National Centre for Energy Systems Integration

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Introduction to the Centre

November 2016

EPSRC Engineering and Physical Sciences Research Council

Newcastle University

Durham University

Heriot Watt University

University of Sussex

The University of Edinburgh

UKERC

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What Is Energy Systems Integration (ESI)?

- “the process of coordinating the operation and planning of energy systems across multiple pathways and/or geographical scales to deliver reliable, cost-effective energy services with minimal impact on the environment” as defined by the International Institute for Energy Systems Integration (iiESI)

Key Point to note

- Every energy system is different!

Benefits of Whole Energy Systems thinking

- Encourages the development of a more **flexible energy systems** for future **security**
- Enables efficient **integration of renewable energy** onto the system and hence **reduce carbon emissions**
- Provides an **integrated platform** for multi-vector solutions to the power, heat and transport fuel future challenges
- Significant **cost saving efficiencies** can be realised as a direct consequence of these flexible solutions

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Challenge	Energy Systems Integration - Approach of the Centre
Energy systems vital for society and industry	Whole system approach with trilemma evaluation. **Its not all about electricity!!!**
Need to improve • policy and planning decisions • planning and operational understanding, processes and models	**Be highly collaborative, not duplicate** Engagement with academic, industry, public and 3rd sector Potentially huge rewards to this approach
Limitations in current methods uncertainty, temporal and spatial variation, behavioural dynamics, co-evolution, technical detail and interdependencies	Co-evolution of supply and demand core part of the centre and research methodology. Multi disciplinary approach, Uncertainty quantification, Agents, SoS, Demonstration coupled with the power of High performance computing **Robust messages about the real world.**

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Research Aims

Address current limitations:

Uncertainty, Calibration, Behavioural dynamics, spatial and temporal variations, Representing interdependencies

Addressed by:

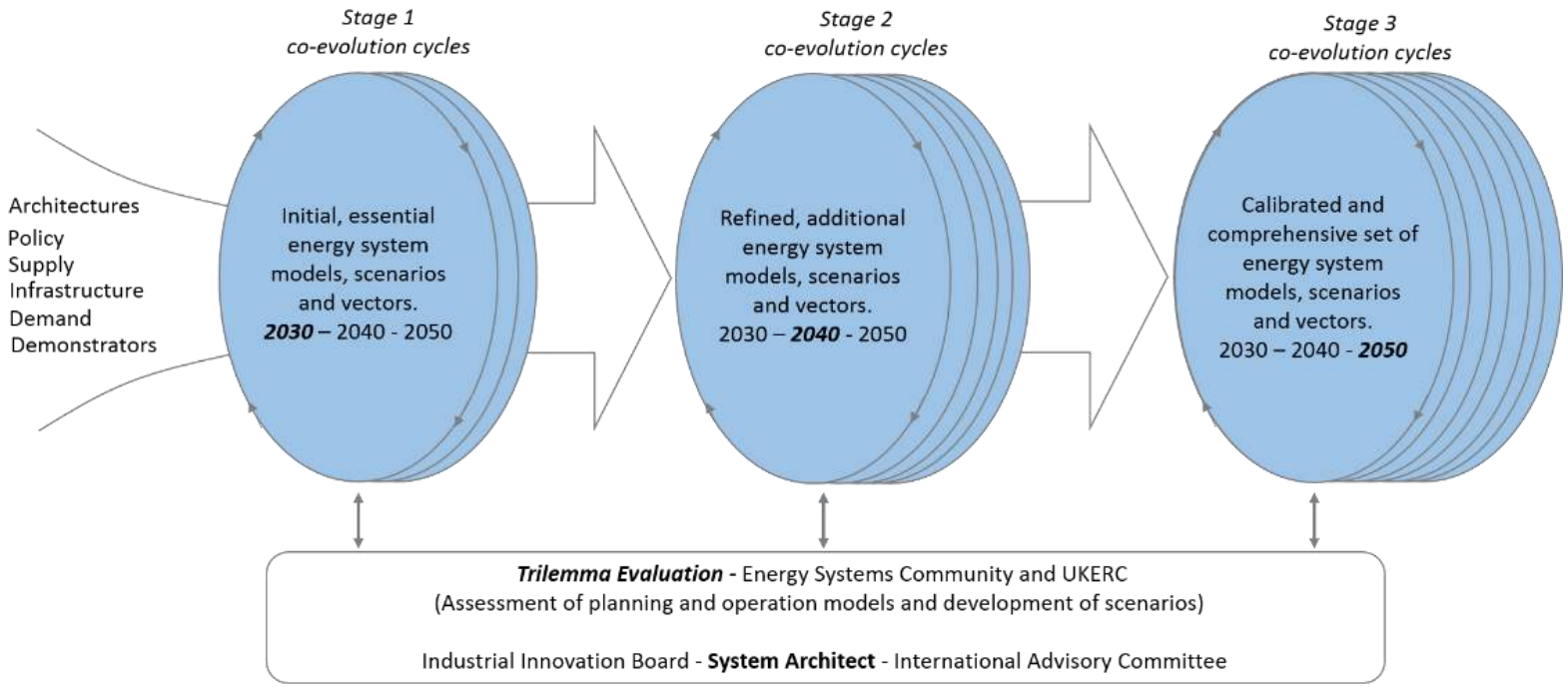
High Performance Computing Framework, Stochastic Programming, Agents, System of Systems, Fine Grain Data, Quantitative and Qualitative, Expert Judgement, Multi-Disciplinarity, Co-evolutionary approach to supply and demand, soft linking between models

Validation:

With full scale demonstrators and hardware evaluation and specifications, range of features, will produce data we can share

Deliverables:

- Whole Systems Methodologies
- Deeper Understanding of ES
- Regulatory and Policy Analysis
- Robust transition pathways
- Common Framework
- Detailed models
- Advance test and demo facilities
- Workshops, engagement



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CESI National Centre for Energy Systems Integration

The Centre Partners

- 5 Leading Research Universities
  - Newcastle University
  - Durham University
  - Heriot Watt University
  - University of Sussex
  - University of Edinburgh
- Leading Industrial Companies, NGOs and Government organisations
- Lead Partner Siemens

Newcastle University · Durham University · Heriot Watt University · University of Sussex · The University of Edinburgh

Supply
DONG energy · centrica · SIEMENS

Storage
redT energy storage · triphase · DENCHI POWER · SIEMENS

Infrastructure
Northern Gas Networks · NORTHERN POWERGRID · nationalgrid · ena energynetworks association · tnei · SIEMENS

Demand
Newcastle City Council · gentoo It's how you live · Durham County Council · Your Homes Newcastle · ZERO CARBON FUTURES · CENSIS · SIEMENS

Policy
KTN the Knowledge Transfer Network · CATAPULT Energy Systems · North East Local Enterprise Partnership · NEA · ofgem · Department of Energy & Climate Change · UKERC · FINDHORN FOUNDATION COLLEGE · arcc building evidence, sharing knowledge · The Scottish Government Riaghaltas na h-Alba

International
NANYANG TECHNOLOGICAL UNIVERSITY · NREL · CenSES Centre for Sustainable Energy Studies · Skoltech Skolkovo Institute of Science and Technology · IESI International Institute for Energy Systems Integration · DTU · enzen · EPRI ELECTRIC POWER RESEARCH INSTITUTE

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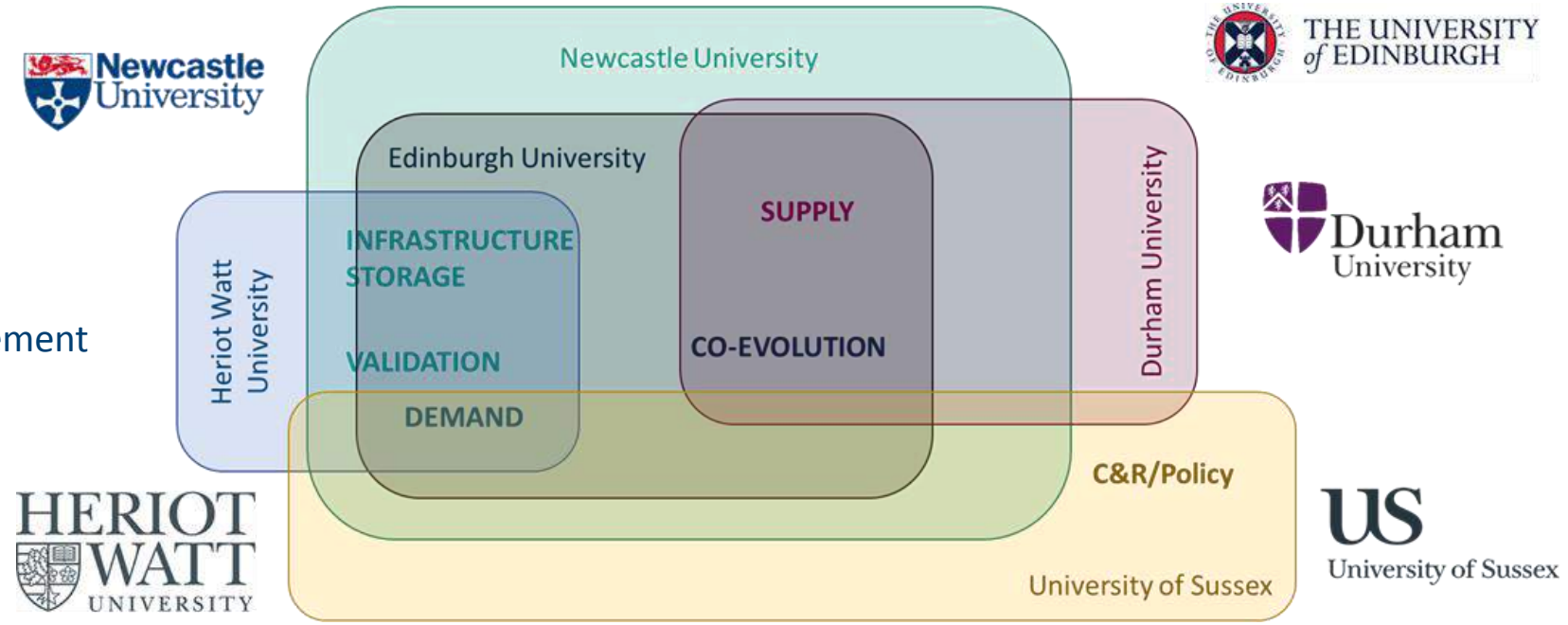
CESI Work packages

- Highly collaborative and multi-disciplinary by design
- Seven work packages investigating the full spectrum of the energy system and its integration

1. Commercial, regulatory and policy aspects
2. Energy supply
3. Infrastructure and storage
4. Energy demand
5. Validation and demonstration
6. Multi-Scale Architectures
7. Impact, engagement and management



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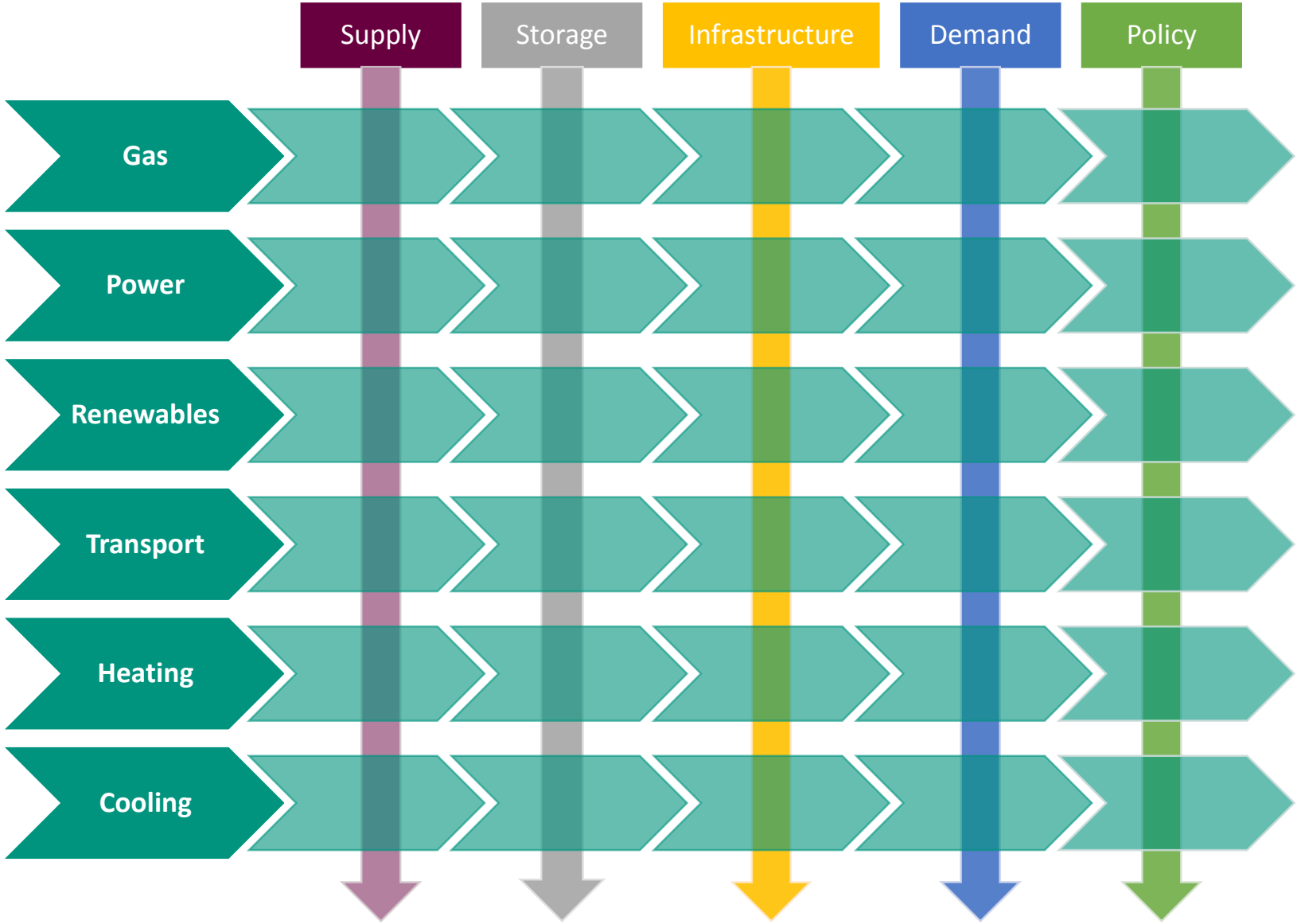
Energy Vector and Research Discipline cross cutting



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Unique collection of Whole Systems Demonstrators:

ScienceCentral
CENTRAL TO NEWCASTLE'S FUTURE

THAMES VALLEY VISION

Scottish & Southern Electricity Networks · DNV·GL · Bracknell Forest Council · GE · LCN Fund Low Carbon Networks · Honeywell · ea technology · University of Reading

Customer-Led Network Revolution

LCN Fund · Northern Powergrid · British Gas · Durham University · Newcastle University · ea technology

Demonstrator	Key Features
Science Central	Urban, Mixed Use, New Build, Multi Vector, Data Rich
ETI/ESCat Smart Systems and Heat	Urban, Domestic, Retrofit, Heat and Power
Findhorn	Eco Village, Socio Technical
Haringey	Socio Technical Urban Living Laboratory
Thames Valley Vision	Industrial and Commercial Demand Response
Cockle Park Farm	Rural, Farming, Anaerobic Digester, Heat and Power
Customer Led Network Revolution	Storage, Smart Grids, Suburban, Rural, Medium and Low Voltage

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Where is the Centre's research positioned?

- Work in partnership with Energy Systems Catapult and Industry
- Feed the energy innovation and ideas conveyor belt to solution development

Technology Readiness Levels (TRL)

Industry (large and SMEs)
Test, Development and Commercialisation

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The Centre Leadership

Director

Professor Phil Taylor Newcastle University

- Siemens Professor of Energy Systems and Director of the Newcastle University Institute for Sustainability,
- An internationally leading researcher and industrial expert in energy systems, electrical distribution networks, smart grids and energy storage integration and control.

Associate Directors

Professor Jon Gluyas
Professor in CCS & Geo-Energy

Durham University

Professor Gareth Harrison
Bert Whittington Chair

University of Edinburgh

Professor Gordon Mackerron
Professor Of Science And Technology Policy
University of Sussex

Professor Tony Roskilly
Director, Sir Joseph Swan Centre for Energy Research
Newcastle University

Dr Sara Walker
Senior Lecturer

Newcastle University

Dr David Flynn
Associate Professor
Director of Smart Systems Group
Heriot Watt University

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The Centre Governance

Industrial Innovation Board

- Members drawn from the Energy Industry, Local and National Government and Energy Stakeholders such as Housing Associations and NGO's

Chair
Colin Henry
Head of Business
Digital Grid Automation Systems
Siemens plc

Purpose and Aims

1. Advise on the innovation of Centre's research and demonstration
2. Advise on the application of the research to the Energy sector
3. To provide feedback on the performance of the Centre
4. To provide a sounding board for testing of ideas and initiatives of the Centre
5. To improve the Centre's interaction with Industry
6. To consider and ratify funding allocations of Centre's £1M Flexible Research Fund

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The Centre Governance

International Scientific Advisory Committee

- Members drawn from the Energy Research community and includes leading international research institutes from throughout the world

Chair
Mark O'Malley
Director of International Institute for Energy Systems Integration **(iiESI)**
Professor of Electrical Engineering
University College Dublin

Purpose and Aims

1. Advise on the state of the art significance of the Centre
2. Advise on the application of the research to the scientific community
3. To provide feedback on the performance of the Centre
4. To provide a sounding board for testing of ideas and initiatives
5. To improve the Centre's interaction with the International Scientific Community
6. To consider and ratify funding allocations of Centre's £1M Flexible Research Fund

Engineering and Physical Sciences Research Council

Foresight

Building energy performance

Building Design

Physics

Grid Systems

Mechanical Engineering

Geology

Electrical Engineering

Future Cities

National Centre for
Energy Systems Integration

Anthropology

Infrastructure

Transport Systems

Uncertainty

Computer Science

Collaboration, Collaboration, Collaboration …

Mathematics

Economics

Analytics

Statistics

Big Data

Cloud Computing

Policy

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CESI

Website	:	http://www.ncl.co.uk/cesi
Twitter	:	@cesienergy
Email	:	cesi@ncl.ac.uk

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