Innovation, Energy Systems & the Circular Economy

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SE Energy Team
Scottish Enterprise

One of Scotland’s two economic development agencies – soon to be three!

Scottish Enterprise aims to deliver a significant, lasting effect on the Scottish economy.

We have over **1100** staff and invest around **£300m** per annum in the Scottish economy.

Our four interconnected drivers of growth
Scottish Development International (SDI) is the specialist trade and investment arm of The Scottish Government, Scottish Enterprise, and Highlands & Islands Enterprise.
Why Innovation? - The Productivity Prize

Innovation boosts productivity by 66% by innovating.
Grow exports twice as fast by innovating.
Generate productivity levels 13% higher by innovating.

Size of Gap 27% £40bn p.a.
SE’s Innovation Strategy

Wider

Deeper

Sector

Open

Workplace Innovation
Deeper innovation

• Deeper relationships with existing innovators
• Long-term game, not an episode
• Catch the imagination – getting workforces involved
Wider Innovation

• Support 800-1,000 companies p.a. become ‘innovation active’
• Process Innovation, Lean Manufacture, SMAS and Industry 4.0
• Embed culture of innovation in all regions and sectors
• Get more products to international markets, and design new solutions
Sector Innovation

- Bespoke sector innovation response in partnership with industry and public agencies.
- Focus on existing (Energy, F&D, Manufacturing) and emerging (Data, Fintech, Subsea).
- Identify infrastructure to accelerate technology, product and process innovations.
Open Innovation

- Companies innovating with suppliers, customers and our University sector
- Large organisations (private and public) leading the way
Workplace Innovation

- Unlock innovation potential of staff, new processes and business relationships
- Innovative & Fair work practices boost productivity - employee voice/shared leadership
SE Support for Product/Service Development

Technical Difficulty

SMART

R&D

Feasibility

Individual Company

Collaborative

Seek & Solve

Innovation Support

Wider Innovation

Idea & Market Research

Feasibility

Analysis & Prototype Development

Final Development

Market Launch & Testing

Commercialisation

Progress to Market
..but important to consider other development requirements (e.g. Tidal Energy)

**Product to market development**

- **Concept Dev.**
  - SMART
  - c. £30k
- **Applied research (Tank testing)**
  - R&D
  - c. £300k
- **Early demo (Scale testing)**
  - WATERS
  - c. £5m
- **Full demo (At sea 'proving')**
  - R&D
  - c. £20m
- **Device refinement/BoP solution dev.**
  - MRCF/MEAD/NER300
  - c. £20m
- **1st array demo.**
  - R&D
  - c. £40m
- **CoE reduction/system refine**
  - Market-ready device/system
  - c. £10m
- **Commercial Manufacture**
  - Commercial
  - c. £50m

**SE/Other grants**

- Innov. Vouchers
- R&D Tax Credits
- DECC Entr. Fund
- SE/Other grants
- SMAS
- RSA

**Investment requirements**

- **Initial Equity**
  - c. £50k
- **1st Round/Seed**
  - c. £1m
- **2nd Round**
  - c. £20m
- **Project finance**
  - c. £50m
- **3rd Round**
  - c. £50m
- **Debt**
  - c. £100m

**SE/Other investments**

- Sc. Seed
- Sc Co-invest
- REIF
- TCE
- Sc Venture/Loan
- GIB

**SE/Other interventions**

- YIE
- Investor Ready
- Organisational Dev. Support
- Leadership Support
- SMAS

**Organisational development**

- Very small, tech focus
- Adequate systems, BP in place, investment pitch
- Transition to more mature systems, broader HR + management
- Mature, Strategic
A circular economy is an alternative to a traditional linear economy (make, use, dispose) in which we keep resources in use for as long as possible, extract the maximum value from them whilst in use, then recover and regenerate products and materials at the end of each service life.

**Linear Economy - now**
Make-use- dispose (linear)

**Circular Economy - aim**
Highest value recovery and recirculation
Reuse, remanufacture, repair, reprocessing

**Design Lead  e.g. Longevity/ remanufacture**

**Services or Product?**
### SE Business Improvement and the Circular Economy

**Efficiency Savings**
- Reduced overheads
- Energy
- Waste
- Water
- Materials
- Transportation
- Decarbonise Heat, Power & Transport

**Customers/Supply Chain**
- ISO systems
- Supporting customer goals

**Green Marketing**
- Green Food and Drink
- Green Tourism
- Product differential

**Reduce Business Risks**
- **Environmental Risks**
  - Legal non-compliance
  - Bad press/lost customers
- **Futureproofing**
  - New regulations
  - Resource scarcity/costs

**New Business Streams**
- Low carbon products and services
- Selling Scotland’s expertise and innovation worldwide
<table>
<thead>
<tr>
<th><strong>SE Business Improvement Support</strong></th>
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<tbody>
<tr>
<td><strong>Sustainability Specialist Support</strong></td>
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<tr>
<td>• Onsite specialist support</td>
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<tr>
<td>• Sustainability diagnostic</td>
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<tr>
<td><strong>Business Improvement Expert Support</strong></td>
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<tr>
<td>• 2 days, 100% funded</td>
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<tr>
<td>• Supports scoping, planning and identification of potential improvement projects</td>
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<tr>
<td><strong>Business Improvement Project Support</strong></td>
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<td>• Flexible support to aid development and implementation of projects</td>
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<td>• Up to 50% contribution on appraisal of business case for support</td>
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<td><strong>Business Improvement Academy</strong></td>
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<td>• Mix of one to many and one to one support</td>
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<td>• Embedding a culture of business excellence &amp; encouraging sustainable continuous improvement</td>
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<tr>
<td><strong>Aid for Environmental Protection</strong></td>
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<td>• Support for capital projects demonstrating environmental gain</td>
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Smart Local Energy Systems – Maximising the Economic Benefit

Scottish Government Draft Energy Strategy

Decarbonising Scotland’s energy production and use, with an emphasis on an integrated approach to heat, power and transport within the context of localised energy systems.

Draft Strategy has already created global interest and furthers Scotland’s reputation as a leader in low carbon energy.

Opportunity to establish Scotland as the place in the world where advanced, smart ‘whole’ local energy system solutions are developed and deployed, and exploit this on a global stage.

Need to be clear about the specific ‘niches’ that provide the best opportunity for leadership and create the best channels for economic growth through export.

Over time, grow cluster around ‘next generation’ solutions – Innovation will be a key differentiator.
Concept: An Energy ‘Setting Typology’

Factors?:

<table>
<thead>
<tr>
<th>Population</th>
<th>Population density (people/km²)</th>
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<tbody>
<tr>
<td>Average Heat Use Per Person (kWh)</td>
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<tr>
<td>Average Electricity Use Per Person (kWh)</td>
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<tr>
<td>Gas Grid Availability</td>
<td></td>
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<tr>
<td>District Heating Network Availability</td>
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<tr>
<td>Electricity Grid Strength</td>
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<tr>
<td>Renewable Electricity Resource</td>
<td></td>
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<tr>
<td>Public Transport Availability</td>
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<tr>
<td>Low Carbon Transport Infrastructure Availability</td>
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For example:

- Small Island
  - Local grid, no link to mainland
  - Imported heating & transport fuel

- Large Town/City
  - National grid
  - Gas Grid
  - Transport Hub

- Rural Market Town
  - National grid (weak)
  - Gas grid
  - Shopping hub

- Remote Rural Village
  - National grid (weak)
  - No gas grid
  - Little public transport

- Small Industrial Park
  - National grid
  - Heating Network
  - Adjacent wind farm
Establishing a Focus for SLES effort

**Scotland**
- Energy Strategy: decarbonisation, decentralisation, integration challenges

**International**
- Low carbon energy system challenges

**Company base**
- Scottish strengths

**For what tech/applications could we be leaders?**

**Competitive position**
- Scotland vs other countries

**SLES Strategic Focus**

**Common settings/challenges**

**Setting Typology**

**OPPORTUNITY**

**Export**

**Setting Typology**

**Domestic**
Focal Settings

Ideally, settings that.....

- Can be identified in Scotland and provide the opportunity for the demonstration of Smart Local Energy System solutions.

  AND

- Can be found in other countries with reasonably low barriers to entry.

  AND

- Can provide the opportunity for application of Scottish technology and know-how.

  AND

- Are not already being addressed by other countries, or involve technologies/methods that we can be at the forefront of.
Current knowledge: Scottish Capability

From Delta EE Study for SE (2016):

● 128 companies: Most in electricity, least in heat.
● Strengths in:
  ✓ ICT/Digital: Especially high-value services e.g. data acquisition & analysis
  ✓ Engineering Services: ‘Hard’ and ‘soft’. Includes renewables remote control/monitoring and network/energy management systems
  ✓ Power Electronics: ‘traditional’ and ‘smart’. Specialisations include integration of low carbon generation systems
  ✓ Network Design/Optimisation: Grid and micro-grid scale
  ✓ Consultancy: across all segments
● But also capability in:
  ✓ Energy storage
  ✓ Heat recovery
  ✓ Charging/refuelling/metering
Current knowledge: a diversity of projects

Mull Hydro-Heat ‘ACCESS’
Hydro scheme matching local energy generation with local energy demand to heat homes on Mull

SMART Fintry
Peer-to-peer energy trading enabled by Smart meters, linking local AD power supply with new electric heating /heat pump use

Levenmouth Community Energy Project
Wind + PV to hydrogen - transport fuel + fuel cell power for buildings

Orkney Surf n Turf
Wind & Marine power to Hydrogen via electrolysis for fuel cell use in buildings, cars and berthed ferries.

Keithick Biogas plant
AD bio-methane plant injection plant producing 3 million m3 of biomethane for the gas grid

East Heat
Heat battery storage system for domestic hot water powered by solar PV system
Current knowledge: the Competition (for example)

- **Germany**
  - Energiewende policy driving major investment
  - Significant effort to digitise the energy system

- **China**
  - Smart city projects using micro-grids, EVs and district heating
  - Air quality issues creating drive

- **USA**
  - Air quality issues, ageing infrastructure
  - California - major energy storage
  - New York state – smart grids

- **Denmark**
  - Integration of renewables through innovation
  - Renewables to DH
  - Sustainable islands

- **S. Korea**
  - Island whole SLES demonstrator – grids, buildings & transport
  - Focus on advanced technology

But nobody much further ahead of Scotland......
Making it Happen

- Basic idea:
  - Establish Focus – which settings?
  - Build Industrial ES Community – stimulating collaboration & innovation
  - Identify and implement Pathfinders – ‘Challenge Programme’
  - Create routes to export markets, e.g. International ‘co-developers’

- ‘Team Scotland ‘Programme approach to implementation, e.g.
  - SE, HIE and SDI
  - Scottish Government
  - Energy Systems Catapult
  - Local/Community Energy Scotland

- Making use of existing/new funding mechanisms, e.g.
  - LCITP/LCIP
  - EU: Smart Grid+ Reg Sys ERANET Co-fund + Interreg + LEADER
  - UK Industrial Strategy Challenge Fund Wave 2
In Summary

- More effective Innovation through engaging with customers, suppliers and staff
- Company growth from circular economy is more than just about product lifecycles
- Energy Systems – an opportunity, but how best can we collaborate and reach out internationally?