

Smart Grids Measurements

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www.hvm-uk.com

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



Power Measurement at NPL

NPL measures power to accuracies of 40 parts per million – ***comparable to detecting the power of flashlight against the background of the full set of floodlights at Wembley Stadium.***

Readings of every electricity meter in UK homes can ultimately be traced back to national standards.

Accuracies are necessary to support the long chain of measurements from primary standard through to peoples homes.



Challenges we address

Planning for the impact of renewables and increased use of HVDC

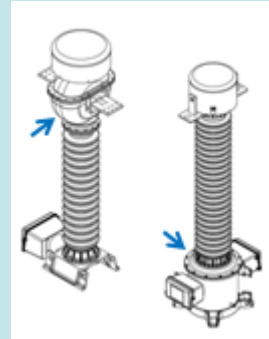
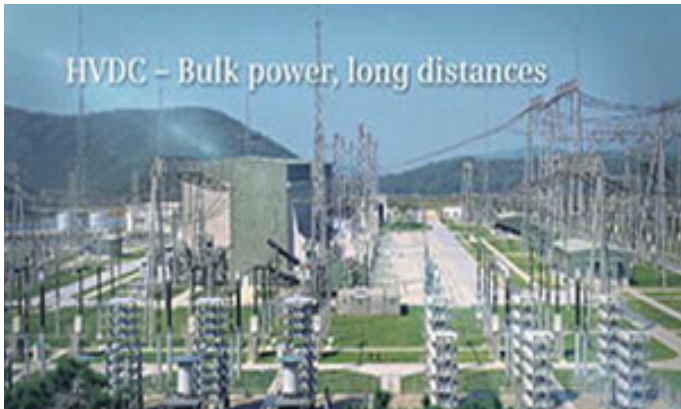
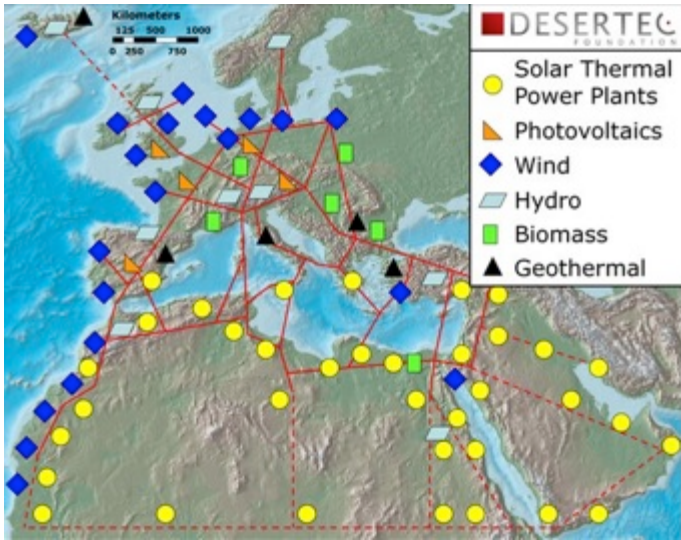
Renewables' impact on network – e.g. voltage rise, power quality?

Instrumentation for networks

*How many sensors required to determine power flow across network?
Where should they be located?*

Determination of carbon savings of smart interventions

How to calculate the net carbon savings in smart interventions and allow inter-comparison with other options?



*1MV Metrology
(Modular divider)*



*DC and AC Metering
(>100kV ac site cal.
+ dc side meter.)*



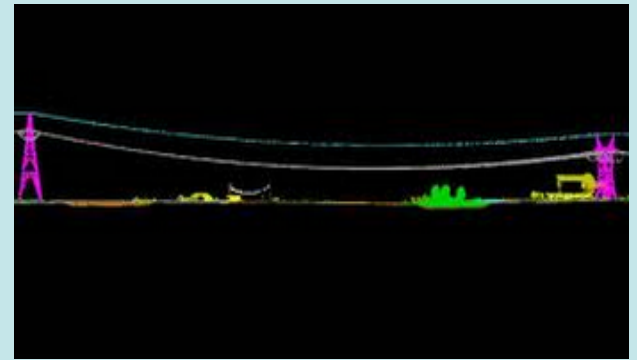
On-Site Metrology



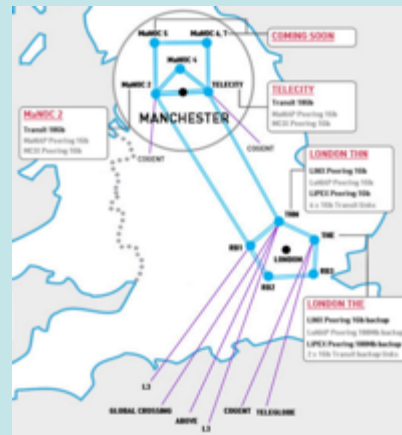
Converter Efficiency



Weather Data



Temperature Sensors

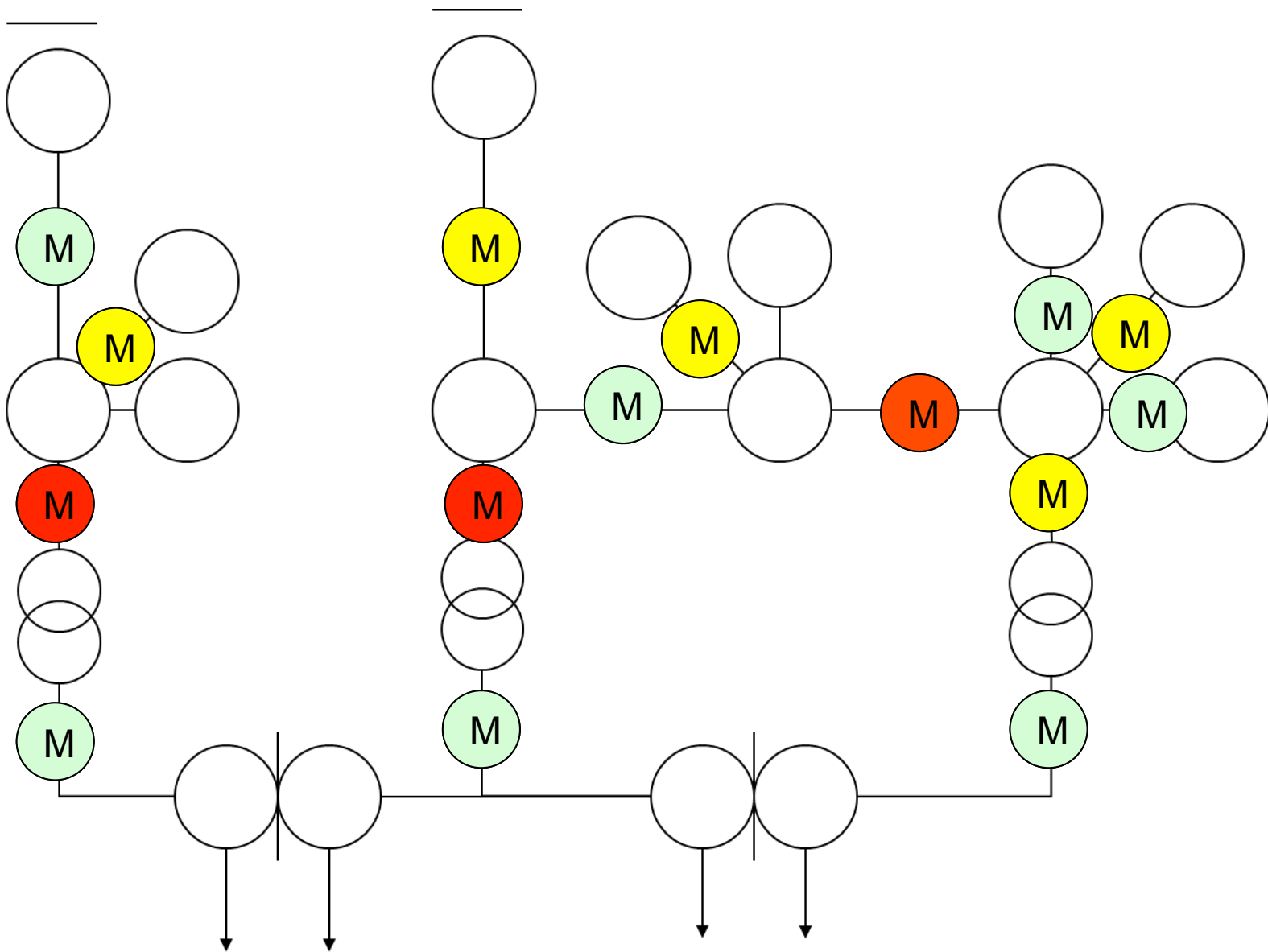


*Data Processing:
Dynamic Rating*



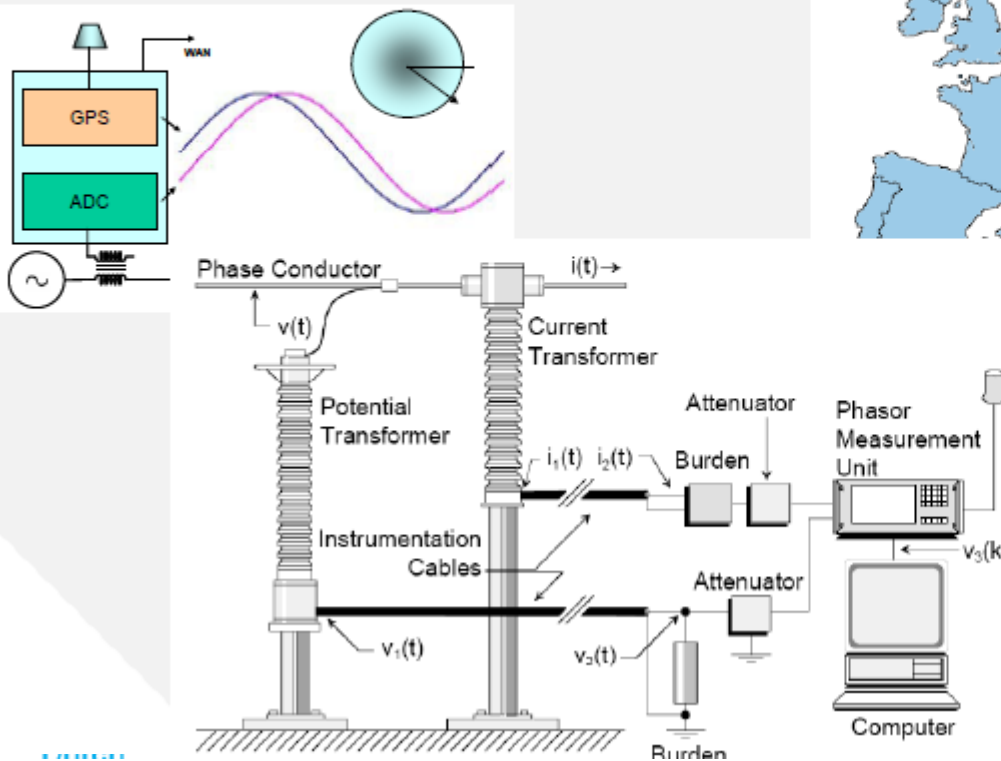
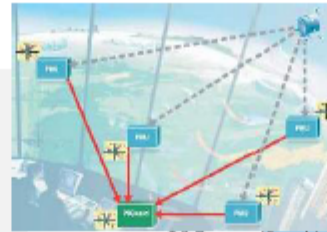
*Better Measurements:
Reduced Load Margins
(on-site calibrations)*

 Vital  Important  Optional



Phasor Measurement Units (PMUs)

PMUs used to monitor static state estimation as well as the dynamic behaviour of transmission networks
“early warning of system instability”

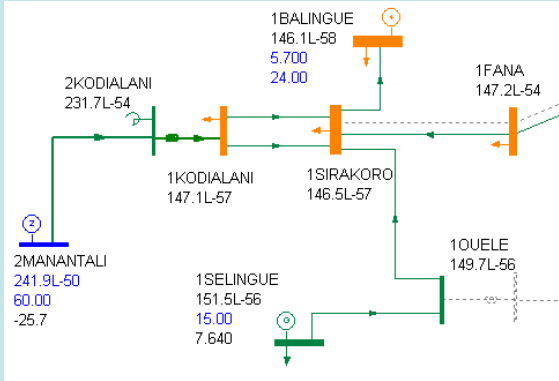


“PMU testing and calibration have become a major hurdle to the further development and implementation of PMU applications in power systems. Utilities need the guarantee of reliability and accuracy of PMUs and also the seamless interchangeability among the PMUs from different vendors.” EPRI

Challenge: Reliability



*Fault Location
(Using wide-area
Measurement - PMUs)*



*Power Flow:
Sensor Networks
(Placement optimisation)*



*Wide Area
Measurements
(Field use of
reference PMU)*

Wind Turbine "Flicker"
Denmark.



Solar PV Retrofit



HVDC Station, Sweden



Determination of Carbon Savings in SmartGrid Trials

Challenge: To calculate the net carbon savings in a smart interventions in a standard and rigorous manner for comparisons with others, for example LCNF trials.



- Smart Grids – choosing the right topologies /techniques/technologies...
- How much carbon does a given scheme save ?
- To scale-up from trials requires rigorous data to make the right decisions

Dynamic Demand Challenge Prize

Create a new product, technology or service that utilises data to significantly improve the ability of households or small businesses to demonstrate measurable reduction in carbon emissions by shifting energy demand to off peak times or towards excess renewable generation.

Expected outcomes:

- Demonstrable shift in peak usage to off peak times
- Responsiveness to dynamics of supply of renewable energy
- Measureable reduction in CO₂ emissions

Thank you!

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Centre for Carbon Measurement



Climate data

Provide confidence and reduce uncertainties in climate data used for monitoring and modelling



Carbon markets & accounting

Support tax, trade and regulatory instruments for carbon pricing and reporting



Low carbon technologies

Accelerate development and assess performance of low carbon technologies