

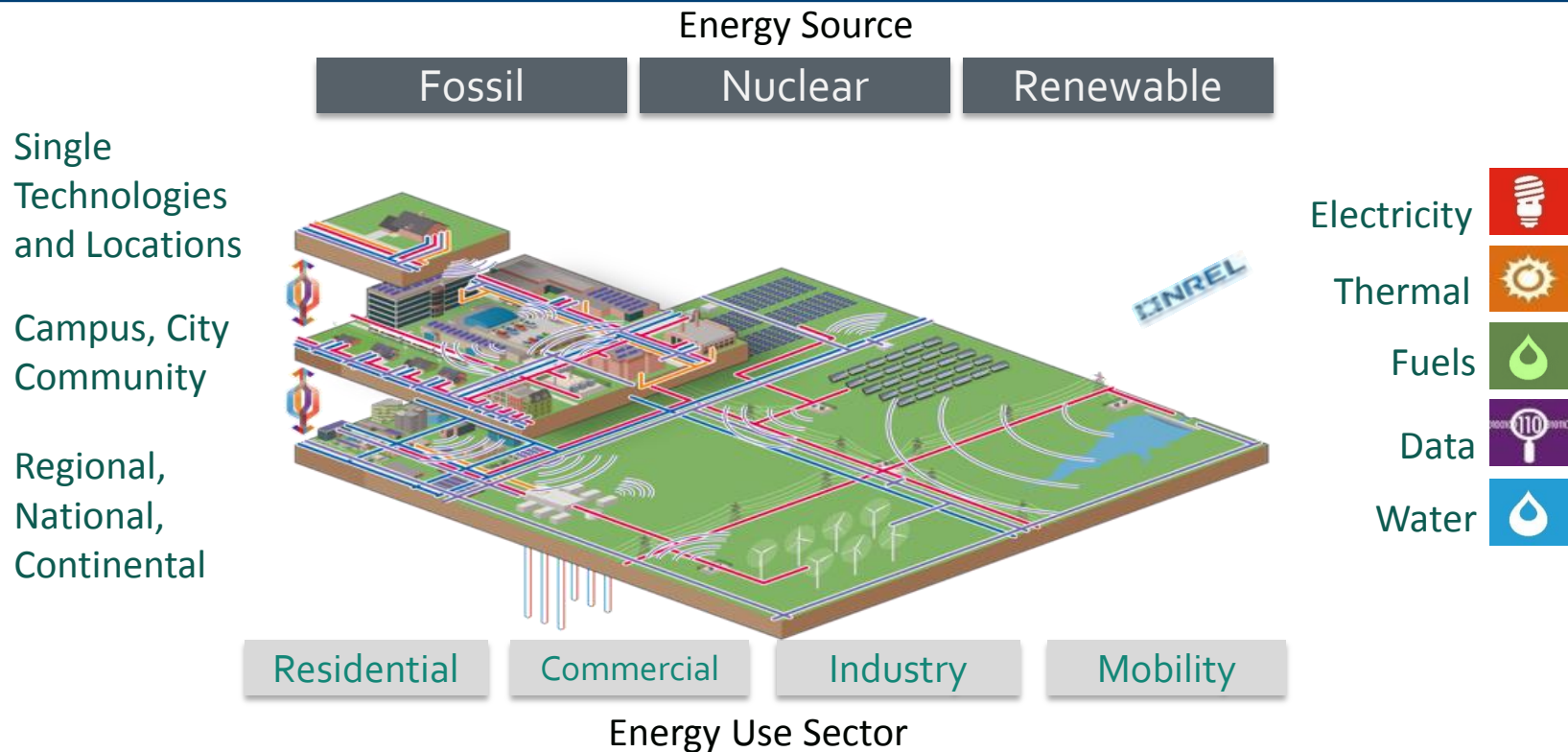
Energy Systems Integration 102

Research Challenges

Outline

- Introductions
- What
 - is Energy Systems Integration (ESI)
 - is the International Institute for Energy systems Integration (iiESI)
 - are the research challenges in ESI
- ESI 102
- Some logistics

Energy Systems Integration (ESI)



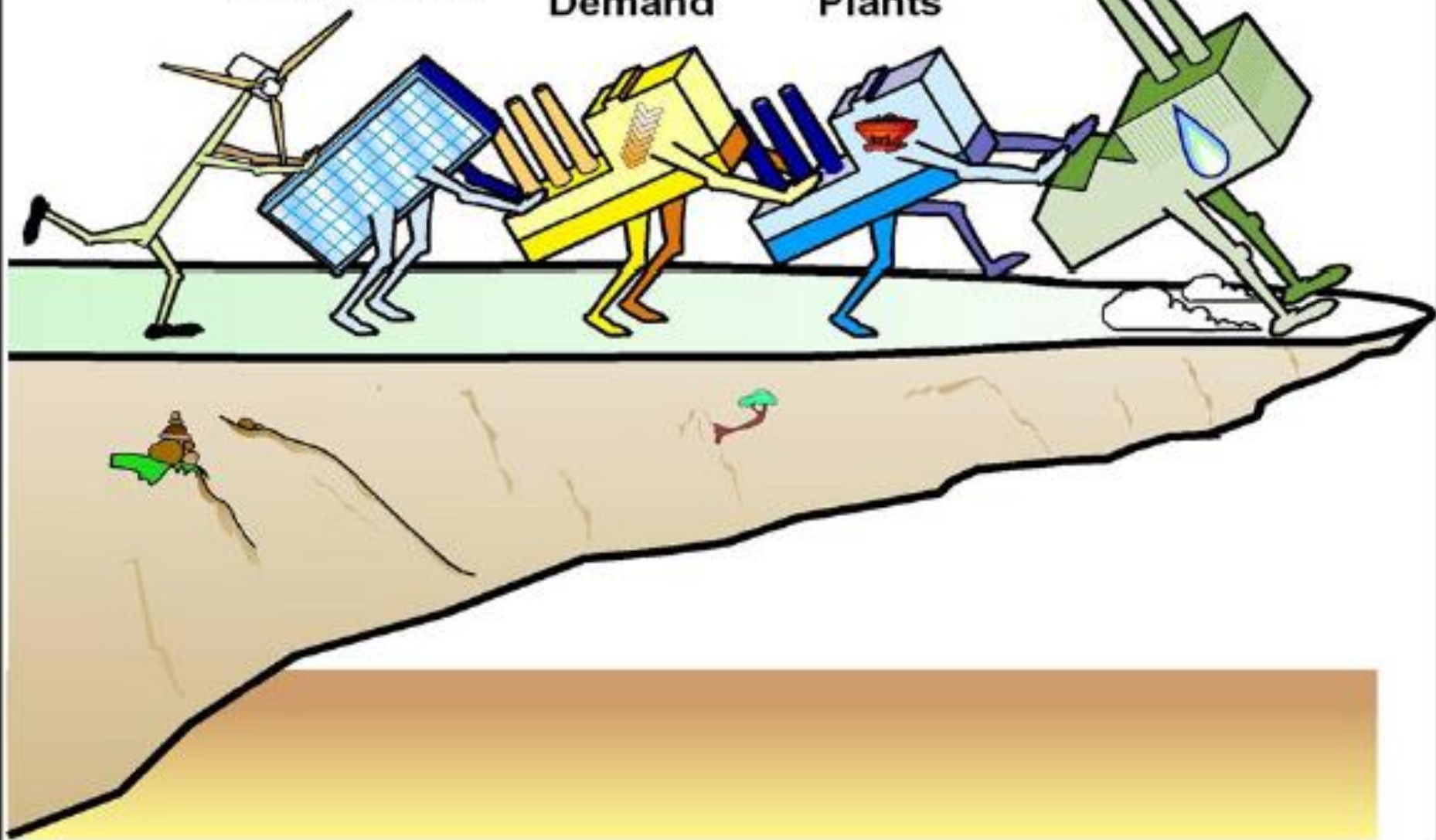
- optimization of energy systems across multiple pathways and scales
- increase reliability and performance, and minimise cost and environmental impacts
- most valuable at the interfaces where the coupling and interactions are strong and represent a challenge and an opportunity
- control variables are technical economic and regulatory

Renewables
(wind and solar)

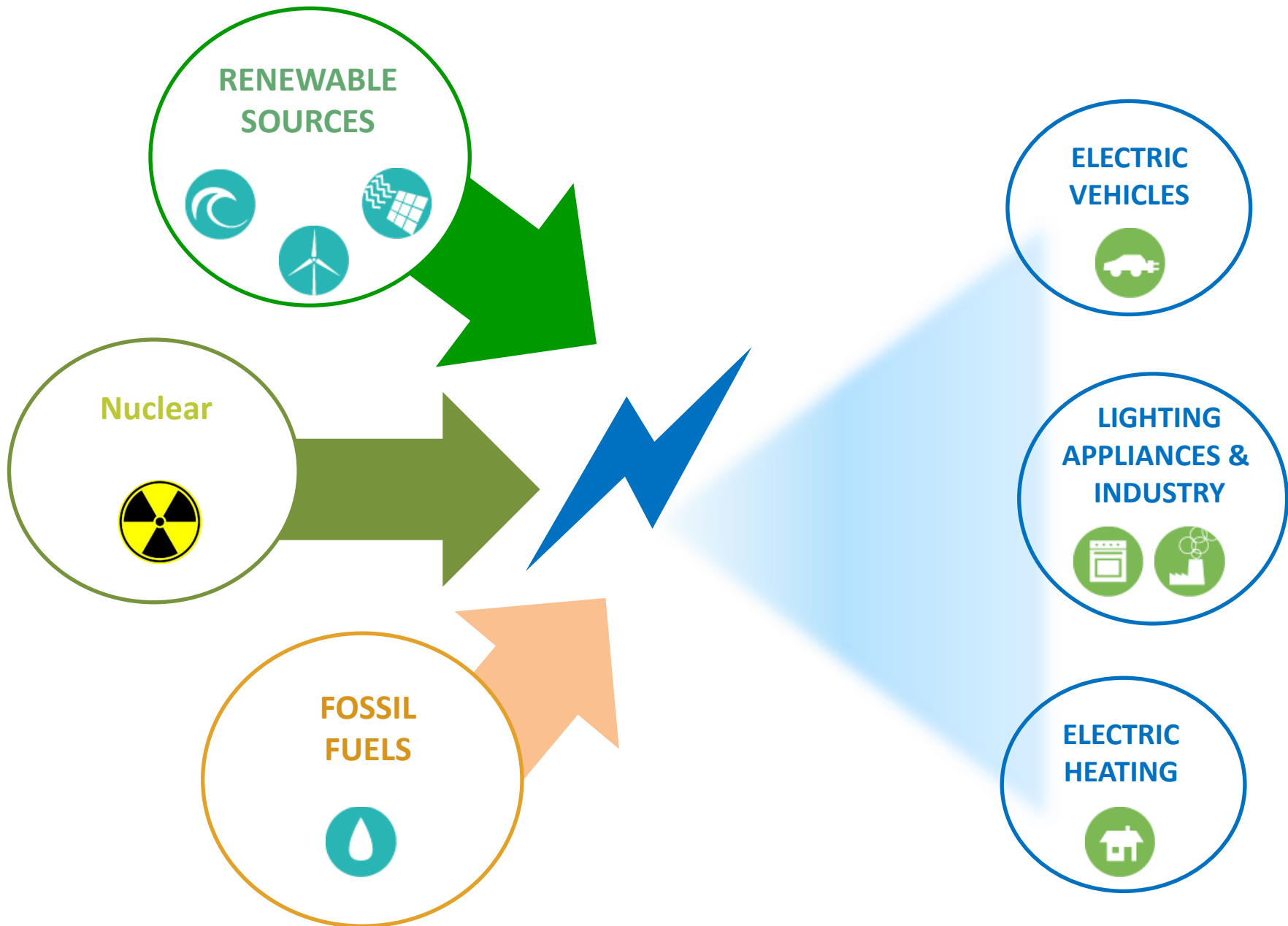
**Low
Demand**

**Coal
Plants**

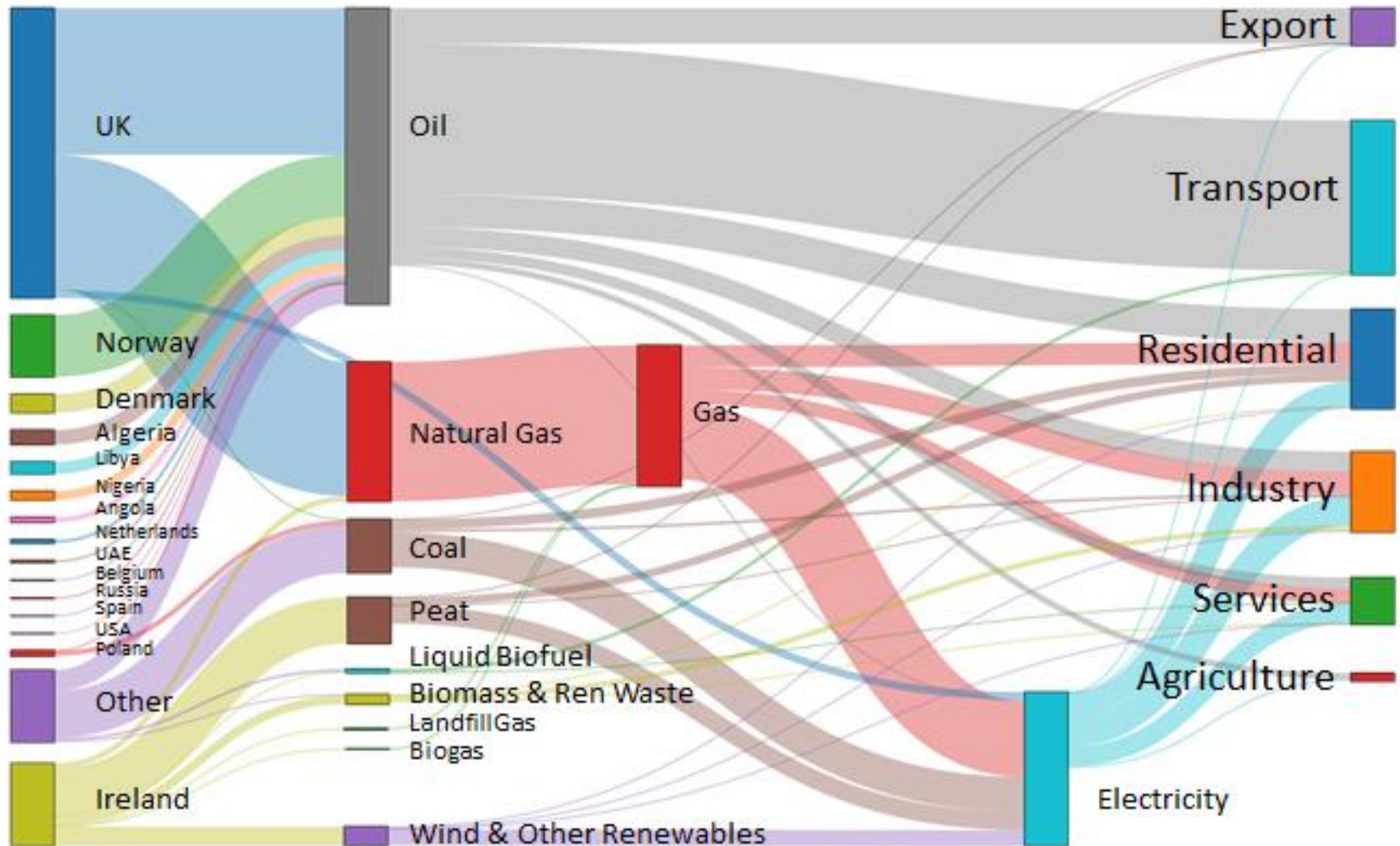
CCGT



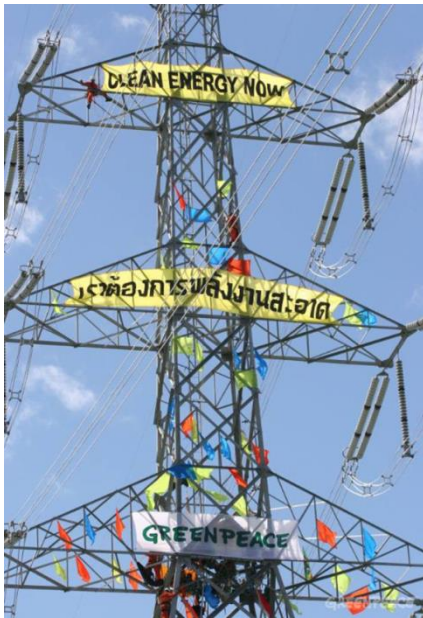
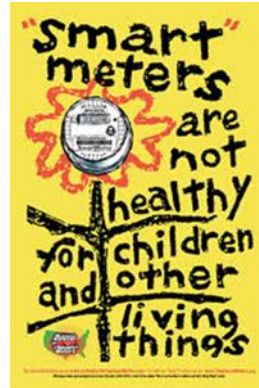
The Electric Future



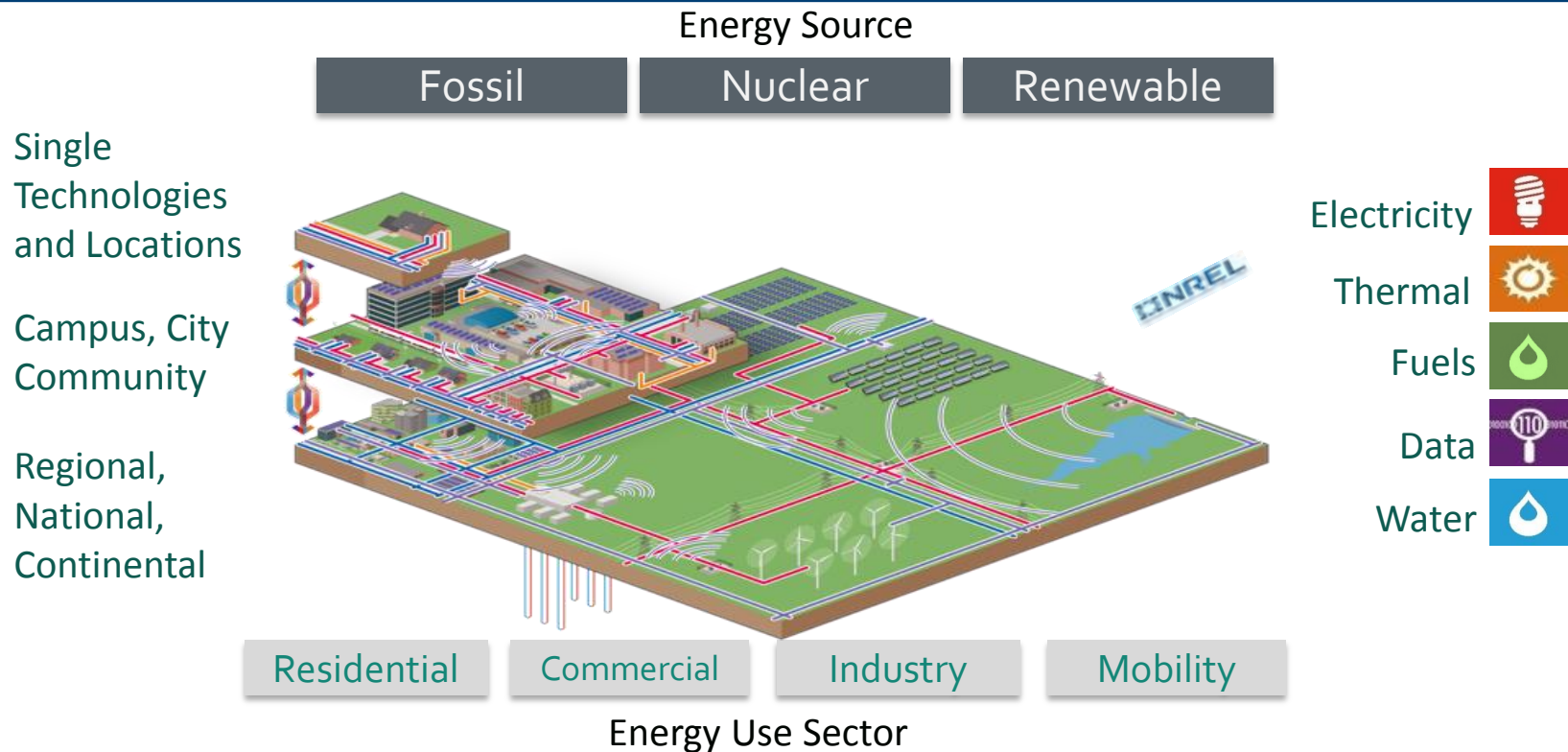
Whole Energy System



Enter the “consumer”



Energy Systems Integration (ESI)



- optimization of energy systems across multiple pathways and scales
- increase reliability and performance, and minimise cost and environmental impacts
- most valuable at the interfaces where the coupling and interactions are strong and represent a challenge and an opportunity
- control variables are technical economic and regulatory

International Context

Strategic Energy Technology (SET) Plan

Towards an Integrated Roadmap:
Research & Innovation Challenges and Needs
of the EU Energy System



 
Energy Technology Systems Analysis Program

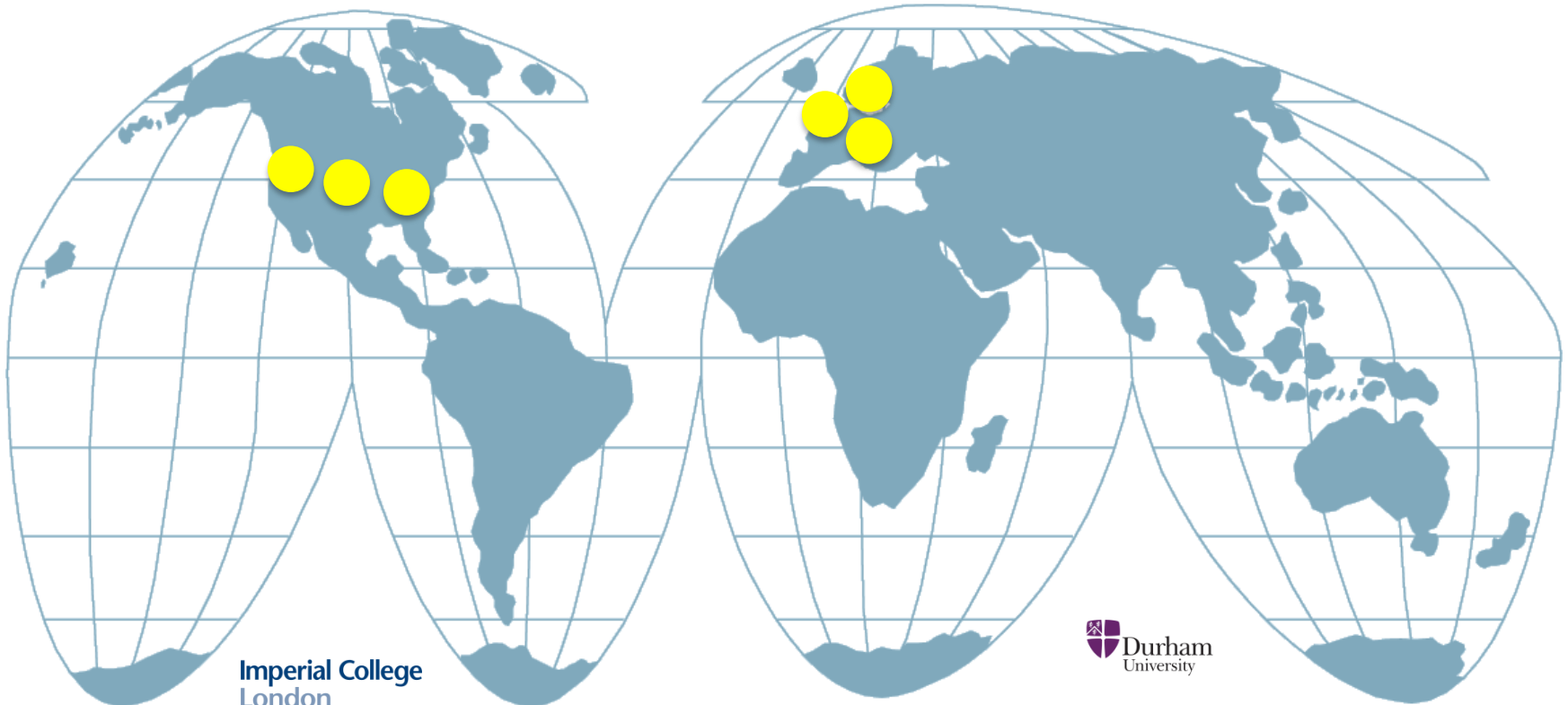


>200 groups in 70 countries using ETSAP
modelling tools

www.iea-etsap.org

Addressing energy challenges through global collaboration

www.iiESI.org





Energy Systems Integration 102 – Research Challenges

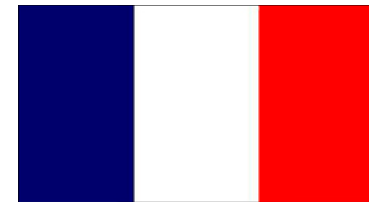
**National Renewable Energy Laboratory (NREL)
Energy Systems Integration Facility (ESIF) – Maxwell Conference Room
15013 Denver West Parkway, Golden, Colorado, USA
August 3rd to 7th, 2015**

The [International Institute of Energy Systems Integration](#) presents a course on Energy Systems Integration (ESI). The course is informed by a recent workshop held in Imperial College London that identified key [research challenges in ESI](#), hence this course is particularly suited for those with an interest in the future research challenges. The course also builds on previous courses held at [NREL](#) (ESI 101) and [KU Leuven](#), but are not deemed to be prerequisites.

The course will cover the research challenges of ESI at all scales (from residential to continental) across multiple energy (and non-energy) domains from a technical, market, regulatory and consumer standpoint. The course is

Monday 3 rd August		
8:30 – 8:45	Introduction and overview	M. O'Malley
8:45 – 10:15	Experience from Europe; ESI challenges and identification of pertinent research issues.	W. D'haeseleer
10.45 – 12:15	Behavior and impact of the consumer in an integrated energy system	L. Steg
1:15 – 2:15	Integrated energy system models	M.O'Malley and I. van Beuzekom,
2:45 – 5:00	Introduction to EnergyPLAN.	M. O'Malley and I. van Beuzekom,
Tuesday 4 th August		
8:30 – 10:00	Business Cases for distributed multi- energy systems	P. Mancarella
10:30 – 12:00	Introduction to HOMER	Peter Lilienthal
1:00 – 2:30	Co-optimization methods for integrated design and assessment of natural gas/electric systems/transportation systems.	J. McCalley
3:00 – 5:00	ESI examples with EnergyPLAN	I. van Beuzekom,
Wednesday 5 th August		
8:30 – 10:00	Economies of scale vs societal interest in small autonomous systems & Questionnaire.	J. McCalley
10:30 – 12:00	Based on the questionnaire that students fill in the responses will be the basis of an active discussion.	J. McCalley
1:00 – 2:30	Cyber physical social systems: modelling of consumer assets and behavior in an integrated energy system	S. Suryanarayanan
3:00 – 4:30	Using EnergyPLAN illustrate an example of ESI (students will be split into groups for this)	I. van Beuzekom
4:30 – 9:00	Social trip to Mount Evans	
Thursday 6 th August		
9.00 – 10.00	From customers to prosumers in an equitable low carbon transition (this will done by skype)	Sandra Bell and Janice Astbury
10:30 – 12:00	Energy System Planning and the interactions with electricity system planning a European model.	V. Silva and M. Zulueta
1.00 – 2.00	Tour of Energy Systems Integration Facility	B. Kroposki
2:00 – 3:30	Flexibility in integrated energy systems and virtual storage	P. Mancarella
4:00 – 5:00	Using EnergyPLAN find the shortcomings of integrated energy system models (students will be split into groups for this)	I. van Beuzekom,
Friday 7 th August		
8:30 – 10:00	Integrated electricity and market modelling; A high performance computing example.	M. Ruth & B. Palmintier
10:30 – 12:00	Electricity Market Models	E. Ela
1:00 – 3:30	Students report out on their ESI examples with EnergyPLAN and the shortcomings of integrated energy system models	M. O'Malley and I. van Beuzekom
3.30	Close	M. O'Malley

Instructors include: Dr. Vera Silva, EDF, France; Dr. Miguel Lopez-Botet Zulueta, EDF, France; Dr. Pierluigi Mancarella, University of Manchester, UK; Prof. Linda Steg, University of Groningen, The Netherlands; Prof. Mark O'Malley, UCD, Ireland; Dr. Ben Kroposki, NREL, USA; Dr. Brian Palmintier, NREL, USA; Dr. Mark Ruth, NREL, USA; Prof. William D'haeseleer, KU Leuven, Belgium; Prof. Siddharth (Sid) Suryanarayanan, CSU, USA; Prof. James McCalley, ISU, USA, Dr. Erik Ela, Electric Power Research Institute, USA. Prof. Sandra Bell, Durham University, UK; Dr. Janice Astbury, Durham University, UK. Peter Lilienthal, NREL, USA.



Some Logistics

- Exits etc.
- Slides
- Handouts
- Videos