

# Bristol University Capability Statement

Alan Champneys Faculty of Engineering



SMART GRIDS meeting 22/01/10

# Contents

- 1. who
- 2. what
- 3. ideas for collaborative research

# 1. BRITE

- A research focus led by Engineering with themes in  
Energy Built Environment  
Transport & Communications  
collecting expertise to engineer a sustainable future
- part of wider University Cabot Institute involving  
Water Climate Modelling, Risk  
Social Insecurities
- Underpinning excellence in  
Systems Engineering, Complexity Science,  
Maths & Stats, Energy Management,  
Dynamics & Materials (BLADE), Comms

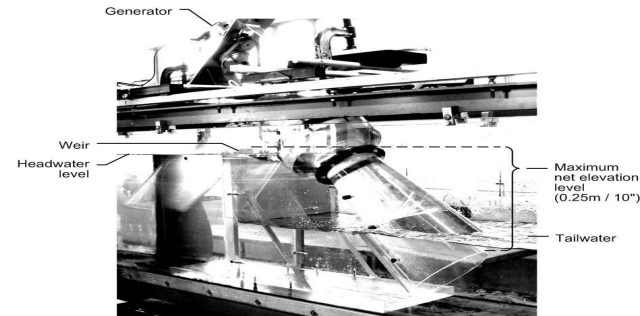
# 2a. EE Energy Management Research

Bernard Stark, Dave Drury, Phil Mellor, Steve Burrow ...

- Scalable & modular power generation

Design of energy-efficient power electronic converters for grid-tied and remote applications. + Test facilities for improving efficiency.

e.g. **Low-head pico-hydro generator**

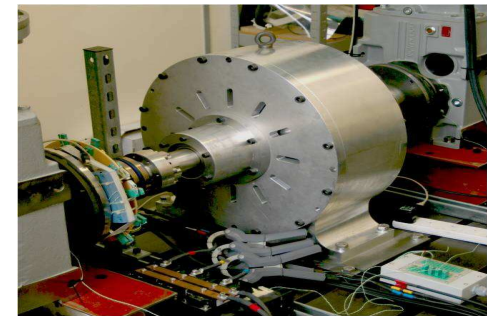
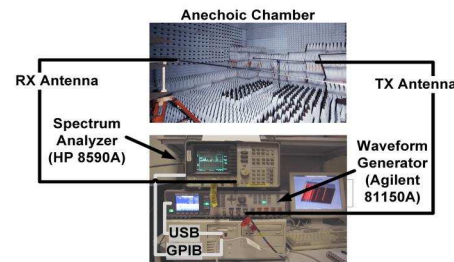
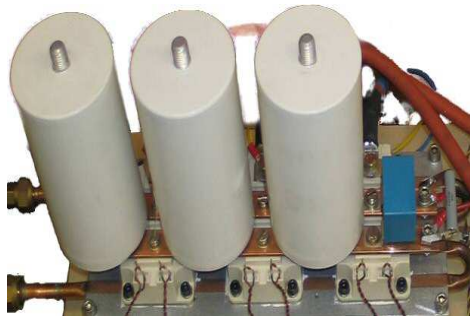


modular design enables management of consumer load

# 2a. EE Energy Management Research

Bernard Stark, Dave Drury, Phil Mellor, Steve Burrow ...

- Scalable & modular power generation
- Advanced control of multi-source micro renewables  
Electrical integration of multiple variable micro-renewable sources such as building-integrated wind and photo-voltaic generators for remote and grid-tied systems.

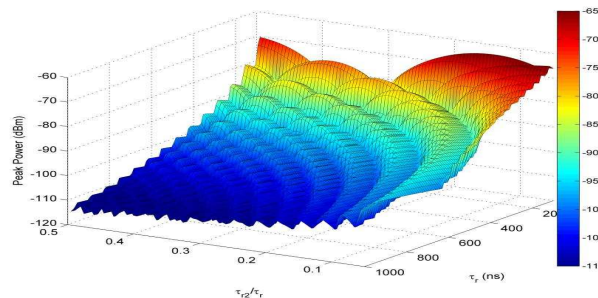


# 2a. EE Energy Management Research

Bernard Stark, Dave Drury, Phil Mellor, Steve Burrow ...

- Scalable & modular power generation
- Advanced control of multi-source micro renewables
- Ultra-efficient power management

New control techniques for efficient and compact power converters switched-mode power electronics and lower electromagnetic interference (EMI).



# 2a. EE Energy Management Research

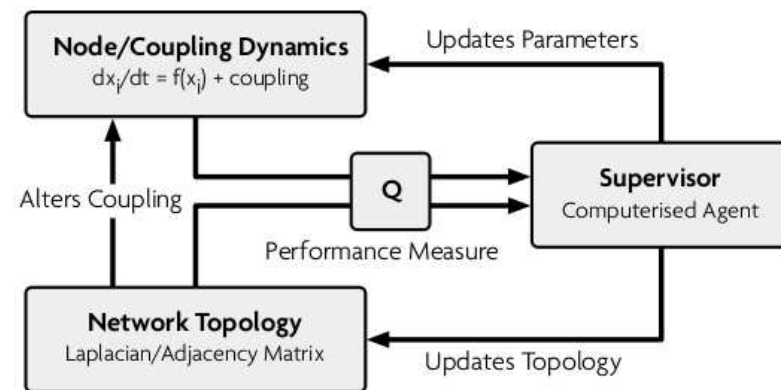
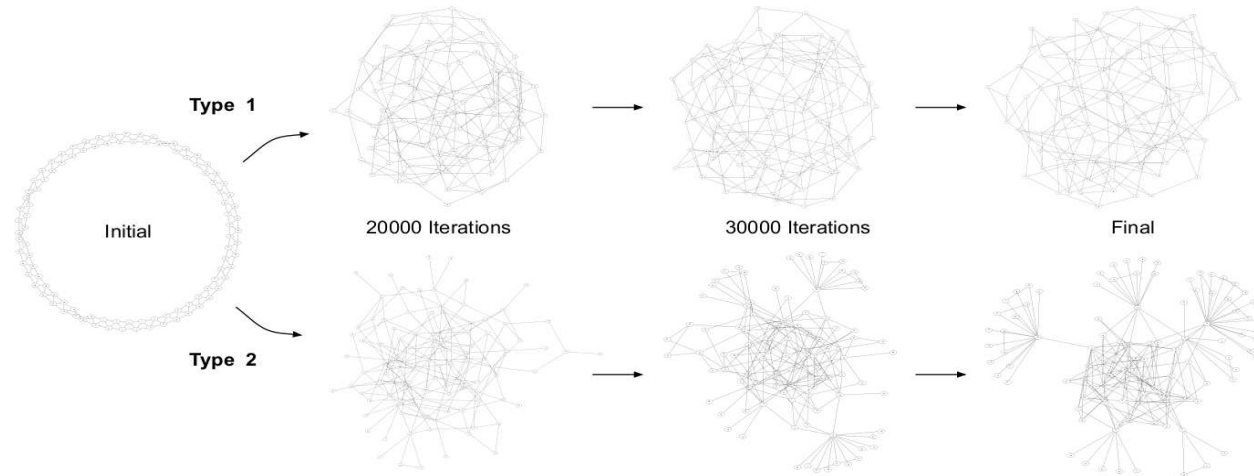
Bernard Stark, Dave Drury, Phil Mellor, Steve Burrow ...

- Scalable & modular power generation
- Advanced control of multi-source micro renewables
- Ultra-efficient power management
- Renewably-powered sensor and energy management networks  
Intelligent, efficient and ultra-low power electronic circuitry & sensor nodes for condition monitoring etc. in extreme environments.

# 2b. Bristol Centre Complexity Sciences

A. Ganesh, Mario di Bernardo, Eddie Wilson ...

Complex networks:



Simulation and Control:

# relevant complex network research

- Adaptive networks

How to **adaptively reconfigure** network to have desired structural properties? How to do so using localized rules?

Seek a **fitness function** that is low for good structures and where the change in fitness can be computed locally.

# relevant complex network research

- Adaptive networks

- Epidemics and fault propagation

How does **shape of network** affect duration of epidemic? number of infected nodes?

Related work on **switching networks** & **voltage collapse**

# relevant complex network research

- Adaptive networks
- Epidemics and fault propagation
- Pricing and congestion control

Internet controlled by **TCP**; mandated user response to congestion indicator

Alternative; set prices and **let users react**.

But how to ensure network stability as users react to spot prices?

# relevant complex network research

- Adaptive networks
- Epidemics and fault propagation
- Pricing and congestion control
- Load balancing

In IT, jobs migrate between servers, based on their load.  
How long does it take to balance load?  
How effective is it in dynamic scenarios?

# relevant complex network research

- Adaptive networks
- Epidemics and fault propagation
- Pricing and congestion control
- Load balancing
- Network design and control

Tools to investigate mechanisms for **optimisation**, **control** and **growth** of complex networks application to user-specified goals. e.g. synchronization, distributed decentralized control  
Inspiration from biological networks **robust** & **flexible**

# 3. What's next?

- Get on board with us

[brite-enquiries@bristol.ac.uk](mailto:brite-enquiries@bristol.ac.uk)

[www.bris.ac.uk/engineering/research/brite](http://www.bris.ac.uk/engineering/research/brite)

**Cabot Institute** launch event Autumn 2010 ...

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- You tell us!! — we're open for collaboration
- Some current collaborative research proposals:
  - **REDLINE** - Kaleshi EE
  - **Resilient Complex Grids** SETSquared + Massachusetts
  - **Adaptive Complex Infrastructure Networks** ERC
  - **ACRE** ...

# ACRE

## Accelerator Consortium on Renewable Energy

- A collaborative proposal through **Great Western Research**
- To enable the SouthWest to become exemplar for 2020 targets
- Involves University of **Bath**, **Bristol**, **Exeter**, **Plymouth** and **UWE**
- + NGOs like **RegenSW** & **Plymouth Marine Lab**
- Want to fund industrial/University collaborative research
- Research at TRL 2-5 on barriers to implementation