

Circularity in Scotland's Clean Heat Transition: a systems- based understanding

IEA Project 65

Heat Pumps in a Circular Economy

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@ZeroWasteScot



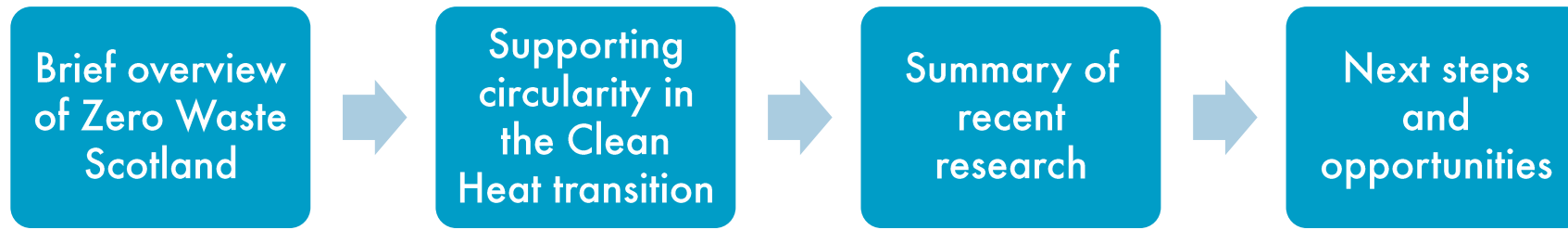
@HowToWasteLess



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Today's presentation



- Key learning intentions
 1. Understanding of Scotland's heat decarbonisation journey
 2. Importance of applying a systems-based understanding
 3. Insight into factors influencing circularity in the Clean Heat transition

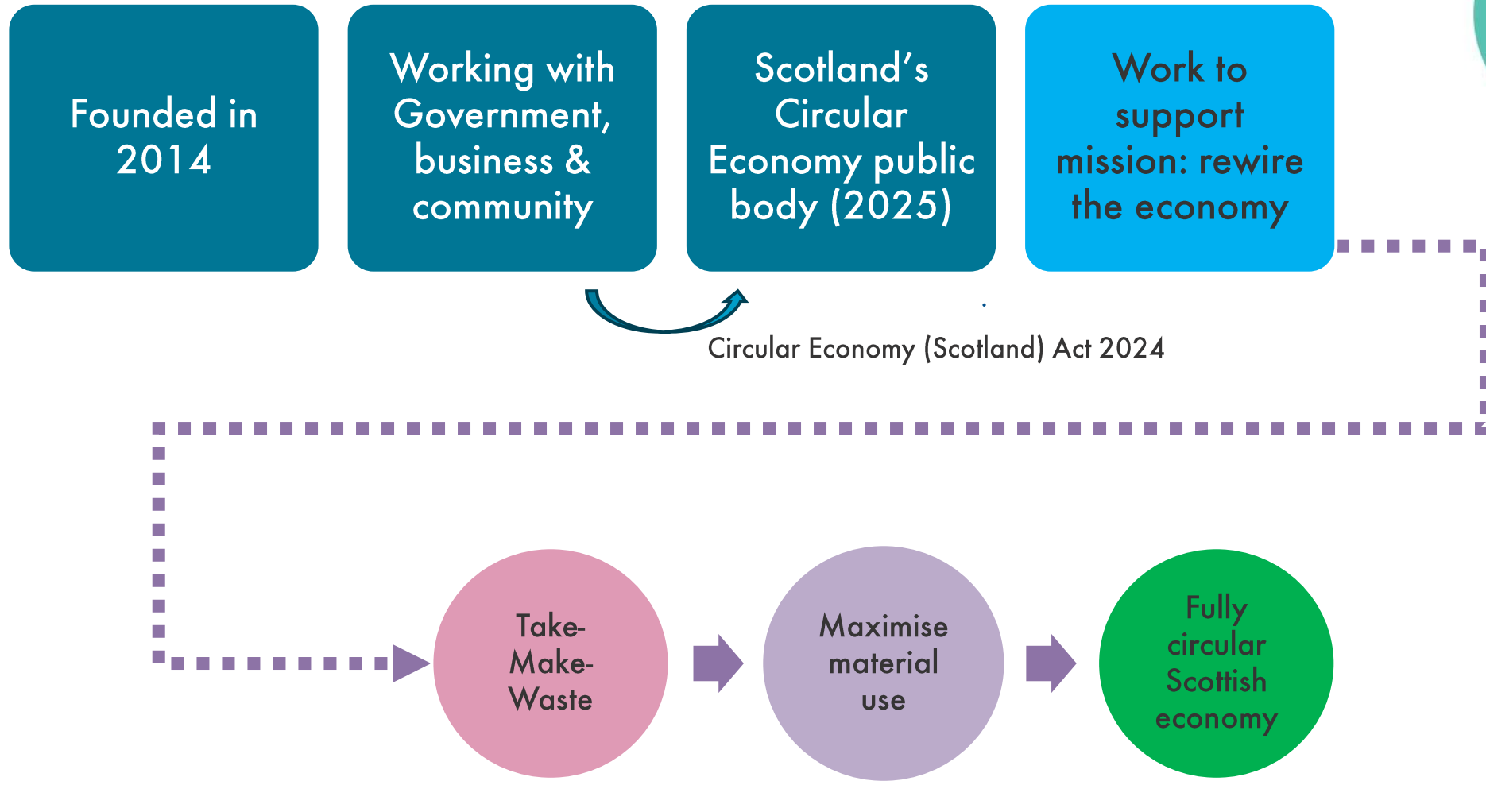




Who are Zero Waste Scotland?



Who are Zero Waste Scotland?



Who are Zero Waste Scotland?

Mission centred around four key themes:



Help people care



Make circularity easier



Do more where it matters most



Improve infrastructure

Who are Zero Waste Scotland?

For further information:

[Zero Waste Scotland Corporate Plan \(2024- 2030\)](#)





How are Zero Waste Scotland supporting a circular Clean Heat transition?



How are Zero Waste Scotland supporting a circular Clean Heat transition?

Identifying technical factors influencing success

Stakeholder mapping to identify collaborative approaches

Develop Roadmaps

Developing and testing interventions with key stakeholders



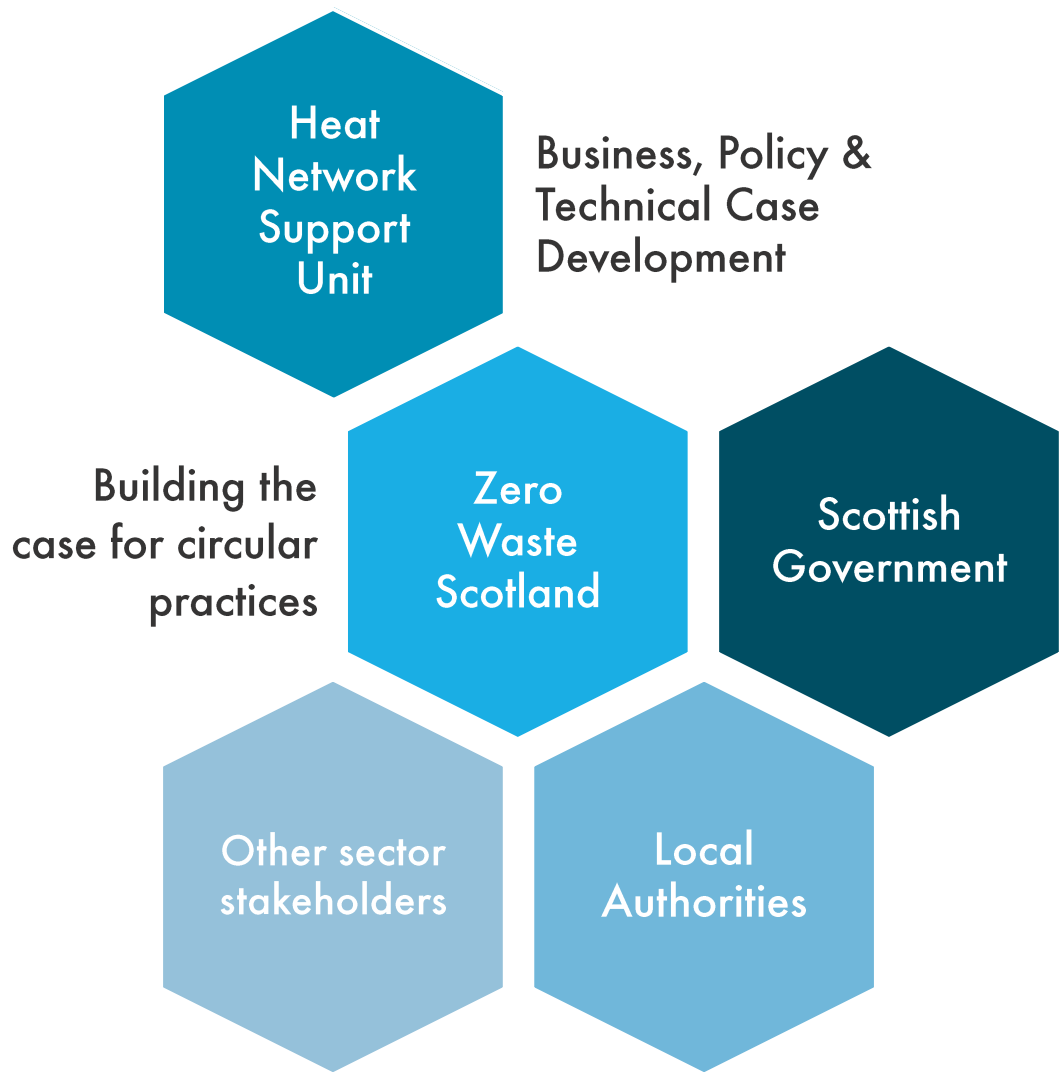
Do more where it matters most

Why is this important?



Stakeholder and policy landscape

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Nature of Scotland's building stock

20% of total
emissions linked
to heating

2.74million

Domestic
([NRS, 2024](#))

~230,000

Non-domestic
([climateXchange, 2023](#))

Diverse set of
building
archetypes

Range of
building tenures

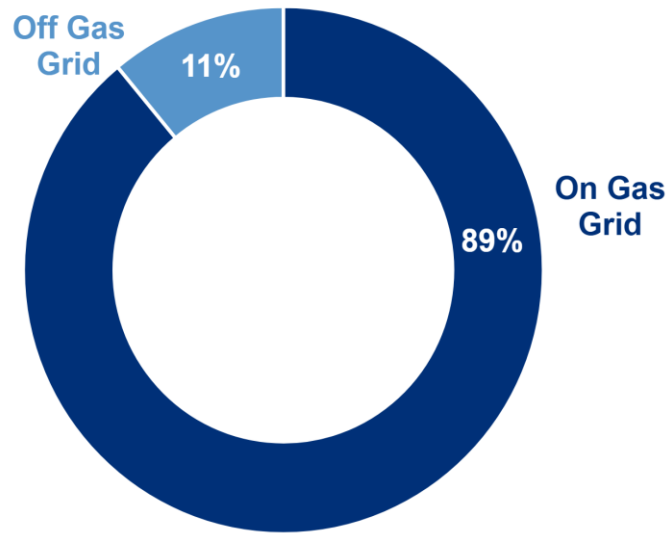
Limited data

Energy use and fuel types
in non-domestic buildings
([climateXchange, 2023](#))

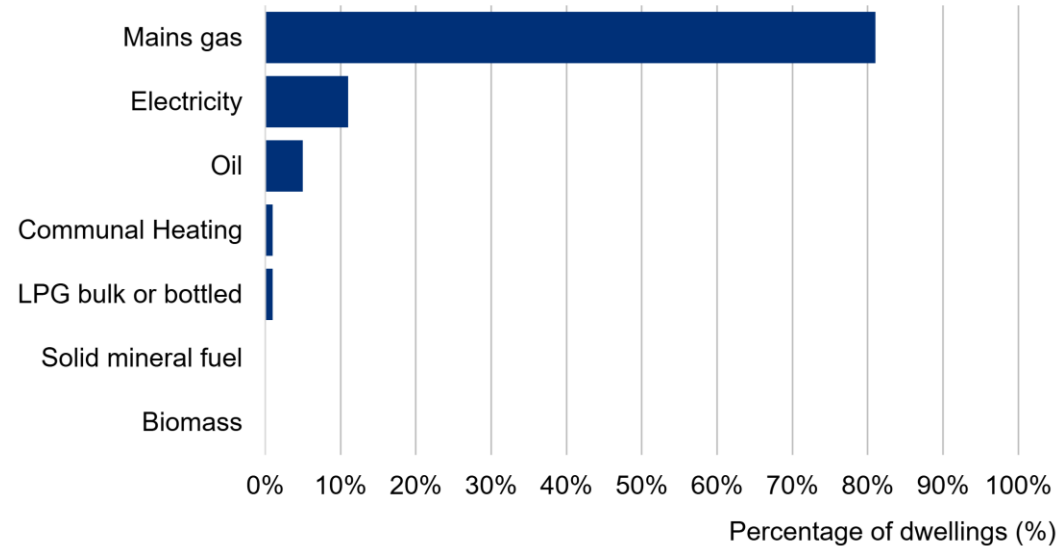


Nature of Scotland's building stock

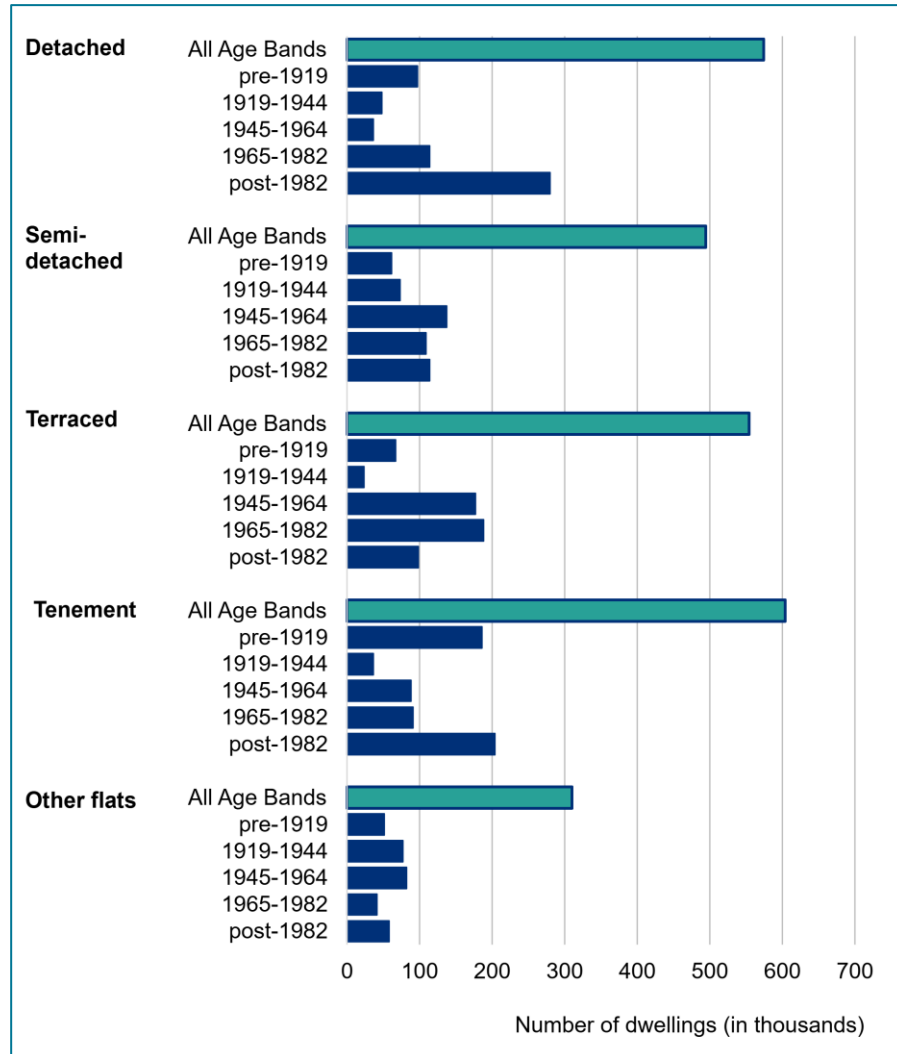
% of Scottish dwellings within coverage of the gas grid



Scottish Housing Condition Survey, 2023



Nature of Scotland's building stock



44.8%

EPC C or better in
Domestic buildings
(SESH, 2019)



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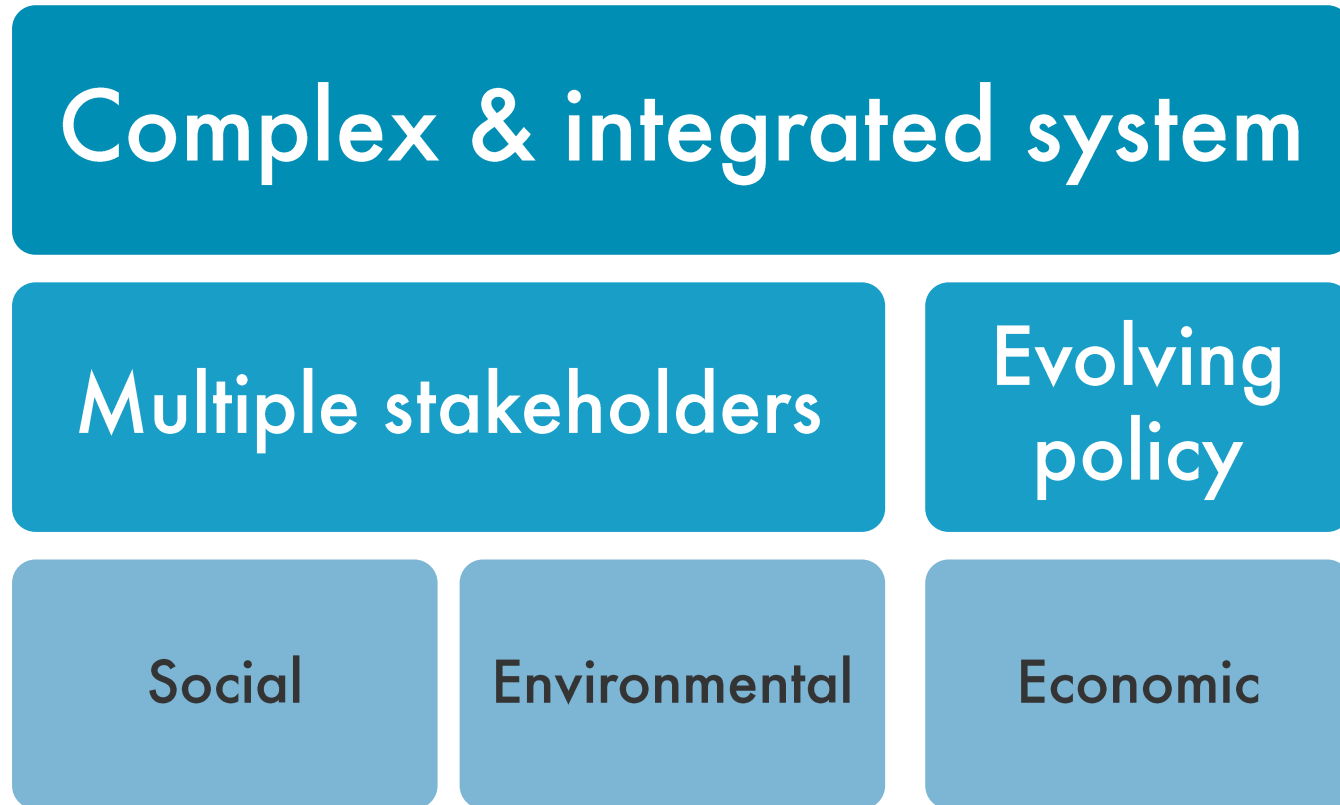
Viewing Clean Heat through a circular economy lens



7,355 installed 2023- 2024



The need for a systems-based approach



Scotland's Clean Heat Transition: a systems-based understanding



Project overview

- Terminology
- Aims and objectives
- Methodology
- Summary of findings
- Conclusions
- Next steps



Key terms and definitions

Systems thinking	Holistic practice of identifying all factors in a system and evidencing their interconnectedness, dynamics, associated stakeholders, and underlying detail.
Behaviour Change	Process of identifying and modifying habits, actions, responses to promote positive social, environmental, personal, economic outcomes.
Behavioural Systems Maps	Visualised output demonstrating relationships, interactions and dynamics within a system.
Circular Economy Practices (CEP) Ecosystem Framework	Framework designed to aid understanding of environment within which businesses operate and areas of influence affecting uptake of circular practices.
Individual, Social, Material (ISM)	Tool developed to design and/ or evaluate interventions supporting sustainable behaviours



Aims and objectives

Improve understanding and evidence of the factors influencing the adoption of circular economy principles and practices in Scotland's low to zero carbon heating transition

- 1 Identifying lifecycle factors influencing circularity
- 2 Mapping stakeholders and their roles
- 3 Understanding barriers, enablers, and opportunities for circular practices
- 4 Developing systems maps illustrating behaviours, relationships, and feedback loops



Methodology

Technological focus

- Enhanced energy efficiency
- Achieve operational emissions reduction
- Policy based targets UK/ Scotland

Air to water
heat pumps



- Drive to explore and expand their use
- Reduced emissions using renewable sources
- Heat Networks (Scotland) Act 2021

District Heating
Networks



Methodology

Research participants

District Heating
Network
Installers/
Operators

Economic
Development
Agencies

Heat Pump
Installers

Manufacturers

Trade Bodies

R&D

Academia

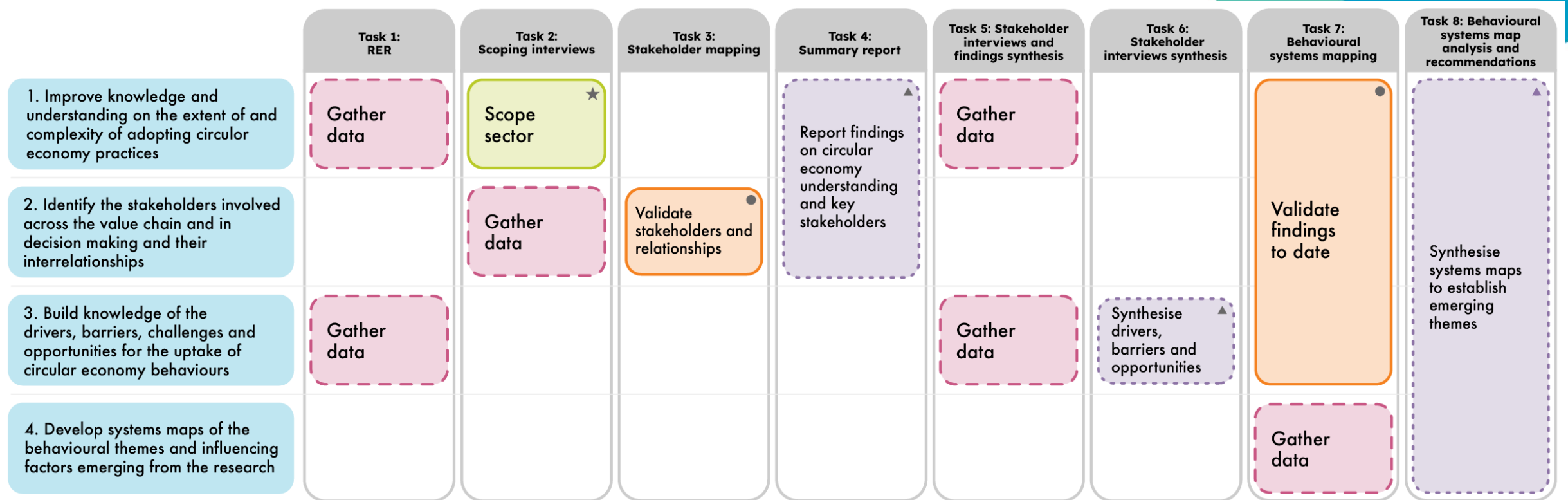
Waste
Management
Operators

Suppliers



Methodology

Delivery schedule



Key

Define ★

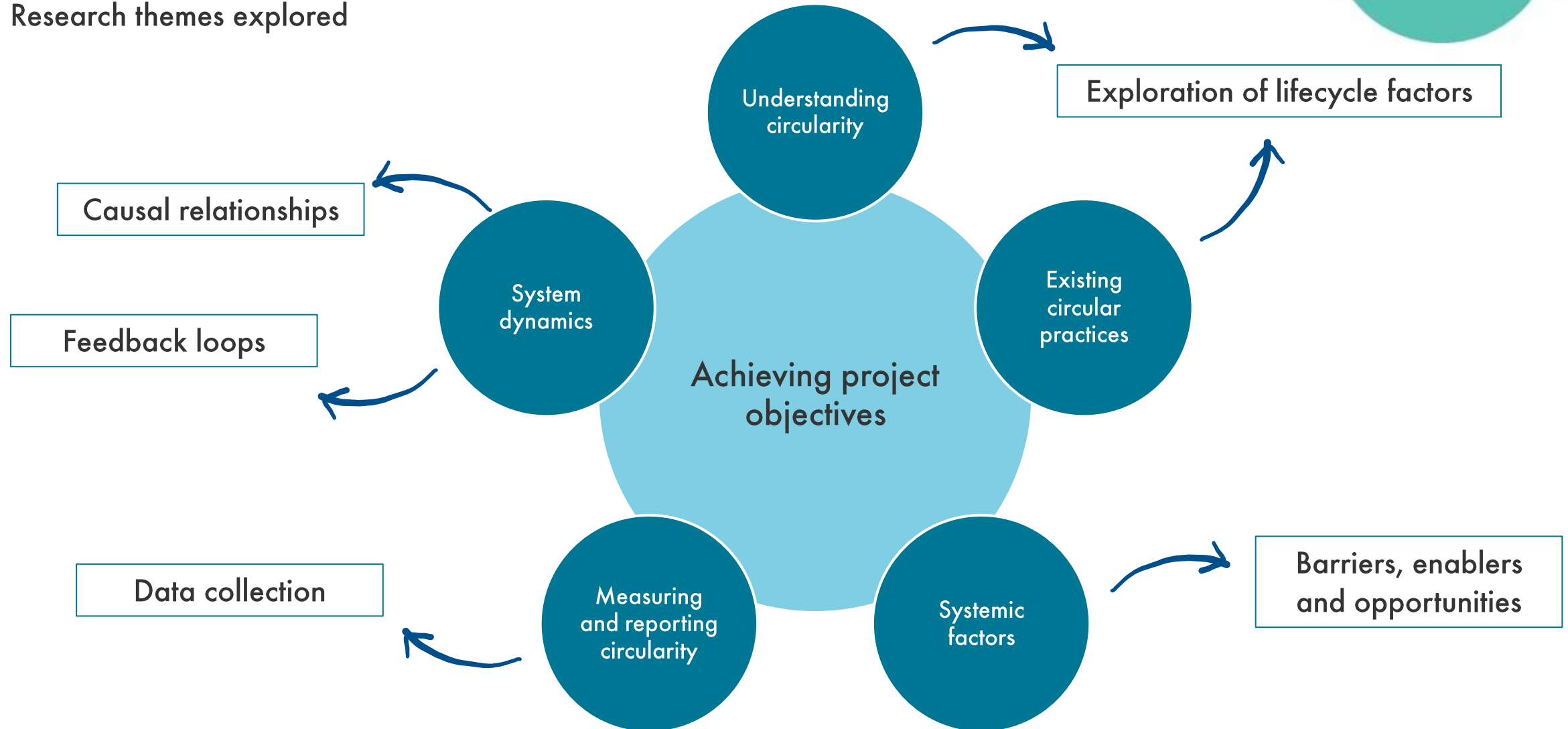
Research

Validate ●

Synthesise ▲

Learning approach

Research themes explored



Summary of findings

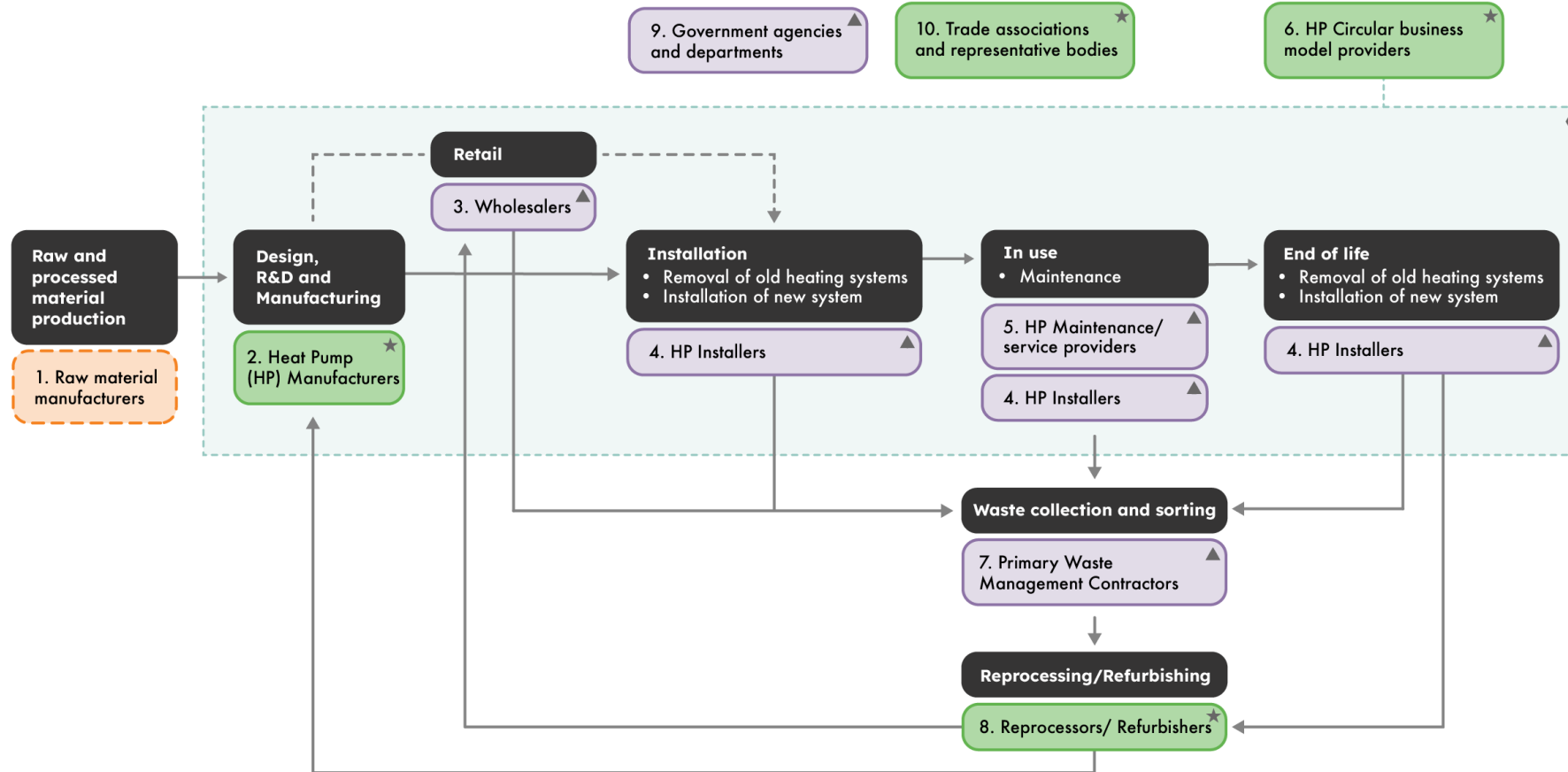


Stakeholder mapping

- Heat Pump
- District Heating Networks
 - ESCo (Energy Service Company)
 - AESCo (Accidental Energy Service Company)



Heat Pumps



Key



Stakeholders are primarily in Scotland



Stakeholders both in Scotland but also UK/overseas

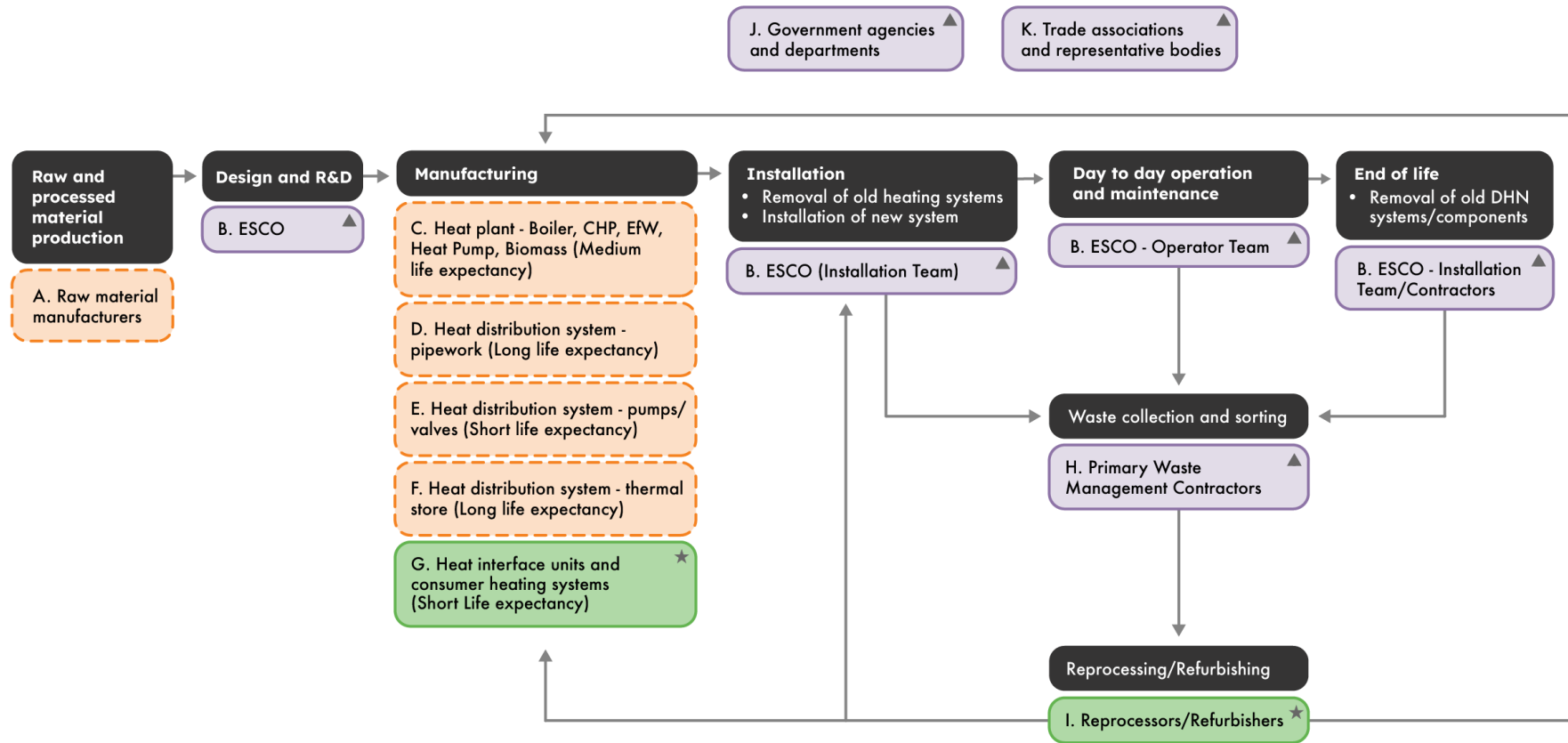


Stakeholders primarily outside Scotland and UK

Circular business model providers



District Heating Networks (ESCo)



Key



Stakeholders are primarily in Scotland ▲



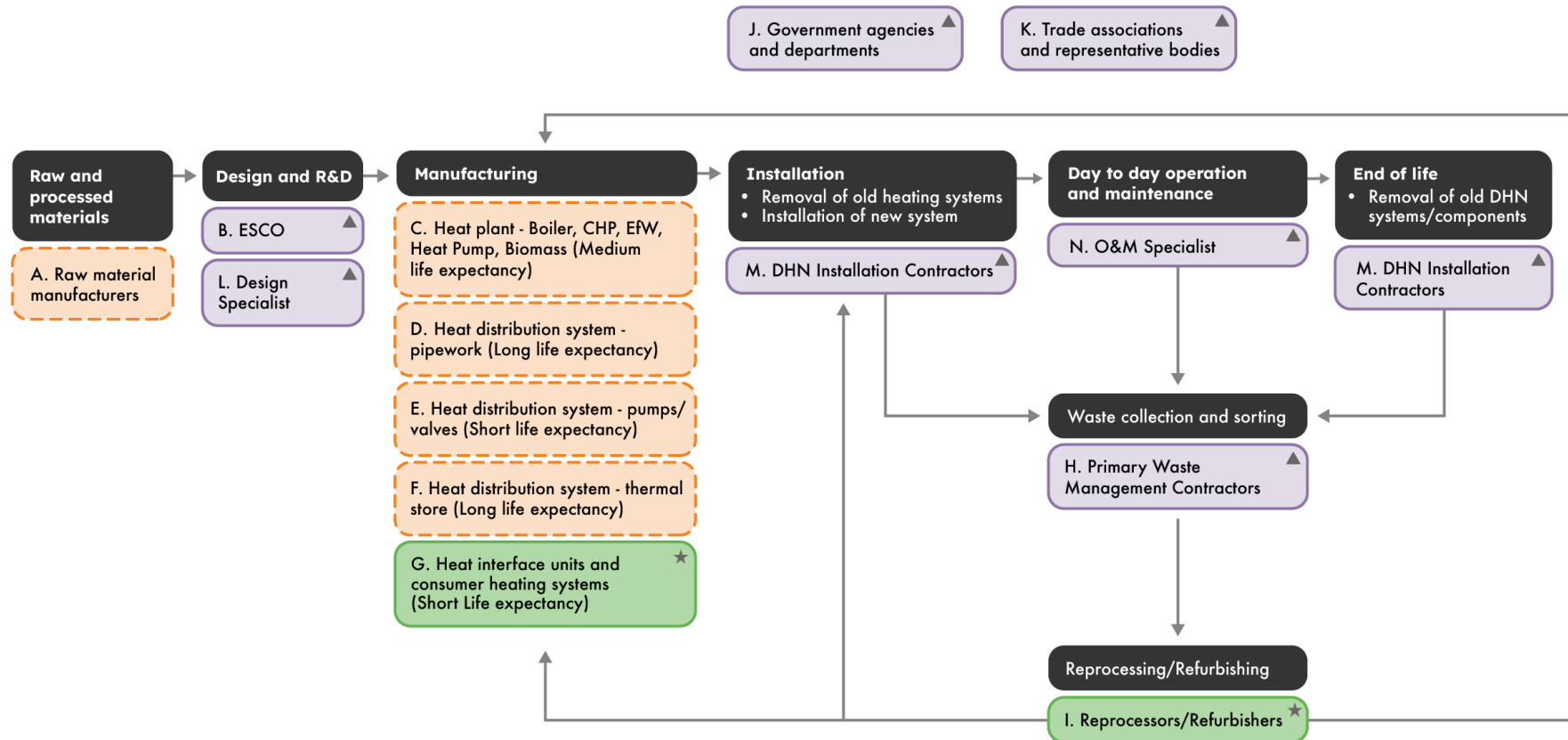
Stakeholders both in Scotland but also UK/overseas ★



Stakeholders primarily outside Scotland and UK ▬



District Heating Networks (AESCo)



Key



Stakeholders are primarily in Scotland



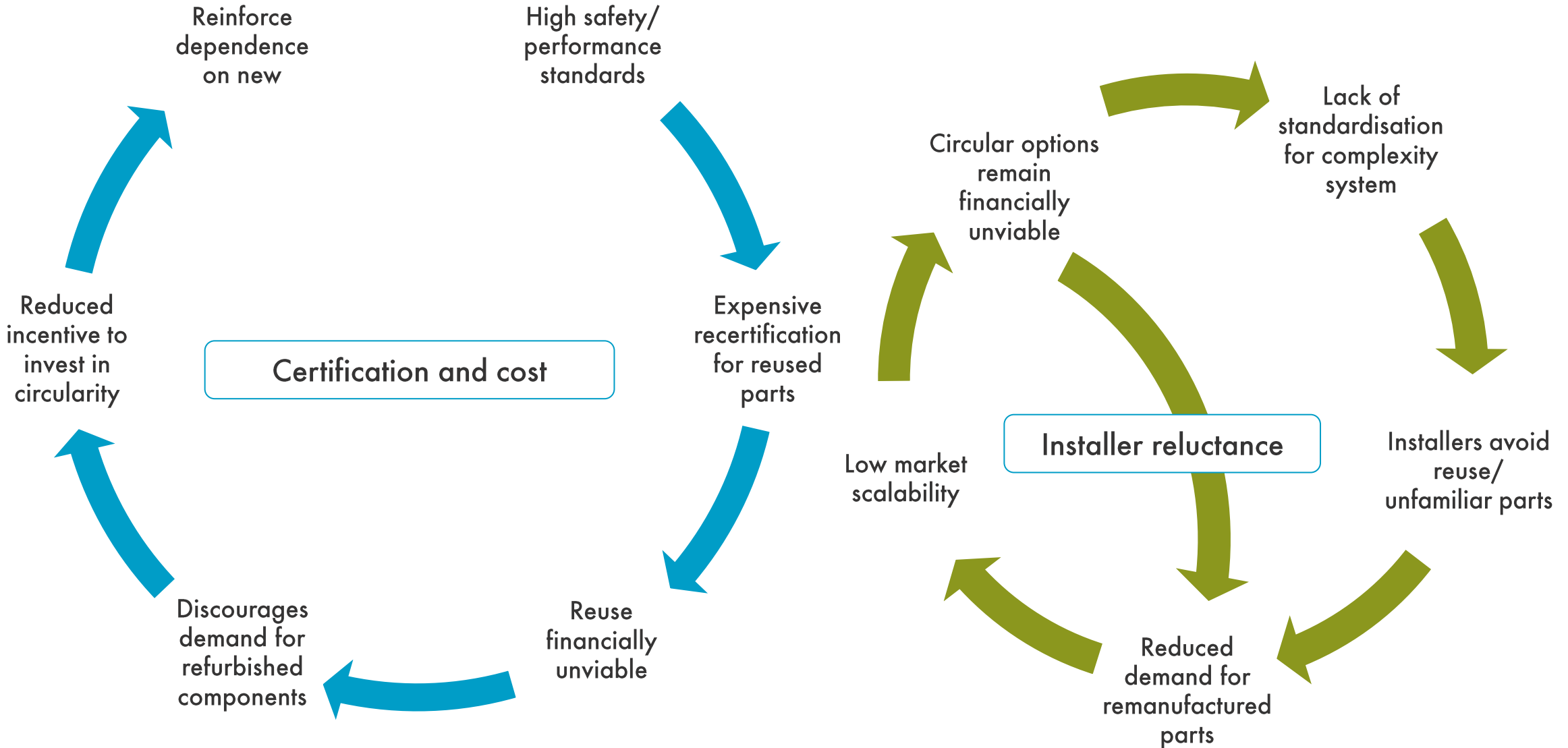
Stakeholders both in Scotland but also UK/overseas



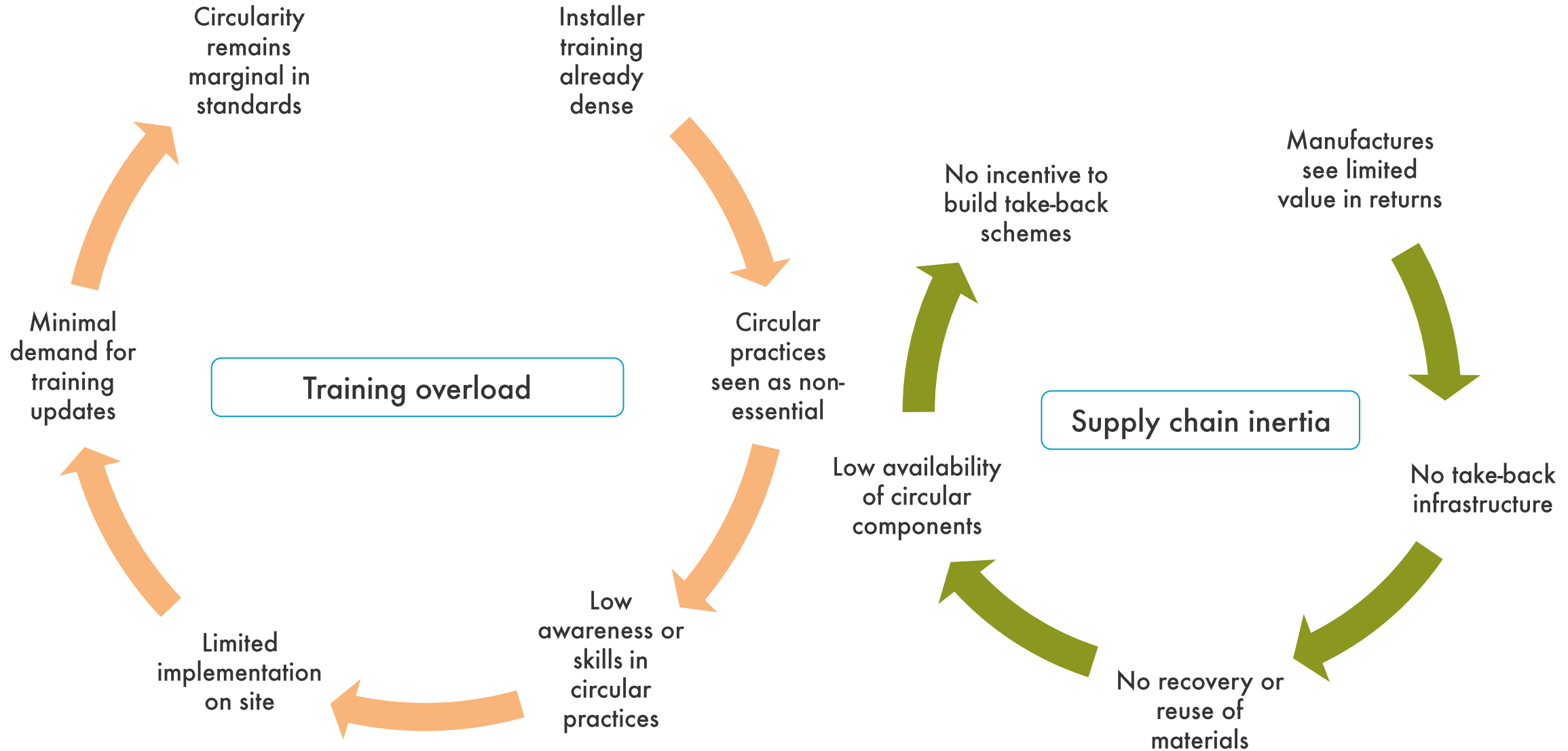
Stakeholders primarily outside Scotland and UK



Causal feedback loops



Causal feedback loops



Summary of findings

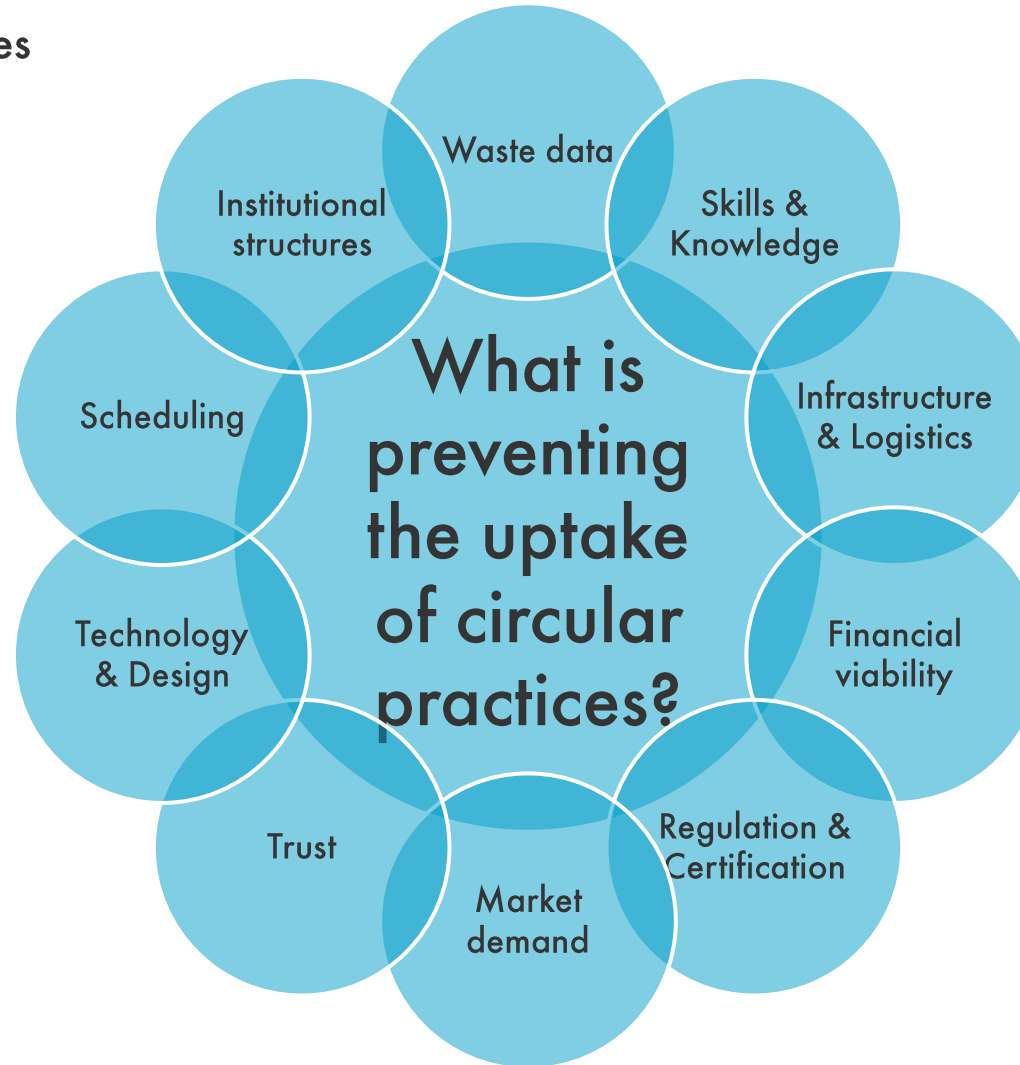
Policy and regulatory change

Proposed change	Purpose	Relevant stakeholders
Develop Circular Economy Standards for Clean Heat Technologies	Minimum expectations for circularity with respect to heat pumps and boilers	Manufacturers, Installers, Regulators, Consumers
Incentivise Circular Procurement in Public Retrofit Projects	Use demand to stimulate the market for circular solutions, components and systems	Public Sector, Contractors, Manufacturers, Consumers
Integrate Circularity into Skills and Training Programmes	Equip value chain with practical skills in circular practices and efficient system sizing	Training/ Education Providers, Installers, Engineers



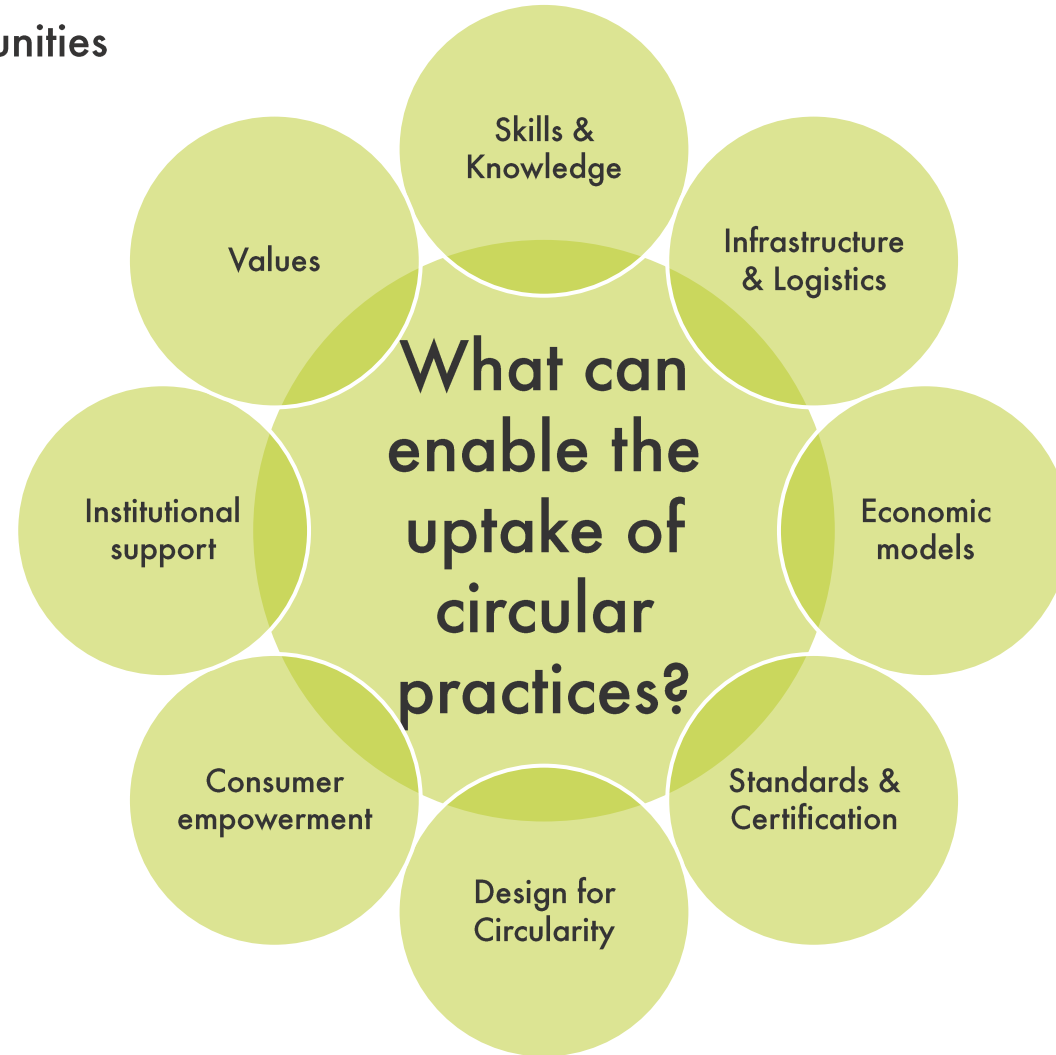
Summary of findings

Cross-cutting barriers and challenges



Summary of findings

Cross-cutting enablers and opportunities



Behavioural systems maps

Optimised solutions identified

1. Minimising the
impact of
decommissioning

2. Demand for
durable and
repairable
systems

3. Reuse and
redistribution

4. Third-party
ownership
models

5. Repair &
maintenance

6. Refurbishment
& remanufacture

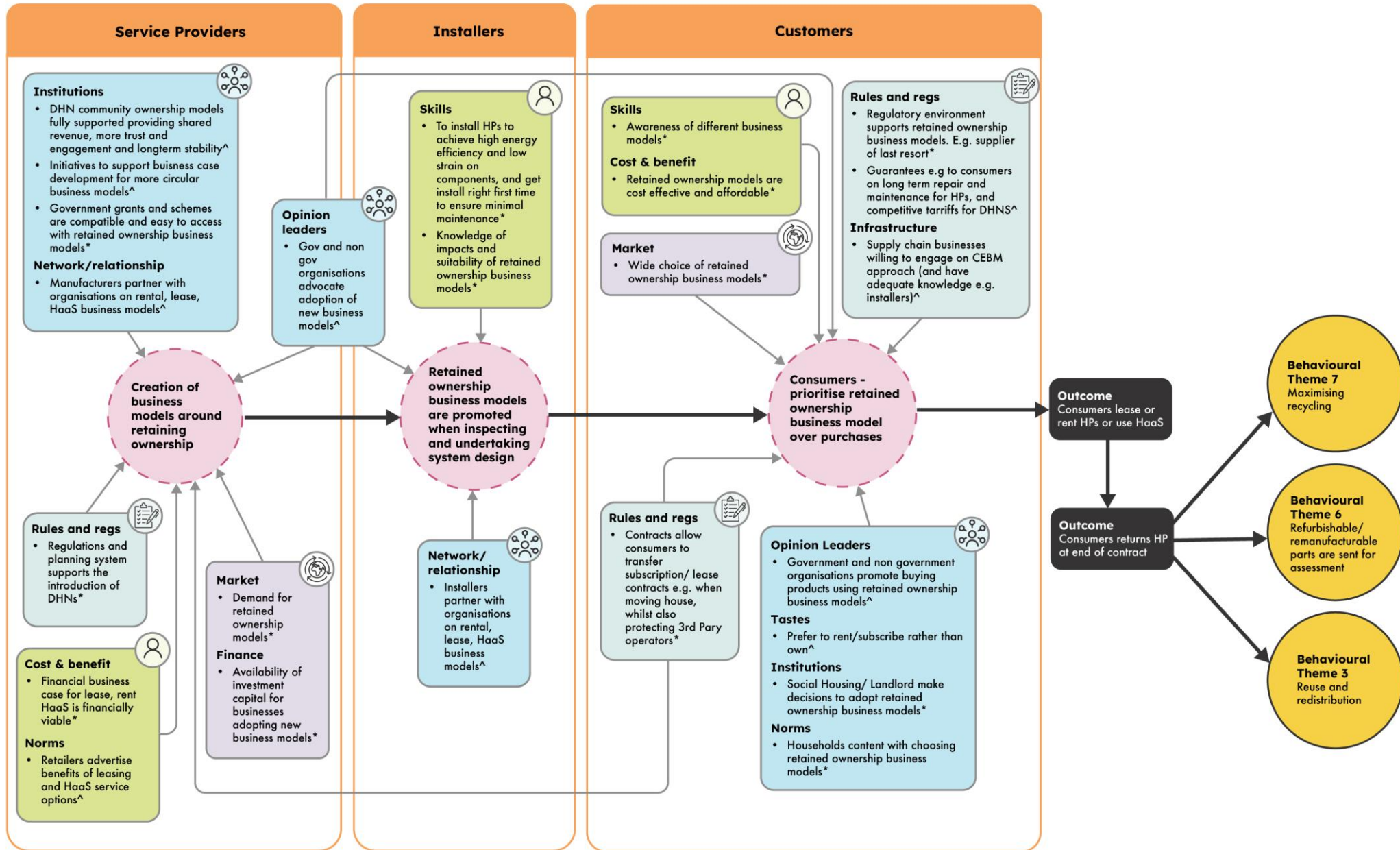
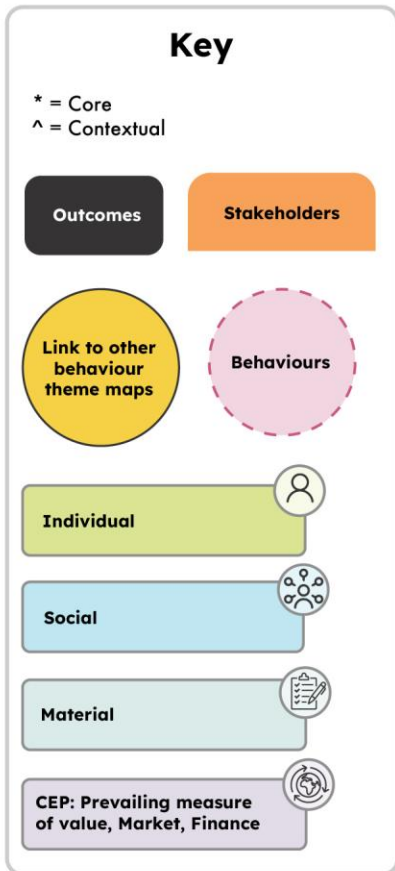
7. Maximising
recycling

8. Lower
embodied
carbon products



Behavioural Theme 4

Heating systems are owned by third parties.



Conclusions

- Complex landscape influenced by a diverse range of factors
- Circularity is emerging across the Clean Heat sector but is not yet fully embedded
- Lack of reliable and available waste data
- Limited skills and awareness among installers, consumers, and commercial teams
- Infrastructure gaps such as the absence of take-back schemes and reprocessing facilities
- Logistical challenges limit potential to scale emerging opportunities
- Unclear economic return deters potential investment in circular opportunities
- Inadequate regulation and certification standards hinder uptake of circular solutions



Recommendations

- Continuation of a systems-based approach key to enabling circular solutions
- Behavioural systems maps have provided a set of tools and a starting point for further dialogue with stakeholders and realising feasible and practicable opportunities

Engagement

- Maximise component retention
- Third-party business models
- OEMs to inform local circular solutions

Learning from existing practices

- Second hand market
- Remanufacturing potential
- Replicating service models

Policy

- Embedding circular criteria in public sector procurement
- Aligning with developing EU policy on product design/ CE
- Develop support mechanisms



Next steps

- Evolving Scottish policy landscape: *Heat in Buildings Bill*
- What next for Zero Waste Scotland?
 - Supporting ongoing business case development of circularity in retrofit and heat network deployment opportunities
 - Implementation of the Zero Waste Scotland Energy Infrastructure Roadmap
- Knowledge exchange opportunities

Collaboration locally, nationally and internationally is critical
Invite those on the call to continue this dialogue beyond today's session



Links to Zero Waste Scotland publications

- Scotland's Clean Heat Transition: a systems-based understanding
- Energy Infrastructure Roadmap
- Scotland's Circular Economy Practices Ecosystem
- Individual, Social, Material



Thank you

Learning intentions:

1. Understanding of Scotland's heat decarbonisation journey
2. Importance of applying a systems-based approach
3. Insight into factors influencing circularity in Scotland's Clean Heat transition



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Thank you