline should be agreed by the

engineering management team and the overall project board, with future changes managed through agreement.

The engineering management team should produce and agree at project level an engineering management plan/document that addresses the overall engineering management and collaboration approach, including any processes relevant to systems engineering, MBSE, change management, decision making, etc.

3. Conclusion

3.1. Summary

The ReFLEX team identified additional stakeholders along with groupings, on top of what had previously been identified in the initial Basis of Design document

The team started to scope out the system boundary from a stakeholder perspective and identify the key relationships.

An initial ReFLEX System of Interest (SoI) was identified and the key interfaces and exchanges of value defined both within and external to the SoI.

The Aspects of Integration concept was introduced to show how it could be used to identify key integration issues and risks.

3.2. Key Findings

Subsystems within the project are quite mature in their understanding and each project partner is confident in their subsystem, but this could be challenged by the definition and agreement of the solution architecture and system design.

The ReFLEX system boundary (what is in, what is out, what is a dependency, and what is an opportunity) should be documented to clearly define what is in scope.

It may be beneficial to explore more around the actors and customer experience (use cases) at the system level to help understand cross-system dependencies and constraints.

The ReFLEX project and business requirements have been considered, these should be formally captured and agreed, and translated into system-level requirements to define what the overall solution needs to do.

The definition of the architecture and system design should be developed and captured in the Basis of Design document. Cross-project collaborative design sessions are recommended to ensure understanding and agreement.

The difference between an affordable consumer proposition and a cheaper one should be understood, and a project-wide position agreed to allow clear communications and manage expectations.

ReFLEX would benefit from an engineering management plan/document that addresses the project's overall management and collaboration approach (ISO-44001), applicable processes, change management principles, etc.

4. Appendix 1 – Exercise 1 Outputs

Figure 1: Offerings and Needs of Project Partners

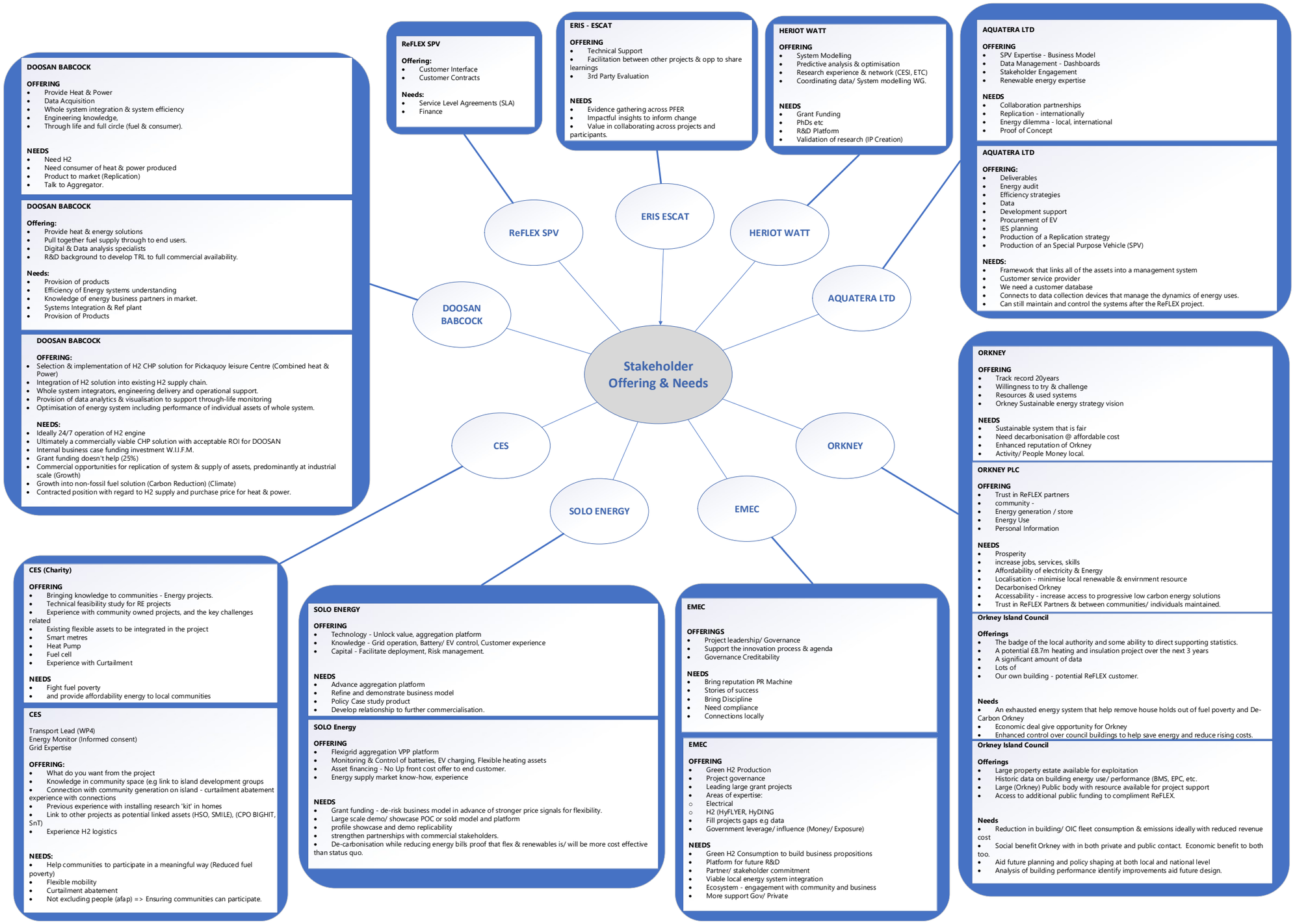

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Table 1: Offerings and Needs from Heriot-Watt University

Solution for HWU	**Impacted Stakeholders**	**Stakeholder's need**	**Stakeholder's Expected Gain**	**Our Needs (HWU)**
Forecasting (Demand & Production) Model	Solo	Accurate forecast as an input of their Control Software	Accurate forecasts to make their decision for battery control	• Previous historic data (Demand and Production) • Requirements from Solo (time interval between forecasts, horizon of the forecast)
Building Thermal flexibility Model	Solo	Knowledge of accessible building flexibility	Able to access thermal flexibility within the community	• Relevant Buildings characteristics • Relevant Buildings historic consumption (hourly)
	Council	Recommendations for Buildings' technologies	New guidelines for buildings' refurbishment adapted to Orkney's case	• Relevant Buildings characteristics • Relevant Buildings historic consumption (hourly)
Economically Optimized Control Algorithm for Batteries	Solo	Need an algorithm to take efficient decisions for charging/discharging the assets	Algorithm to be implemented in the EMS of Solo	• Forecasts of Demand/Production (from HWU) • Requirements from Solo (for the control algorithm)
Market Design	Regulatory / Scientific Communities	Determine what future local Electricity markets could be	Architecture and assessment of the proposed Framework for Orkney's case	• Orkney infrastructure characteristics • Previous historic localized data

5. Appendix 2 – Exercise 2 Outputs

5.1. Group#1 (Started with current list)

5.1.1. Pickaquoy Leisure Centre

Stakeholders

- Orkney Islands Council
- Picky Trust
- Orkney Community

Requirements

- Same/cheaper cost of energy (heat and power)
- Minimal disruption
- Same/better reliability/availability
- Same/better maintenance and operational costs
- Reduced/zero carbon footprint
- Not visually impacting site
- **NEW: Affordability**

5.1.2. Domestic Property Owner

Stakeholders

- Homeowner (mortgage/landlord)
- Home tenant (private/public)
- Orkney Islands Council (council-owned properties)
- Building contractors
- **NEW: Tourists, AirBNB**
- **NEW: Orkney Housing Association (OHAL)**

Requirements (no solar/wind)

- Reduced/same power/heat costs
- Potential to pay more for 'zero carbon' heat and power
- Improved comfort in the home
- No additional effort in managing the home power/heat controls
- Interest in reducing/optimising energy demand
- **NEW: Home EV Charging**

Requirements (with solar/wind)

- Reduced/same power/heat costs
- Potential to pay more for 'zero carbon' heat and power
- Improved comfort in the home
- No additional effort in managing the home power/heat controls
- Interest in reducing/optimising energy demand
- Use of self-generated power/heat for home
- Use of self-generated power/heat for electric vehicles
- Ability to sell surplus power and heat
- Ability to store surplus power and heat

- **NEW: Knowledge,**
- **NEW: Easy to use**
- **NEW: Install and forget**
- **NEW: Maintenance/ Support/ Cost/ Service**
- **NEW: Should not devalue property etc.**

5.1.3. Commercial/ Industrial Property Owner

Stakeholders

- Owner (mortgage/landlord)
- Tenant (private/public)
- Orkney Islands Council (council-owned properties)
- Building contractors
- **NEW: Tourist B&B**
- **NEW: Fire Service**

Requirements (no solar/wind)

- Reduced/same power/heat costs
- Potential to pay more for 'zero carbon' heat and power
- Improved comfort
- No additional effort in managing the power/heat controls
- Interest in reducing/optimising energy demand
- **NEW: Response times**
- **NEW: Value for business**
- **NEW: Maintenance / support/ Failure/ Response time/ Impact of Failure**

Requirements (with solar/wind)

- Reduced/same power/heat costs
- Potential to pay more for 'zero carbon' heat and power
- Improved comfort
- No additional effort in managing the power/heat controls
- Interest in reducing/optimising energy demand
- Use of self-generated power/heat for business
- Use of self-generated power/heat for business electric vehicles
- Ability to sell surplus power and heat
- Ability to store surplus power and heat
- **NEW: Battery – Redundancy**
- **NEW: Maintenance no invasive**
- **NEW: Home charging infrastructure**

5.1.4. Orkney Islands Council

Stakeholders

- Councillors
- Community
- **NEW: Officers, including Harbour**
- **NEW: Scottish Government (Member of Scottish Parliament) MSP**
- **NEW: Local MP of Orkney & Shetlands**

- **NEW: Electrical Maintenance contractors**

Requirements

- Reduced carbon footprint (ideally zero/negative)
- Reduced fuel poverty
- Reduced operational costs for OIC assets (TLC)
- Position as UK lead in 'Race for Zero'
- **NEW: Maintenance requirements**

5.1.5. Electric vehicle infrastructure user

Stakeholders

- Owner (OIC, community, private)
- Users (individuals, fleets, community transport businesses)
- Operator (manufacturer, contractor, Back office – Charge Place Scotland)
- Installers
- **NEW: Maintenance engineers**
- **NEW: Spares company**
- **NEW: Taxi**
- **NEW: Bus Operators**
- **NEW: Coach Operators**

Requirements

- Same/better reliability/availability
- Reduced/same charging cost
- Ability to store surplus power
- Ability to sell surplus power
- **NEW: Reduced Maintenance costs**

5.1.6. Community transport

Stakeholders

- Hoy community
- Hoy development trust
- Operator of service
- **NEW: Orkney Island Council (OIC)**
- **NEW: Building contractors**
- **NEW: Electrical contractors**
- **NEW: Heat contractors for refit and maintenance**
- **NEW: Fuel Garages**
- **NEW: Community Groups (WI)**
- **NEW: Taxi Drivers**
- **NEW: Car Dealerships**
- **NEW: Other PFER projects**
- **NEW: Scottish & Southern Electricity Network (SSEN)**
- **NEW: Building contractors = New buildings**
- **NEW: Electrical contractors, plumbing contractor, installers**

Requirements

- Increased mobility
- Same/better reliability/availability
- Same/better cost to use
- Reduced/zero carbon footprint

5.2. Group #2 (Started with blank sheet)

5.2.1. Electricity Network & Markets

Stakeholders

- Scottish & Southern Electricity Networks (SSEN)
- National Grid
- Flexibility trading platform providers (e.g. Electron)
- Energy Suppliers

5.2.2. Partners

Stakeholders

- Aquatera
- OIC
- EMEC
- DOOSAN
- CES
- SOLO
- Heriot Watt University

5.2.3. Funding

Stakeholders

- Government
- Funders (BEIS/ Innovate UK)
- Private finance

5.2.4. Visitors

Stakeholders

- Visitors
- Tourists
- Cruise Liners

5.2.5. Services / Assets

Stakeholders

- Battery (All other assets) Suppliers
- H/S Installations/ Maintenance
- Car Providers
- Charge place Scotland
- Generators (<20kw)

- Generators (>20kw)
- Car Club providers

5.2.6. Orkney Plc

Stakeholders

- Local SPV
- Replication areas/ communities
- Community Organisation
- Orkney Renewable Energy Forum (OREF)
- Flexible Bus Services

5.2.7. Domestic

Stakeholders

- Commercial
- Public (Sector)
- Ferry Operator

5.2.8. PFER

Stakeholders

- Energy Rev
- IPSOS MORI
- Energy Systems Catapult (ESC)

Figure 2: Map of stakeholder groups from Group 2



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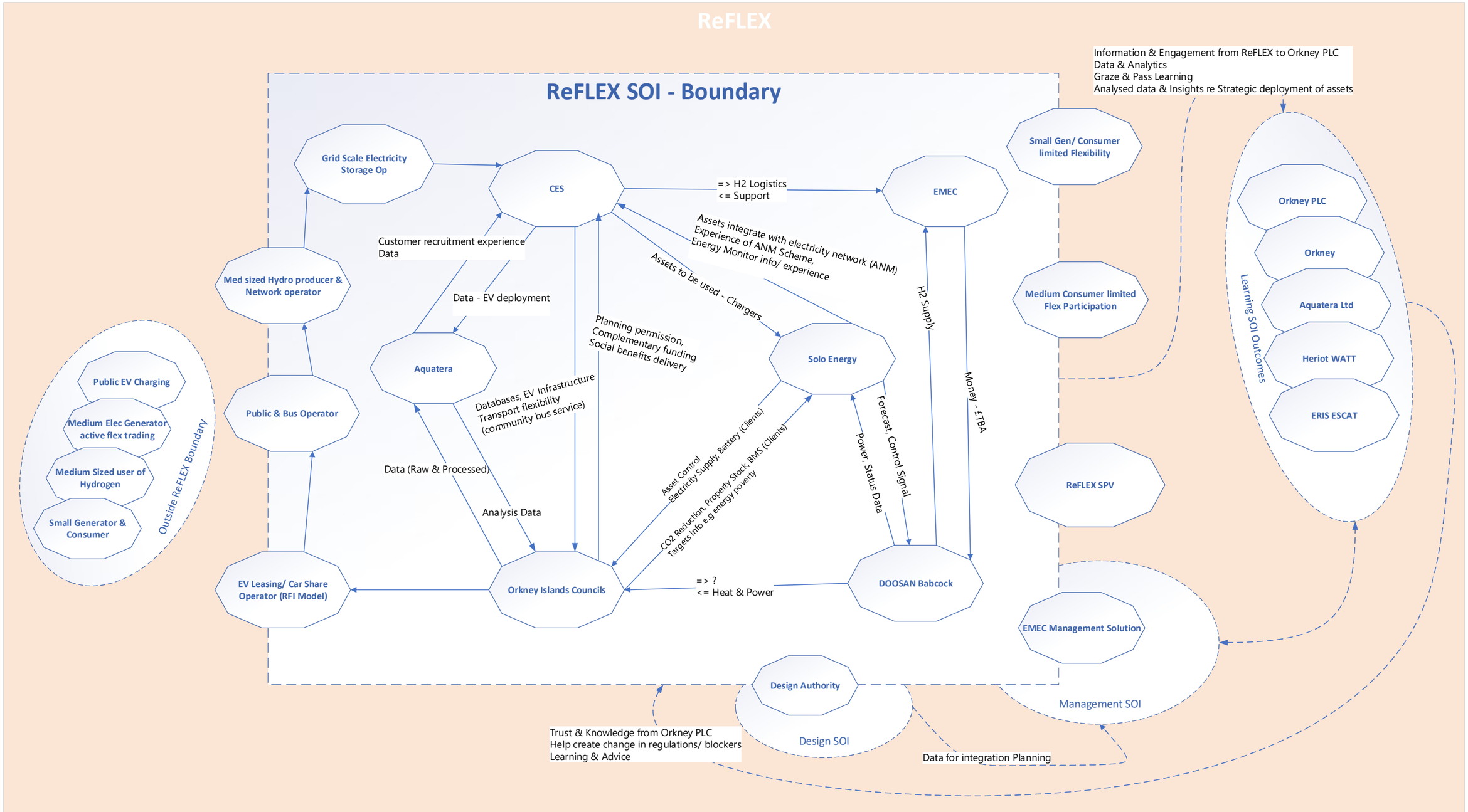
6. Appendix 3 – Exercise 3 Outputs

Figure 3: ReFLEX System of Interest (SoI)



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7. Appendix 4 – Aspects of Integration

7.1. Overview

Aspects	Description
Technology	Availability and readiness of any new or existing technology required for the solution, and its manufacture, installation and commissioning
Information	Availability, accessibility and security of any new or existing information required for the solution, and its management and operation
Infrastructure	Availability and readiness of any new or existing infrastructure required for operation or support of the solution
Interoperability	Ability of the solution to work in harmony with current or planned parts of the WES and interrelated (sibling) solutions at the 'system of systems' level to meet local and national level objectives
People	Consumer and cultural impact and readiness. Integration of human factors for operation and support of the solution. Training Needs. Job creation. Actors include people, companies, government and communities
Policy and Legislation	Compliance with existing or planned policy, legislation and regulation. Need for any new or changed policy, legislation and regulation
Commercial / Organisational	End to end order, manufacturing & logistics process in place. Price & profit sustainability Resilient to market fluctuations (exchange rates, competitor offerings).
Operation and Support	Operation, Support and Maintenance of the solution. Disposal and Decommissioning or Withdrawal from service at the end of the planned lifetime. Reliability and Quality (continuous improvement) during the planned lifetime.

7.2. Technology

Solution technology	Manufacturing technology	Scalability of solution technology	Scalability of manufacturing technology	Installation	Commissioning
Hardware, software and processes. One solution may have multiple technologies	Manufacture and creation of the final 'production standard' solution	Scalability of the solution to the target volume and types of users and locations	Can enough components be manufactured to the required standards?	The installation of the solution or production technology by skilled people	The enabling and activation of the solution

7.3. Information

Consumption	Generation	Organisation	Access	Governance	Quality of Service
General, Availability, Metrics	General, Extractions, Characteristics, Metrics	Modelling, Classification, Semantics, Structure, User Experience	Search, Discovery, Analytics, User Experience, Navigation, System Interface, Metrics	Stewardship, Classification, Policy	Security, Availability, Reliability, Scalability, Usefulness

7.4. Infrastructure

Logistics / distribution	Operational housing/hosting
The practical implementation of supply, transport and storage of your solution up until operation	While in operation where is the solution hosted / housed. Hosting can refer to servers and data processing. Housing refers to the physical location of the solution components and the need for shelter, power, light, etc.

7.5. Interoperability

Compatibility with sibling solutions	System boundaries	Compatibility with known and future WES
Describes how this solution is compatible with other solutions either already incumbent or as part of this solution and future solutions	Describes where this solution ends and handover to other systems takes place	Describes how this solution is compatible with the wider whole energy system. Much of this is covered in codes and legislation to ensure compatibilities. Consideration for a new solution are the introduction of new compatibility challenges

7.6. People

Cultural/societal	Consumers	Other Actors	Human Factors	Training & Business Change
Behaviours of groups, either locally to the solution but also aware of wider societal needs and impacts.	The end receiving consumer or customer of the services to meet their needs of business, mobility and domestic life	Local residents where planning is required, or quality of life indirectly affected by the solution	Safe and ergonomic interface between humans and the solution; operation, installation and support	The training, documentation and change activities related to integrating the solution into its intended

7.7. Policy and Legislation

Policy	Regulation and Legislation	Standards and codes	Licenses
Policy set by governing bodies at the local, regional, national and international level	Regulation and legislation set for the operating space of the solution	The standards and codes applicable for implementing and operating the solution	The licenses needed to operate and implement the solution

7.8. Commercial / Organisation

Business model	Operating model	Commercial model
Financing, value analysis (additional benefits and dis-benefits that make or break the value), Return On Investment, Risk management, CAPEX/OPEX, Capabilities, Services/Products, (IP Licencing)	Logistics, Supply Chain, delivery force, lines of communication, Organisational construct (Ltd, LLP etc.), People (SQEP, committed, available), Processes, Insource, Outsource, Governance, Functions (HR, Trading, sales and BD)	Contracts (B2B & B2C), pricing, Tariffs, SLAS/OBAs, Measures, Incentives, Customer Relationship Management (methods and tools), Supplier Relationship Mgmt., IP. Interoperability of commercial agreements (back-to-back arrangements)

7.9. Operation and Support

Retirement	Operation and Update	Planned Lifetime	Service and Support Model	Training for installers and maintainers	Quality and Reliability
Withdrawal options for the solution and its supply chain are understood Decommissioning costs and impacts	Arrangements for the day-to-day operation of the solution	An understanding of the longevity of any physical solution as well as the lifetime of any trial	Documented escalation paths for SLA breaches	Hardware training requirements for installers working on behalf of the solution	Quality assessment of each stage of the customer journey with management plans in place for monitoring of quality of service to SLAs

8. References

Scanned items from the workshop can be found in the attached zipped folder labelled 'Supporting Material'.

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