



Collaboration between UCD and DTU

Visit by Her Excellency Ms Cliona Manahan,

Ambassador of Ireland





.... balancing of the power system



■ Wind power □ Demand

In 2008 wind power did cover the entire demand of electricity in 200 hours (West DK)



■ Wind power □ Demand

In 2014 more than 40 pct of electricity load was covered by wind power.

For several days in 2014 the wind power production was more than 120 pct of the power load.

July 14th, 2015 more than 140 pct of the power load was covered by wind power

From large central plants to Combined-heat and power production



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From a few big power plants to many small combined heat and power plants – however most of them based on coal



What has since been achieved: De-coupling of consumption and GDP growth



Source: Energy Policy in Denmark. Danish Energy Agency. December 2012



Energy Systems Integration Hypothesis

The **central hypothesis of ESI** is that by **intelligently integrating** currently distinct **energy flows** (heat, power, gas and biomass) we can enable very large shares of renewables, and consequently obtain substantial reductions in CO2 emissions. *Smart Grid solutions are not effective and not sufficient.*

Intelligent integration will (for instance) enable lossless 'virtual' storage on a number of different time scales

This is recognized by both UCD and DTU, and I consider this as the main driver behind the good and fruitful collaboration between UCD and DTU



ESI national projects in Ireland and Denmark



The *Center for IT-Intelligent Energy Systems in Cities (CITIES)* is aiming at establishing methodologies and solutions for design and operation of integrated electrical, thermal, fuel pathways at all scales.

This Center is the largest Smart Cities and ESI research project in Denmark – see http://www.smart-cities-centre.org (Led by Henrik Madsen). Here UCD/ERC plays an important role. The focus of UCD is on power/gas.



Example: Storage by Energy Systems Integration



Denmark (2014) : 48 pct of power load by renewables (> 100 pct for some days in January)

(Virtual) storage principles:

- _ Buildings can provide storage up to, say, 5-12 hours ahead
- _ District heating/cooling systems can provide storage up to 1-3 days ahead
- _ Gas systems can provide seasonal storage

Energy Systems Integration Partnership Programme

Pending (not yet funded) €11M (half from industry)

Funding Agency Science Foundation Ireland













Coláiste na Tríonóide, Baile Átha Cliath

Trinity College Dublin Ollscoil Átha Cliath | The University of Dublin

KU LEUVEN

Proposal (UCD, DTU, KU Leuven): ESI Joint Program as a part of European Research (EERA) Main driver is Prof. Mark O'Malley, UCD



FESI International Institute[™] for Energy Systems Integration

Addressing energy challenges through global collaboration

Vision: A global community of scholars and practitioners from leading institutes engaged in efforts to enable highly integrated, flexible, clean, and efficient energy systems **Objectives:** Share ESI knowledge and Experience: Coordination of R&D activities: Education and Training Resources

Activities 2014 ·Feb 18-19 Workshop (Washington) ·May 28-29 Workshop (Copenhagen) ·July 21 – 25, ESI 101 (Denver) ·Nov 17th Workshop (Kyoto) Activities 2015 ·Dublin, Denver, Brussels, Seoul





ELECTRIC POWER RESEARCH INSTITUTE







Conclusions



- Ireland and Denmark have recognized that Energy Systems Integration using ICT has been the key to a large scale integration of renewables
- We acknowledge the good collaboration with the leading Electrical Engineering Research Center in the world (ERC lead by Prof. Mark O'Malley)
- Successful exchange of PhD students and researchers
- Decoupling of GDP growth and energy consumption
- Energy Systems Integration can provide virtual and lossless storage solutions
- District heating (or cooling) provides virtual storage on the essential time scale (up to a few days)
- Today almost 50 pct renewables (mostly wind) in the Danish power system
- Markets and pricing principles need to be reconsidered; we see an advantage of having a physical link to the mechanism (eg. nodal pricing, capacity markets)