Measurement for Smart Grids

Jane Burston

Head, Centre for Carbon Measurement
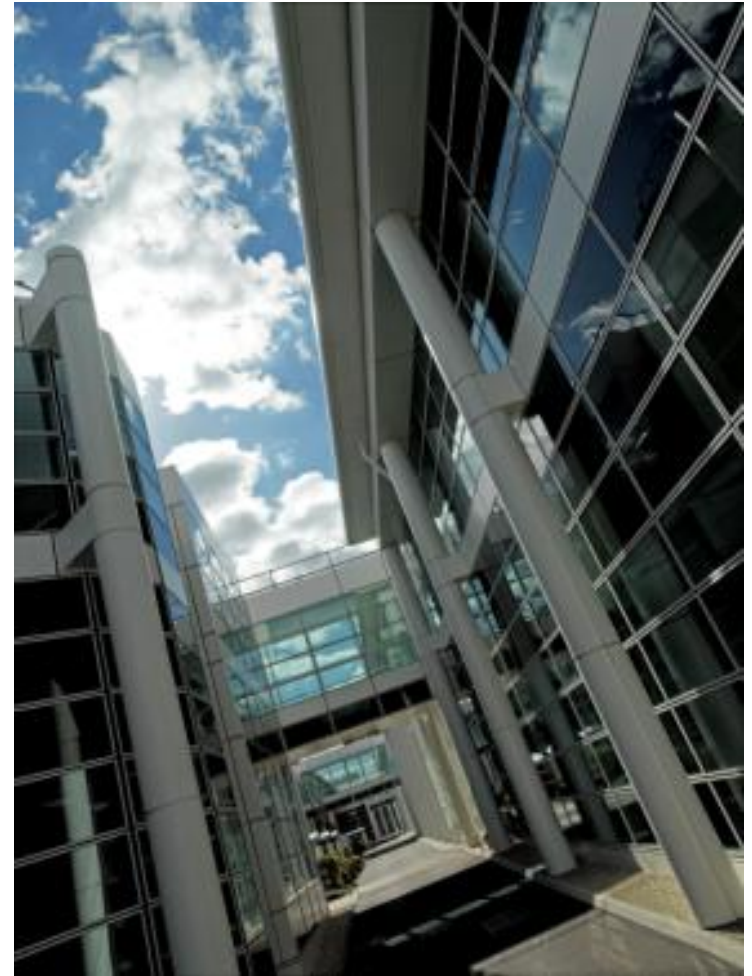
National Physical Laboratory
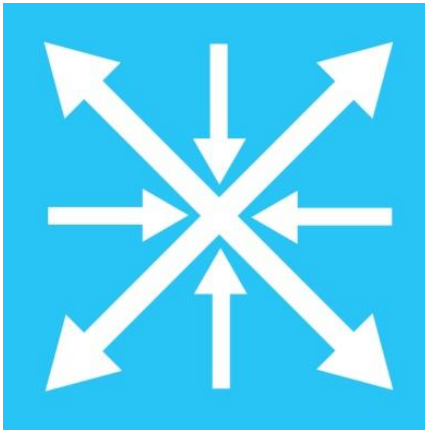
5th Annual Smart Grids & Cleanpower 2013 Conference
5 June 2013 Cambridge

www.cir-strategy.com/events/cleanpower

What is NPL?

- World-leading science and technology laboratory

- Directly-owned by BIS

- 550+ staff

- Working with and for business, academia and government

- Science with impact

Measurement at the frontiers

Smart and interconnected measurement

Embedded and ubiquitous measurement

"The Centre for Carbon Measurement at NPL **brings together academic and business partners with government** and is designed to ensure that we can have **confidence in the measurements** we need to deliver policies for mitigating climate change, and accelerate the development of low carbon technologies."

David Willetts

Minister of State for Universities and Science

Planning for the impact of renewables

Challenge: What effect will renewable retrofit have of a network – e.g. voltage rise, power quality?

Power Quality Analyser

CURRENT INPUTS   Mains Fuse   VOLTAGE INPUTS

1
2
3
4

⚠ WARNING HIGH VOLTAGE
PRESENT INSIDE!

STATUS

● DSP OK
● FPGA OK
● 1 PPS
● GPS ACTIVE

TEMPERATURE
MODULES
STATUS

H   L

● ● 1
● ● 2
● ● 3
● ● 4
● ● 5

ISOLATED
SUPPLY
STATUS

● 1
● 2
● 3
● 4
● 5
● 6

POWER
OFF ON

S/n 104

NPL
National Physical Laboratory

Site PQ Measurements
Solar Retrofit - Anglesey

North Substation

Mid Point

South Substation
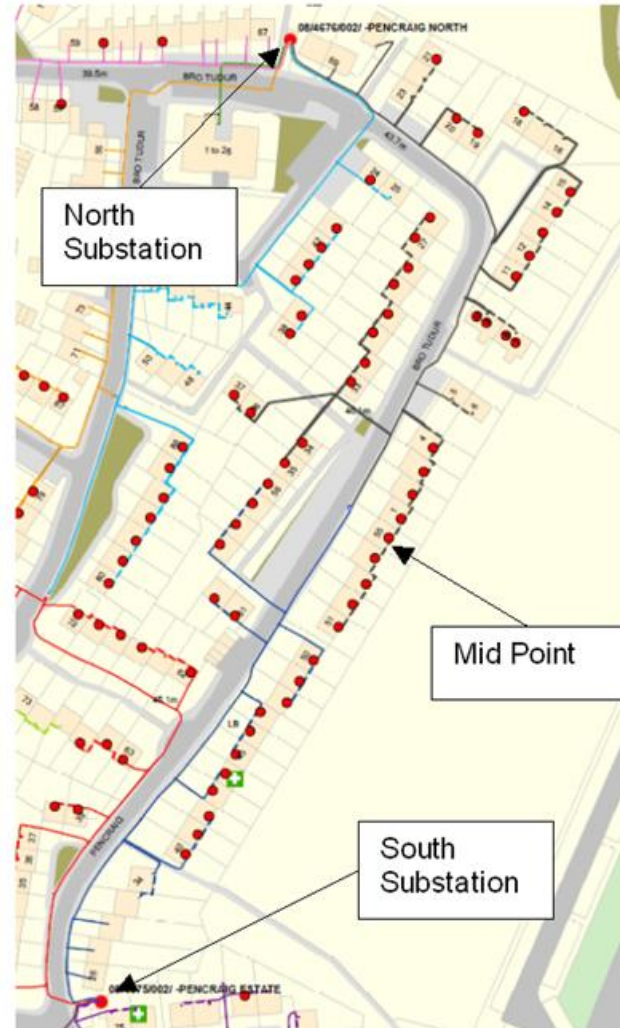
Metrology for HVDC

Wind turbine flicker
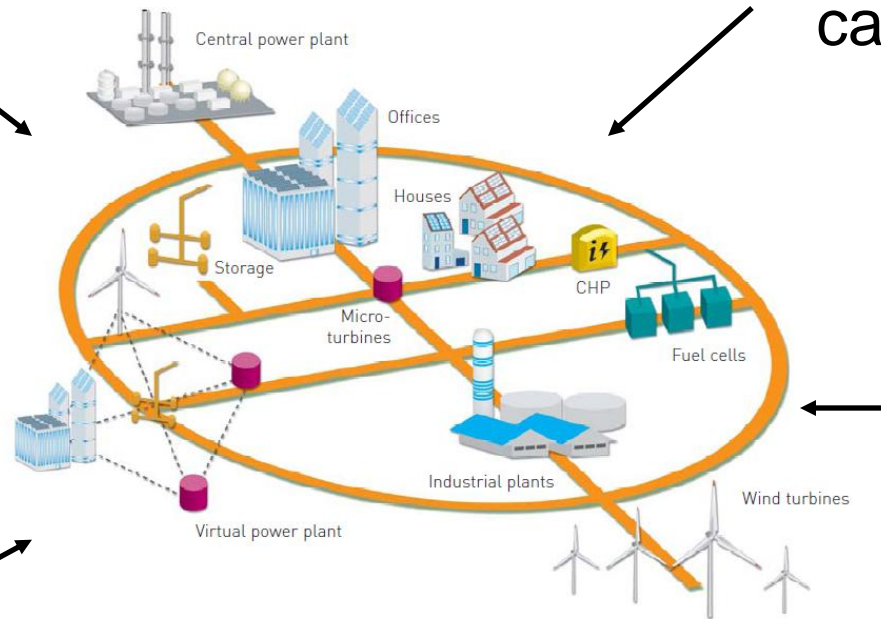
Instrumentation for Networks

Challenge:
Control and instrumentation of networks - How many sensors are required to determine power flow in a network? Where should they be located?

Sensor coverage in Electricity Networks

How to handle
too much data ?

Which sensors
can be removed?

Central power plant

Offices

Houses

Storage

Micro-
turbines

CHP

Fuel cells

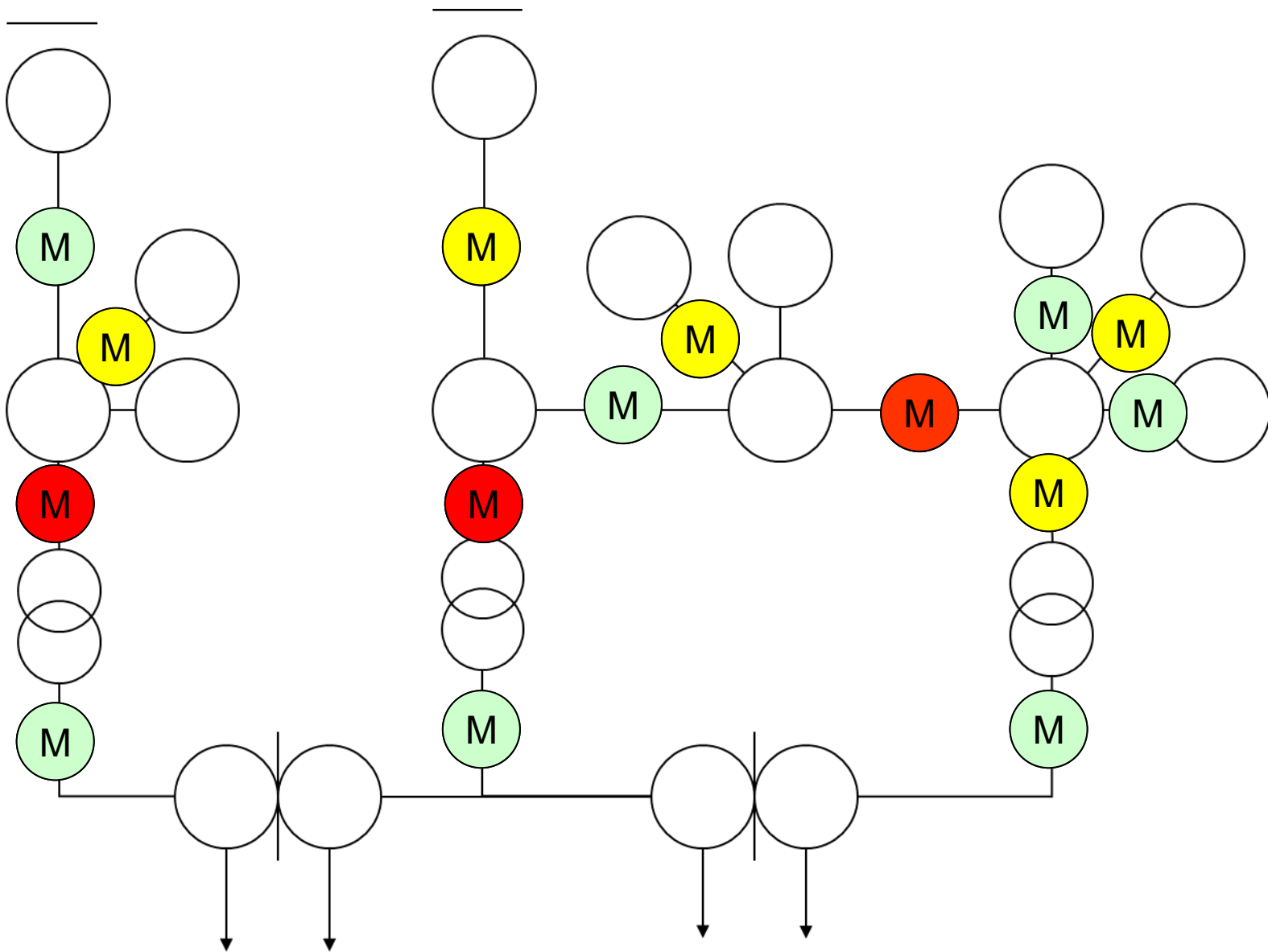Industrial plants

Wind turbines

Virtual power plant

What
happens
when a given
sensor fails?

How many
sensors are
needed ?

How accurate
should a given
sensor be?

Vital   Important   Optional

Determination of Carbon Savings in Smart Grid Trials

Challenge: How to calculate the net carbon savings in a Smart Grid trial in a consistent and rigorous manner, for comparisons with other trials and business planning?

Carbon Savings model

Develop model to estimate and optimise carbon savings in smart grids projects

Trial with case studies e.g. LCNF projects

Develop a PAS (Publicly Available Specification) with industry partners

Future projects

Wide Area PQ
(PQ propagation using GPS locked digitizers)

Grid Impedance
(Field Measurements Vs. Models)

Dynamic Rating of OHLs
(Field Measurements)

Sensor Networks
(Optimal number of sensors and placement)

Smart Meter Networks
(Power Flow using S/M data)

Demand Response
(Sensor Networks + algorithms)