

CLASS technical

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LCNI conference, Liverpool, November 2015
Session 3.4 Facilitating Low Carbon
Energy and New Connections



Back to school for a moment...



This fundamental relationship is
at the heart of CLASS

But how will it change over time
as customers
adopt new devices?

How could we use this
relationship in a smart
way to benefit customers?

*voltage is proportional
to demand*

*if voltage is increased
demand increases*

And vice versa . . . !



How does it work?



00:03:00

2%



00:00:08



2%

The cost £ to make your cup of tea is always the same!

*“A problem shared
is a problem
halved...”*

20,000 homes in a town

200,000 homes in a city

26 million across the GB



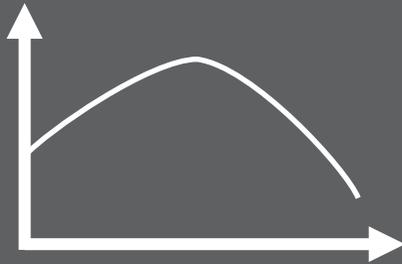
What problems could we solve ?

CLASS aims to harness thousands of tiny changes at just the right time



Today

High peak demand



Reduces peak demand
Faster LCT connections
Lower network cost

Tomorrow

Respond and reserve



Primary and secondary
frequency response
Allows more renewable
generation
Flexible reactive power
absorption

Future

Wind following



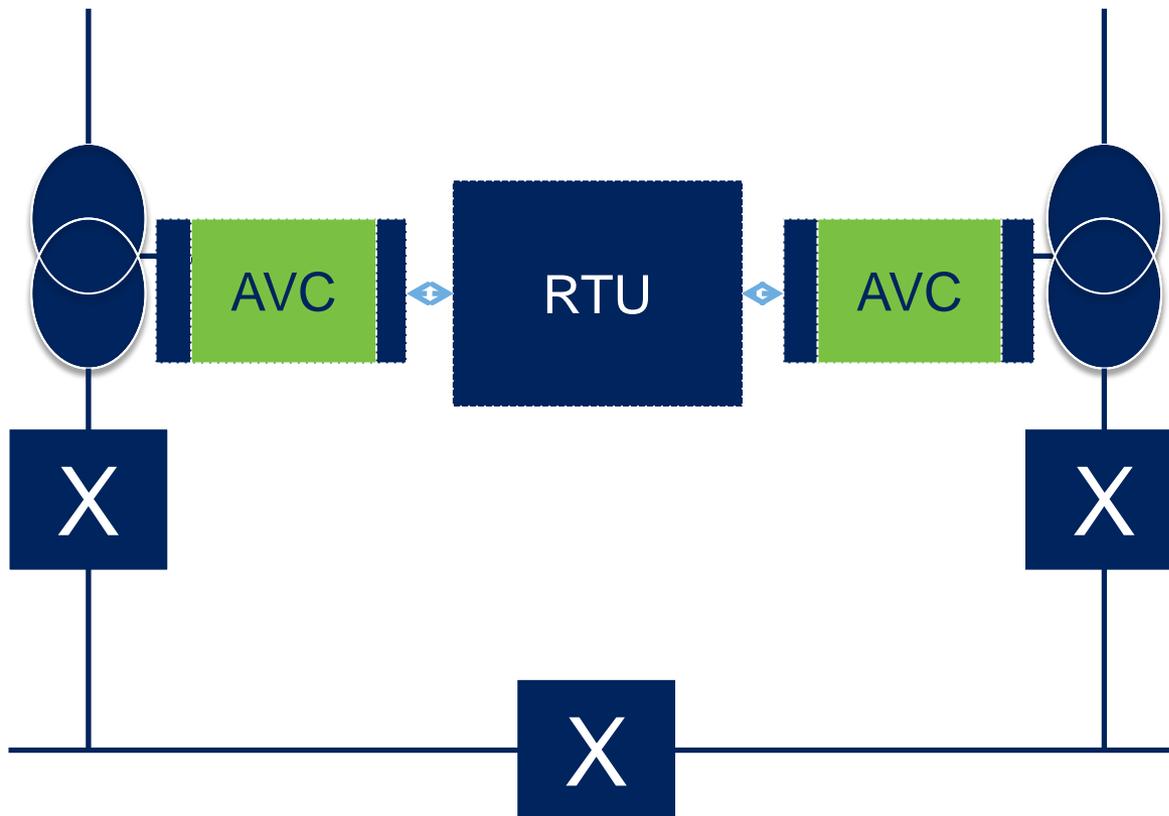
Facilitates demand boost
Lower energy costs
Mitigates inertia issues

The CLASS functions



	Objective	Technique
Automatic peak reduction	Reduce demand to within substation capacity	Lower tap position
Demand boost / reduction	Boost or reduce demand	Lower / higher tap position
Frequency response	Primary response to reduce demand when frequency falls on the network	Switch out transformer
	Secondary response to reduce demand when frequency falls on the network	Lower tap position
Reactive power	Absorb high voltages that occur on the transmission network	Stagger tap position

Typical substation overview

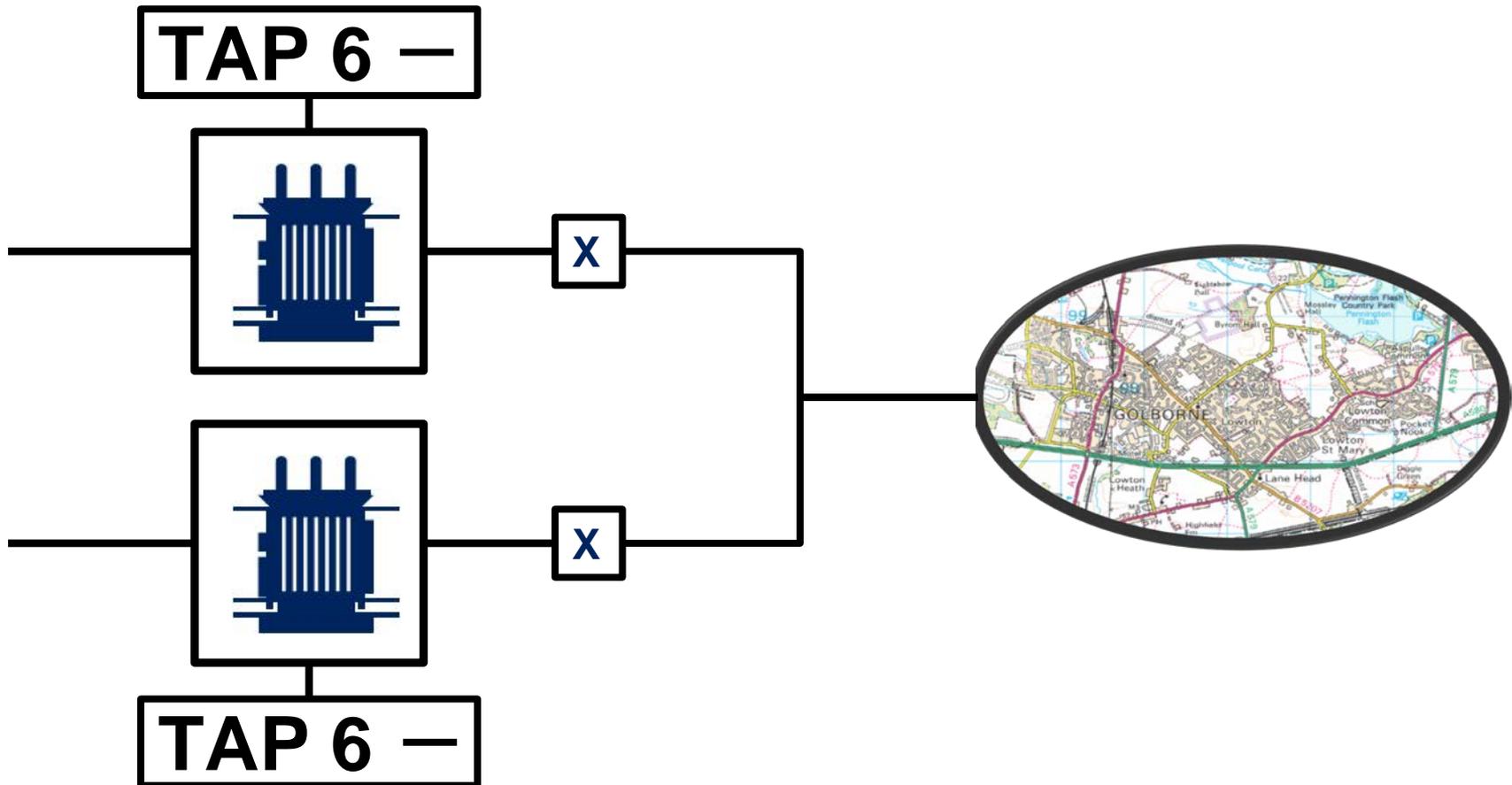


Typical primary arrangement - Golborne



33kV

11kV

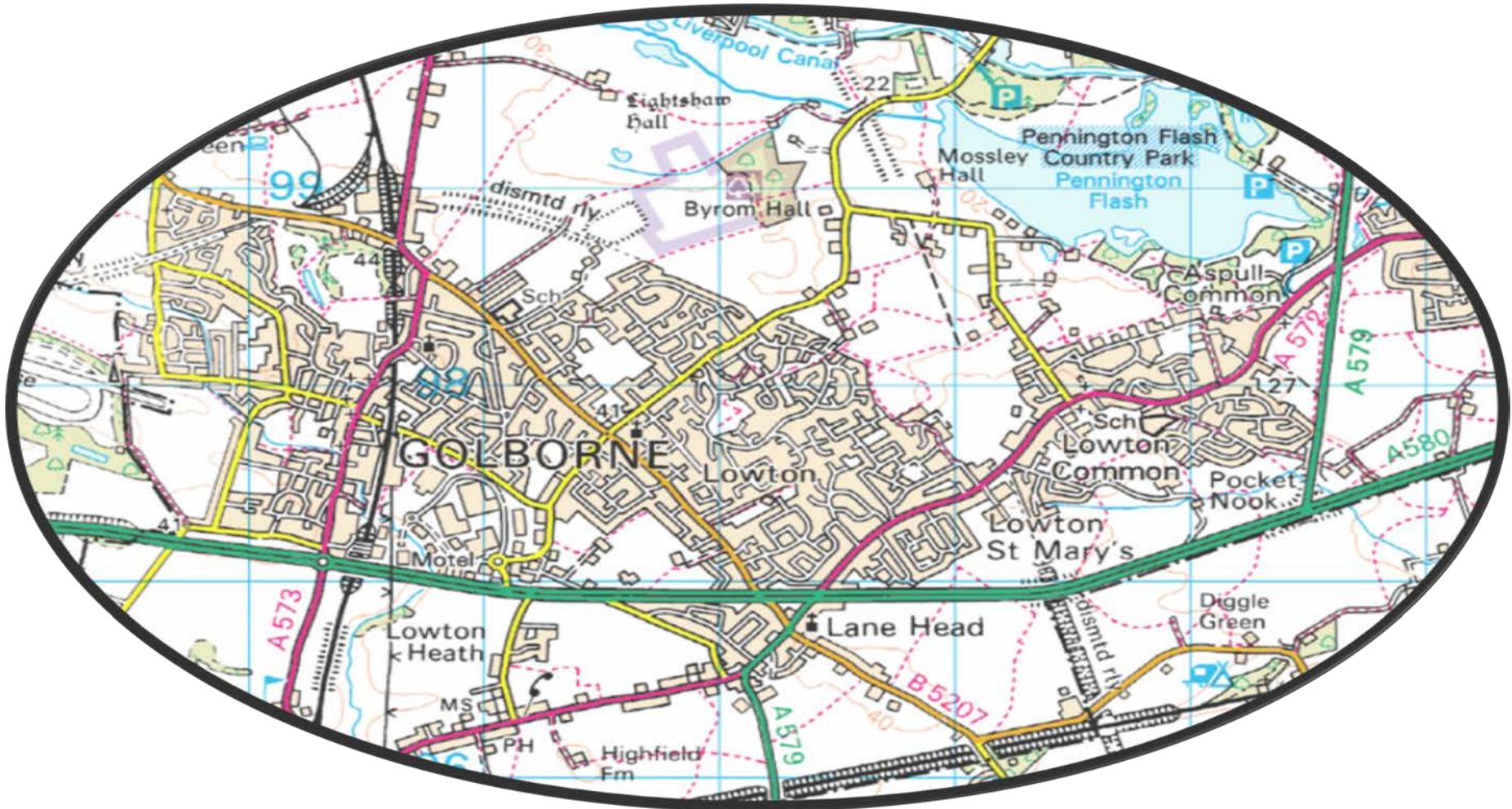


Golborne area



electricity
north west

Bringing energy to your door

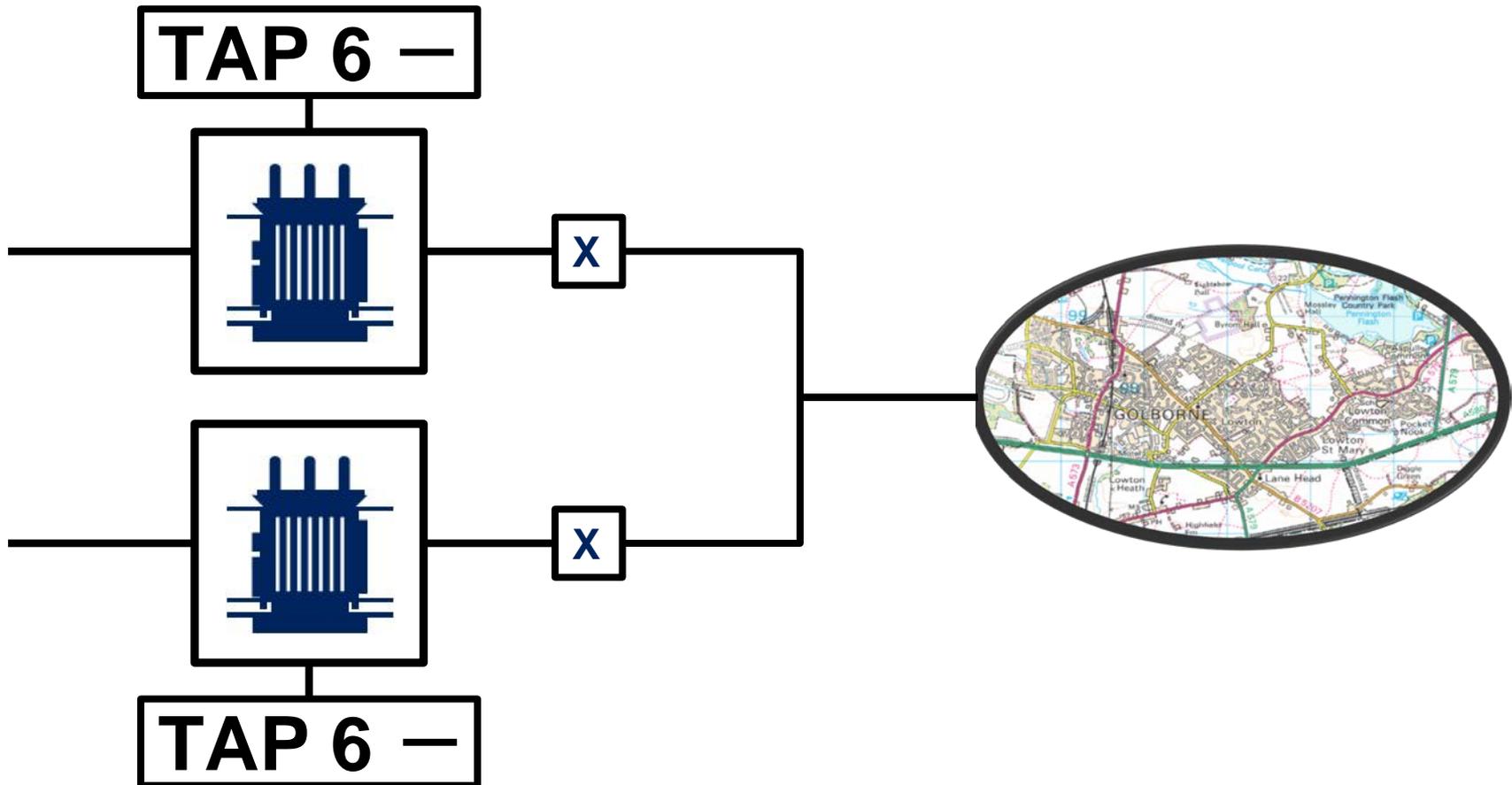


Typical primary arrangement - Golborne



33kV

11kV



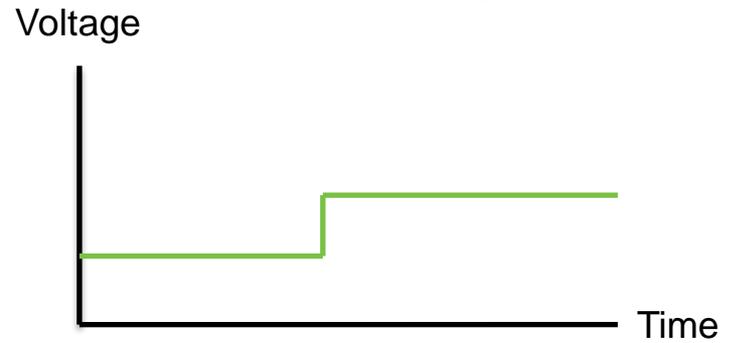
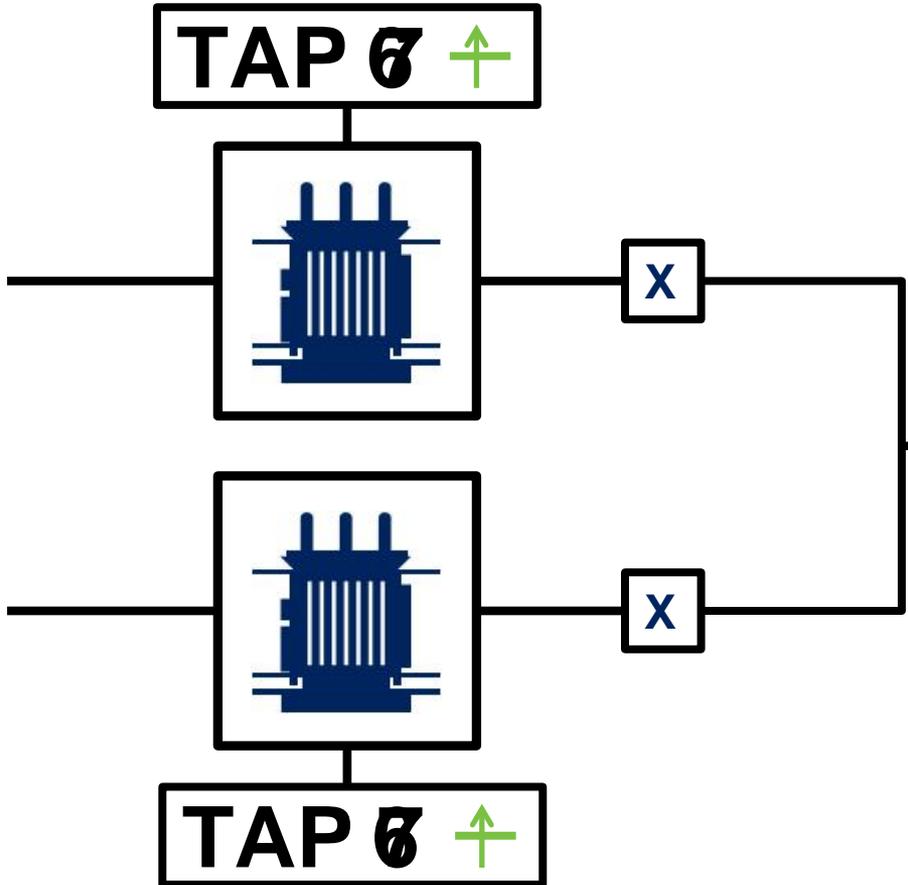
Primary transformer



Typical operation - Golborne



33kV

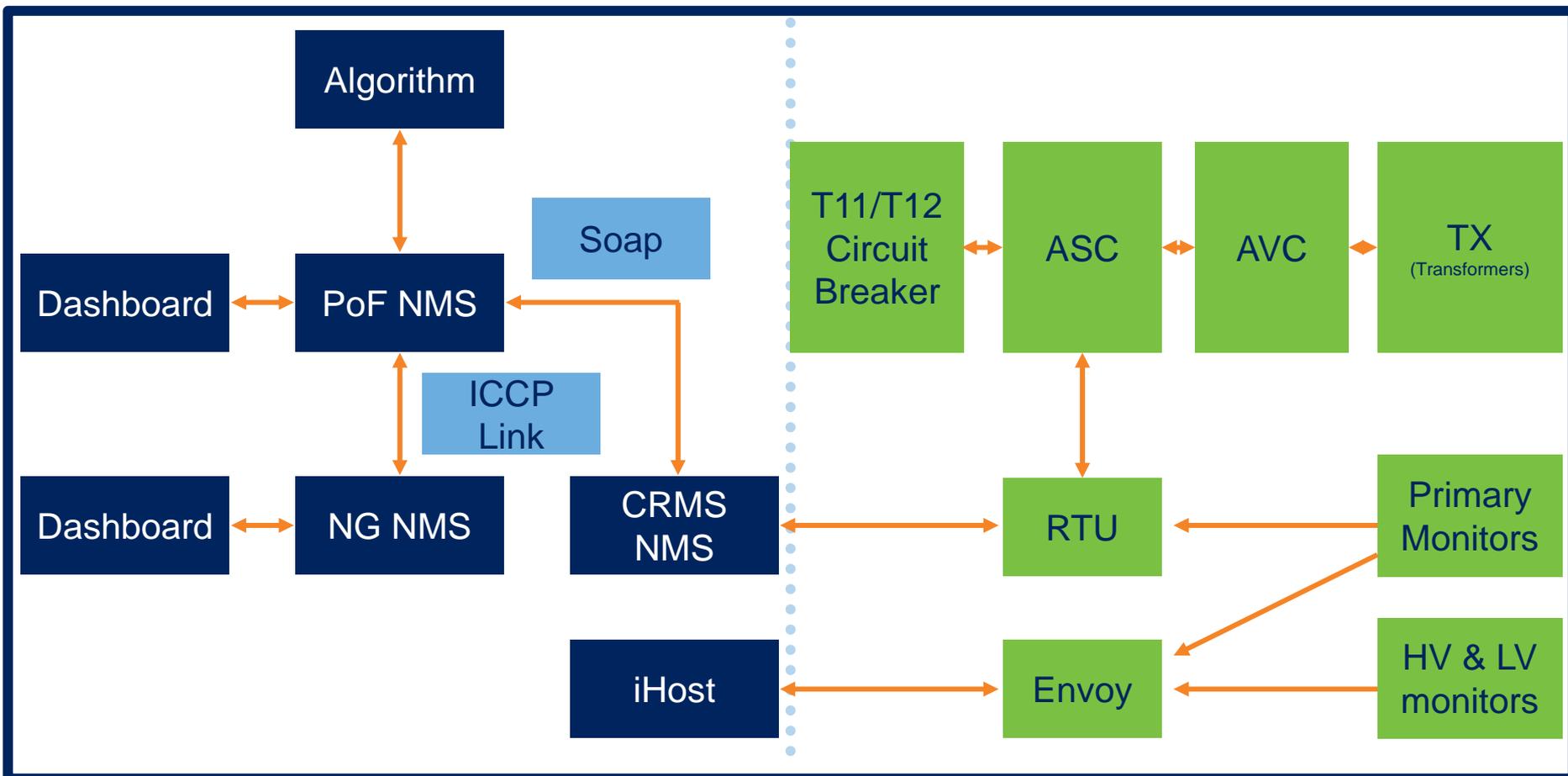


Complete CLASS system

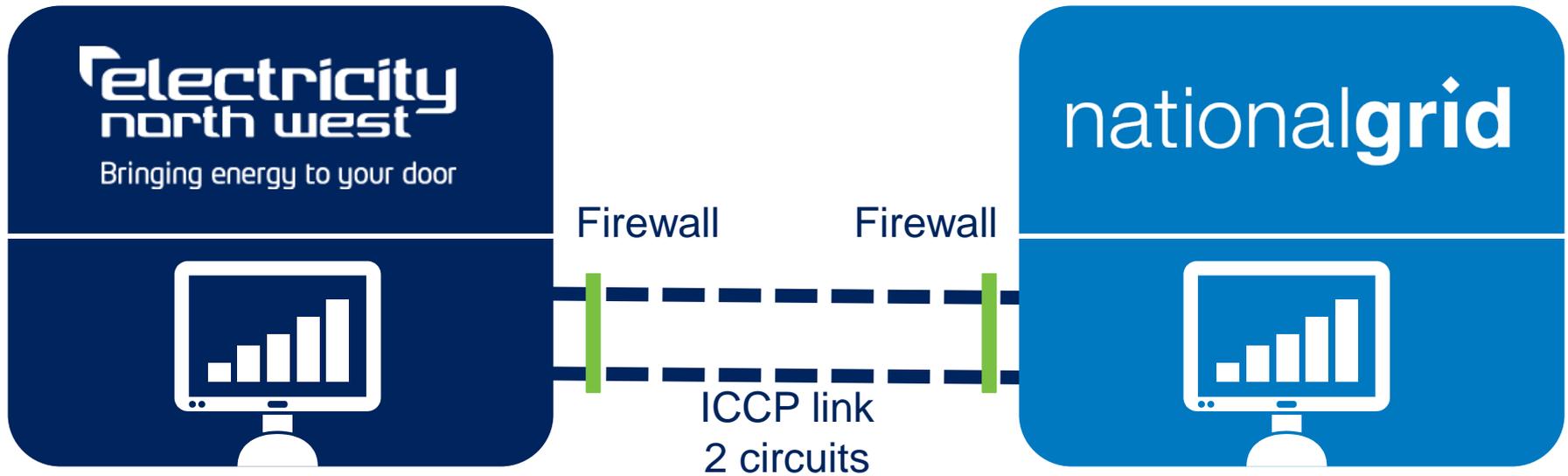


Control room

Substation



What is an ICCP link?

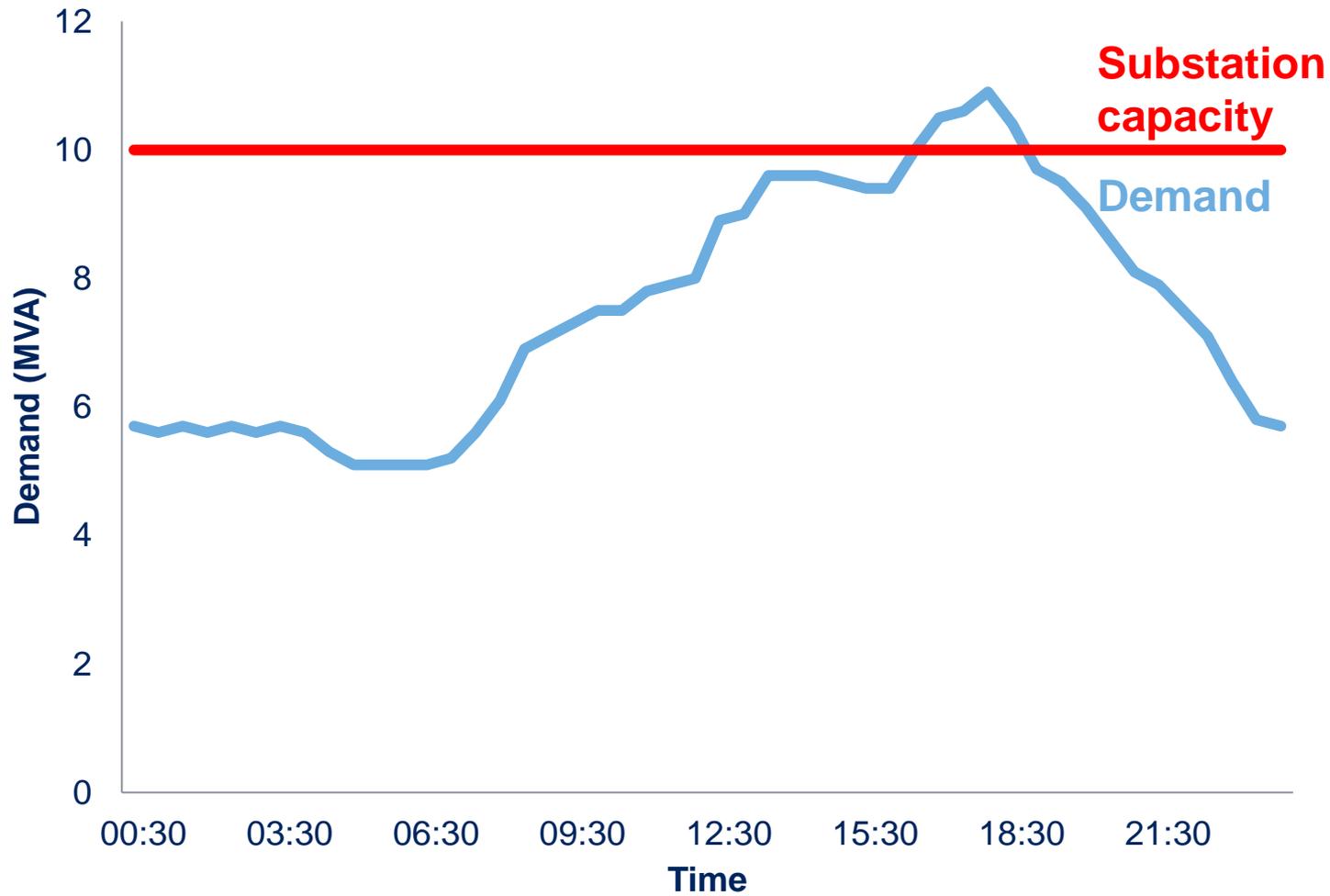


Secure inter control centre protocol is the industry standard

Direct fibre optic connection

Enables data exchange between energy management systems

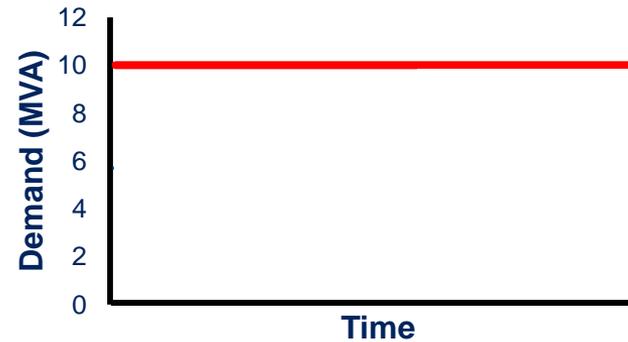
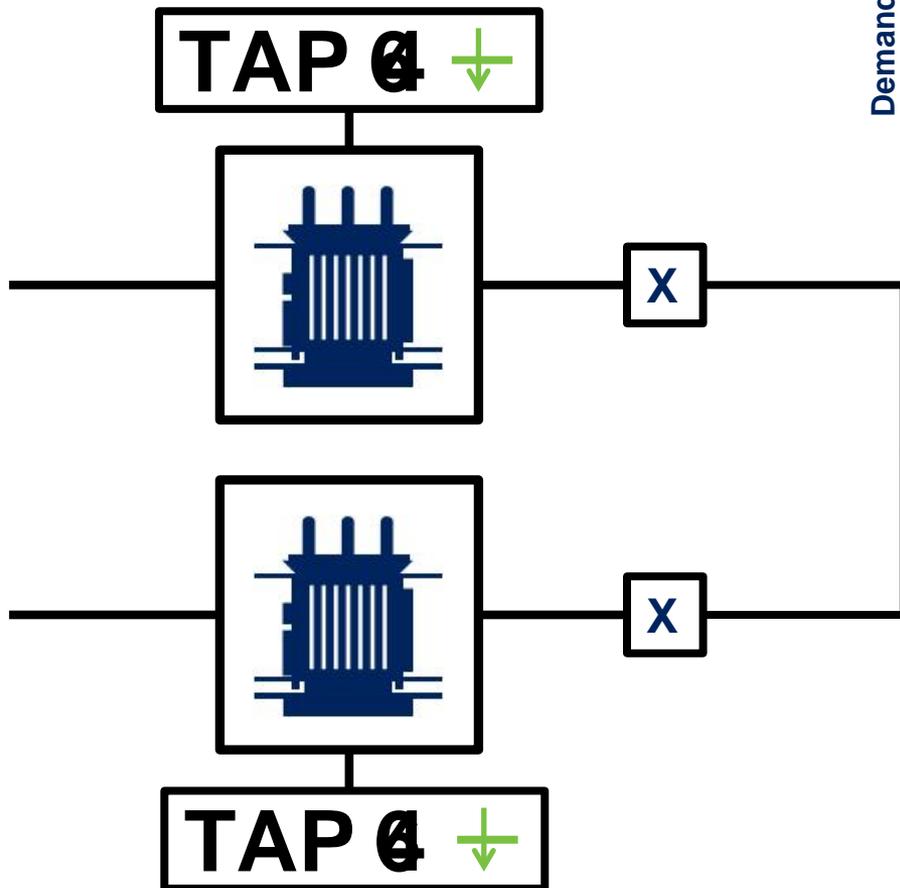
Daily demand curve



Peak reduction - Golborne



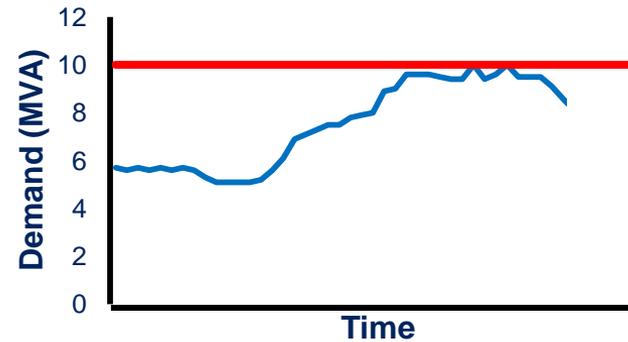
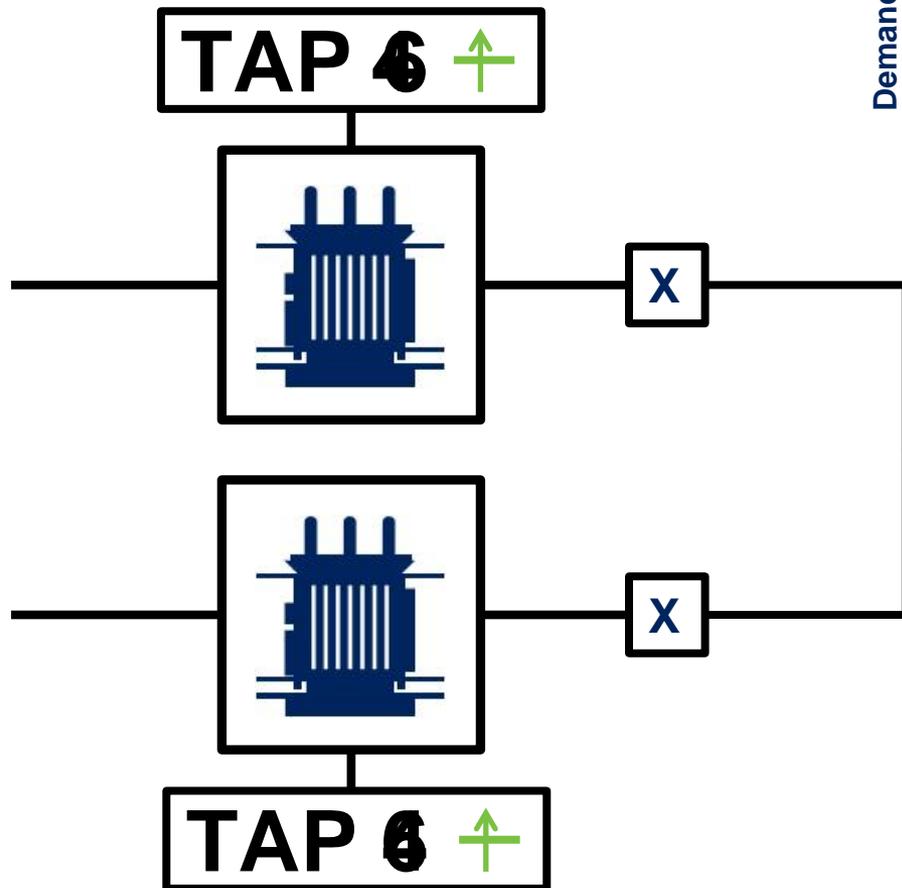
33kV



Peak reduction - Golborne



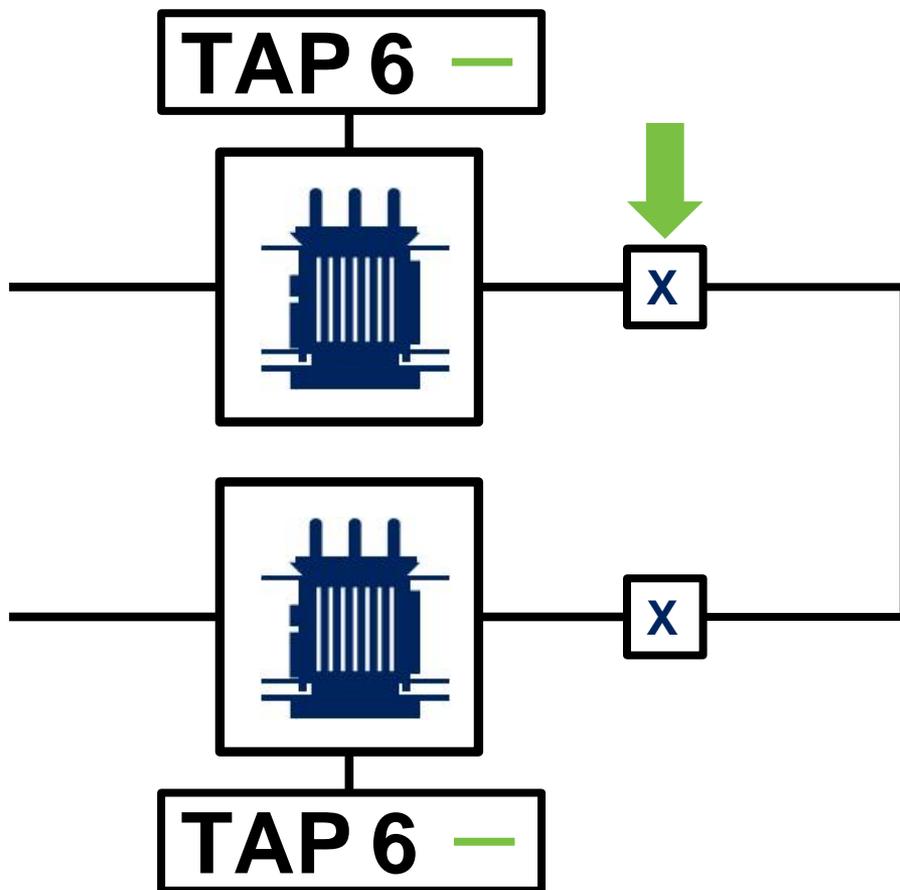
33kV



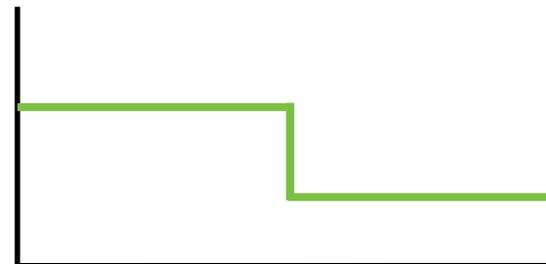
Primary frequency response - Golborne



33kV



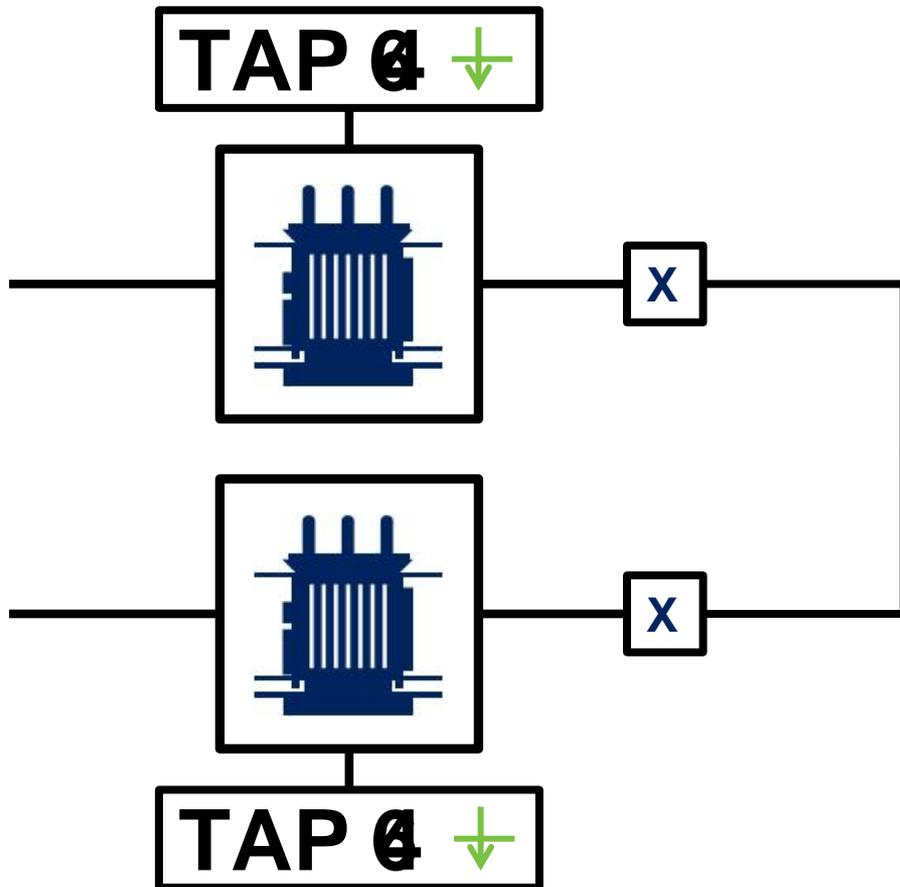
Voltage



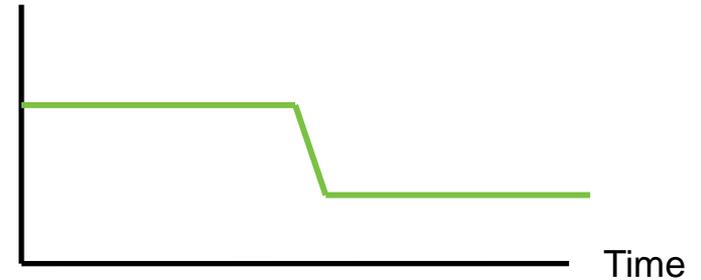
Secondary frequency response - Golborne



33kV



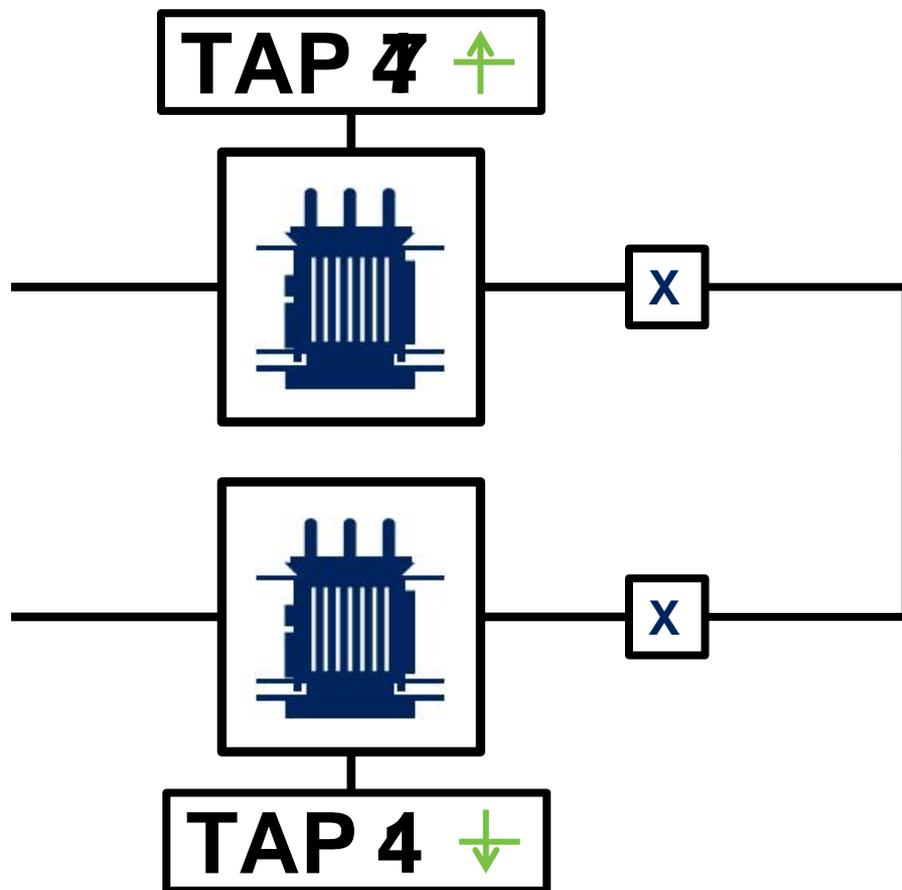
Voltage



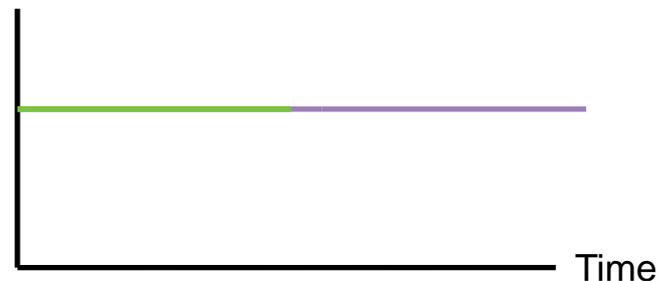
Reactive power response - Golborne



33kV



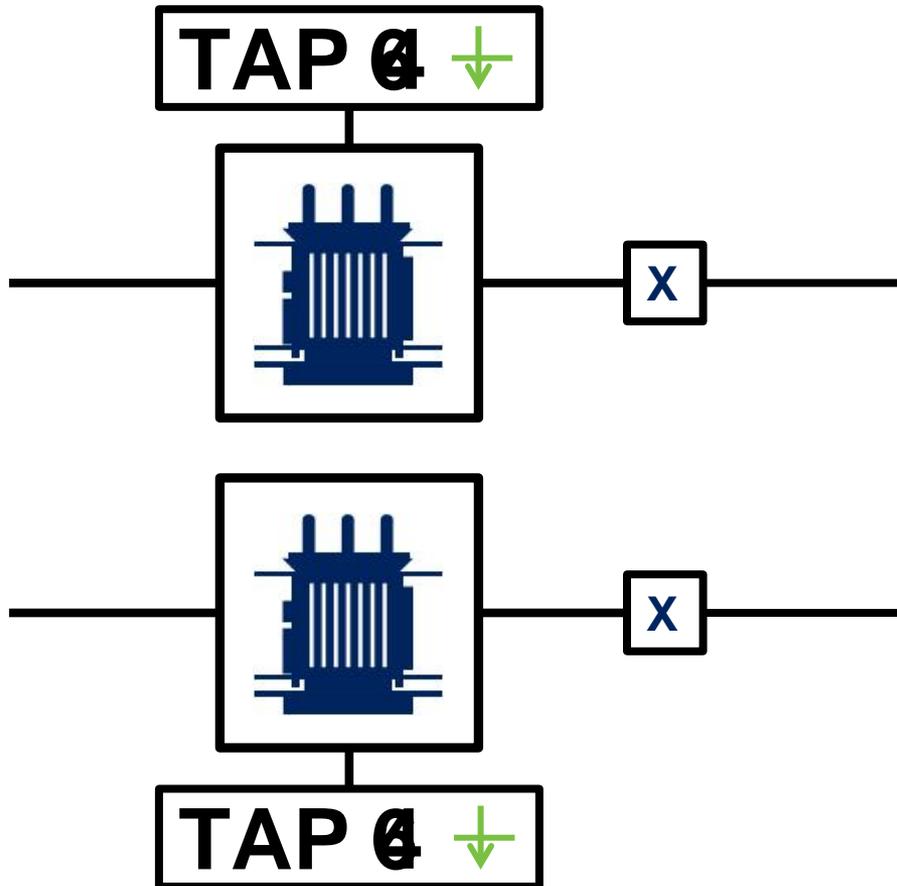
Voltage



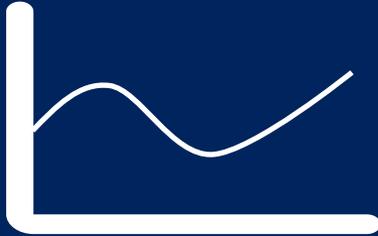
Demand reduction / boost - Golborne



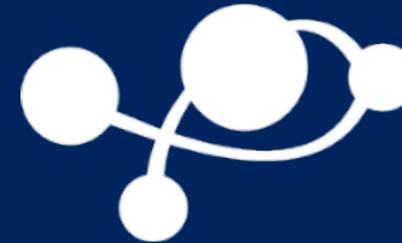
33kV



Academic research



Demand profiles through modelling and validation using trial data



Demand response quantification methodology and results



Q absorption capability and availability study based on EHV network



Asset health



Carbon impact

Trial 1 voltage/demand relationship



1% change
in voltage ~
1.3%
change in
real power

1% change
in voltage ~
1.48%
change in
real power

1% change
in voltage ~
1.22%
change in
real power

Demand response (DR)



Great Britain
5% VR = 6%DR



Summer
Minimum
demand
response =
1120MW



Winter
maximum
demand
response =
3150MW

Great Britain
6% VR = 7.2%DR



Summer
Minimum
demand
response =
1340MW



Winter
maximum
demand
response =
3780MW

Reactive power absorption



Great Britain



Spring

1419MVA_r to
1716MVA_r



Summer

1474MVA_r to
1672MVA_r



Autumn

1452MVA_r
to 1749MVA_r



Winter

1441MVA_r
to 1837MVA_r

Did customers notice CLASS?



electricity
north west

Bringing energy to your door



No differences by
customer type, trial type,
region, vulnerable
customers, survey season

No complaints from
customers about power
quality that could be
attributed to CLASS



485,000
customers

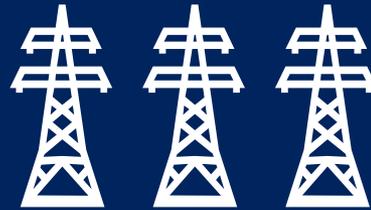


Customers did *not* notice the CLASS tests

Summary



Statistical findings are that domestic customers did not notice the CLASS functions



Lessons have been learned during the installation phase, that can be integrated into any future 'rollout'



CLASS has provided National Grid with the ability to use an ICCP link which provides them with a demand response during a system frequency event



CLASS has shown an approximately linear relationship between voltage and demand

High level benefits



	Low cost high speed frequency support
	3GW demand reduction or boost
	2GVA _r National Grid voltage control
	Reinforcement deferral
	24/7 voltage/demand relationship matrix