Living without electricity
Lessons from Lancaster

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Storm Desmond
December 2015

Cumbria
350 mm in 24 h

Map from NASA
Peak flow: 1,742 m³/sec
Would fill an Olympic pool in 1½ sec
Extent of floods
But why is the substation next to the river?
Lancaster power station

c. 1970

Photo: Lancaster Museum
History of substation

- Power station next to River Lune since 1915
- When it closed in 1975 substation was left
- Last serious flood 1907
- No-one could justify the cost and disruption of moving the substation
- Much of our infrastructure was not planned. It is there “by accident”.
22:39 on 5 December 2015
Supplies lost to 60,987 consumers
Fully restored 19:18 on 8 December
75 generators brought from all corners of the UK
Internet

• Fibre from exchange to street

• Routers, connecting fibre to copper, powered from mains

• Broadband hubs in homes powered from mains
Fixed-line phones
Mobile phones

Load on 230V typically 1 kW
Effects on households

- No lights
- No central heating
- No TV or digital radio
- Only traditional phones working
- No internet
- Powered garage doors not working

- No street lights
- Shops closed
- Credit cards not accepted
- Cash machines not working
- Schools cannot get in touch
- No petrol or diesel
OK for those with a log burner and gas hob
Living in flats

- No heat
- No cooking
- No lights
- No extractor fans
- No water (inc. toilet flushing)
- No lifts
- No entryphone
Fortuitously:

• Mains water supply generally reliable
  • Reservoir full
  • Filtration/chlorination plant working

• Sewage network didn’t flood
  • Backup supplies for pumps

• Gas supplies available
  • Pumping/pressure reducing stations backed-up or outside affected area
The hospital

• Backup generators working
• Difficult to contact patients
• Some staff unable to get in
• More A&E patients – unable to use other health services
• People came “off the street” to use canteen and charge their phones
Where to turn in a crisis?
A care home

• No light, heat, hot water, cooking, lifts, adjustable beds, powered medical equipment, emergency call alarm, telephone PABX, ... ... or TV

• Chef made BBQ in garden

• Relatives brought in camper van with Calor Gas cooking.
Care in the community

Chair lifts

Carer alarm systems

Dialysis machines

Oxygen concentrators

... all rely on mains electricity
Primary school

- Can’t communicate with staff
- Can’t contact parents
- Access control not working
- Alarm messages routed elsewhere
- No road lighting or crossing control
- Heads are on their own
  - Academisation policy
  - No contact from emergency planners
Shopping

• Booths had backup generator contract
• ATM and electronic tills working
• No credit/debit card payments
• No other supermarkets open
• No other ATMs
• Closed at 16:00 due to Sunday trading laws, when still very busy.
Impact on University

• Closed for Christmas a week early

• Usual means of communicating with students didn’t work

• No fire alarms or lighting so evacuated college bedrooms

• Some students went home, others slept in Great Hall
Electricity at the railway station

- Power supply and signalling fed from outside the area
- Town supply used for:
  - Platform lighting
  - Public address and CCTV
  - Ticket machines & ticket offices
  - Point heaters, etc.
- With no supply, station had to close at dusk
“What is Gold Command?”
Indications of complexity

• Large numbers of participants sharing responsibilities;
• Wide geographical/organisational distribution of a single critical system;
• Dependencies between various critical systems;
• Many actors with incentives to optimise their own corner of the system.

Complex systems tend to have unpredictable failure modes
Escaping dependency – creating resilience

Where should resilience be located?

• In the home or local community?
• With the service provider?
  e.g. Internet or mobile phone companies, gas and water suppliers
• In the local electricity network?
• With the central electricity industry?

Experience in Lancaster suggests doing nothing is not an option
What else could cause a loss of supply?

• Complex interactions of network control systems
• Instabilities introduced by consumer energy apps
• Cyber attacks:
  • *WannaCry* ransomware,
  • *Stuxnet* worm, ... ... ... ...
• Physical terrorist attacks on infrastructure
“Improved connectivity is revolutionising our quality of life, from how we work and how our children learn, to how we spend our leisure time, how we do our weekly shop, and how we engage with public services.

“Broadband Delivery UK (BDUK), part of DCMS, is delivering superfast broadband and better mobile connectivity to the nation.”

But it increases our dependence on 24/7 internet access.
Lessons and questions from Lancaster

• As a society, we are dependent on electricity
  • Government policy encourages us to become more dependent
  • Communications depend on the internet, which depends on electricity

• How resilient is the policy of “care in the community”? ?
• Are privatised services less resilient than when state-run ?
• Where do people go for help in natural disasters?
• How can emergency planning teams communicate with residents when there is no electricity?
Report available on the web

Search for:
“RAEng living without electricity”