Breakout Session 1.5
Innovation in Electricity Network Design

LCNI Conference

Wednesday 6 December 2017

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The ATLAS project (Architecture of Tools for Load Scenarios)

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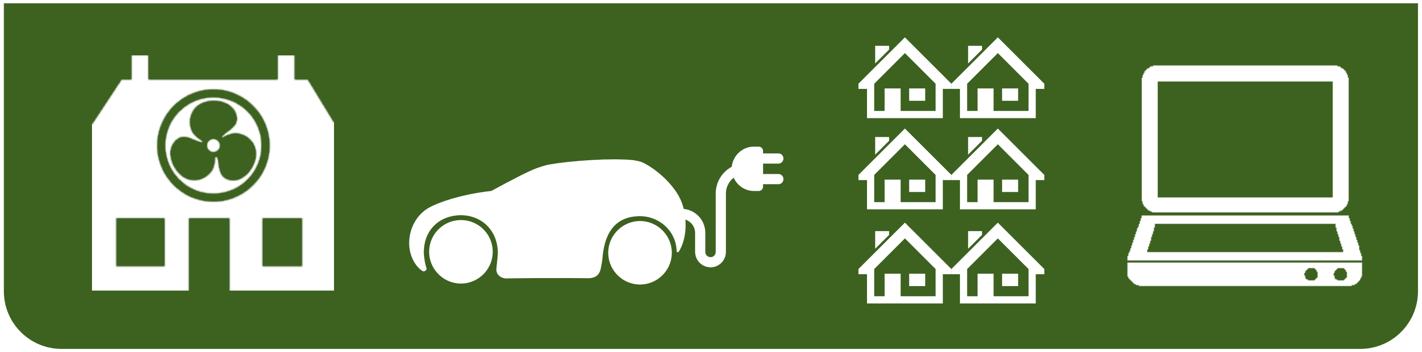
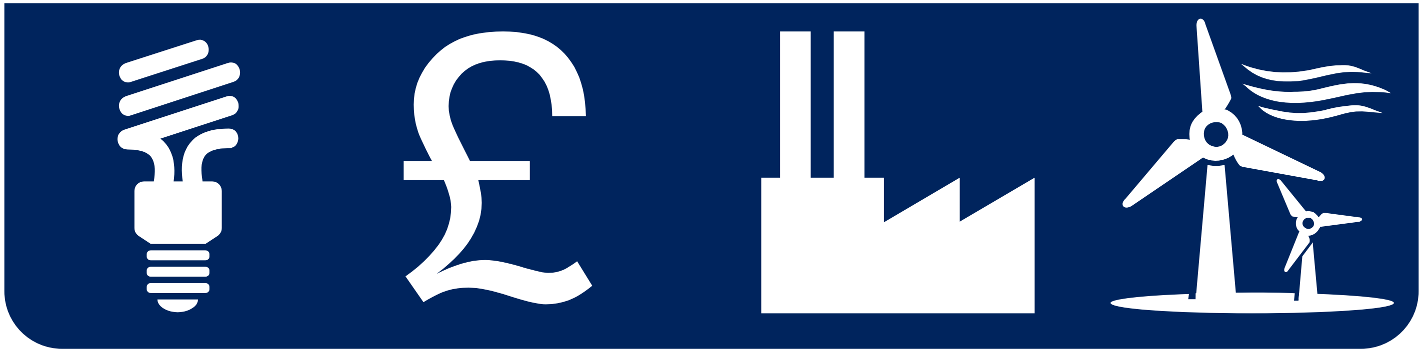
Future demand is uncertain

Load may rise...



... and it may fall



Objectives of our work

Credible demand and generation scenarios, reflecting uncertainty

Tailored to our region, assets and data

Support well-justified strategic planning of network capacity

Enabling good decisions about solutions to capacity problems, and informed dialogue with National Grid and other stakeholders

This presentation

Overview of the ATLAS project

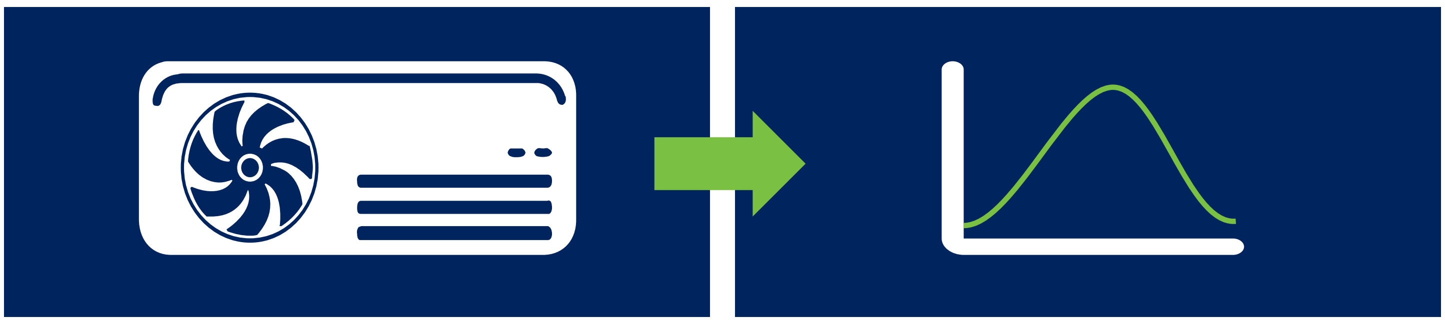
New approach to MW (P) forecasting

New approach to MVAr (Q) forecasting

Next steps

Two NIA projects on load scenarios

Demand Scenarios with Electric Heat and Commercial Capacity Options



Winter / summer peak load

Heat pumps & air con

The Real Options CBA model

April 2015 - October 2016

ATLAS (Architecture of Tools for Load Scenarios)

Half-hourly (hh) through year

Demand & generation

Seasonal peak and min

P (MW) & Q (MVAr)

Nov 2015 – December 2017

ATLAS scope

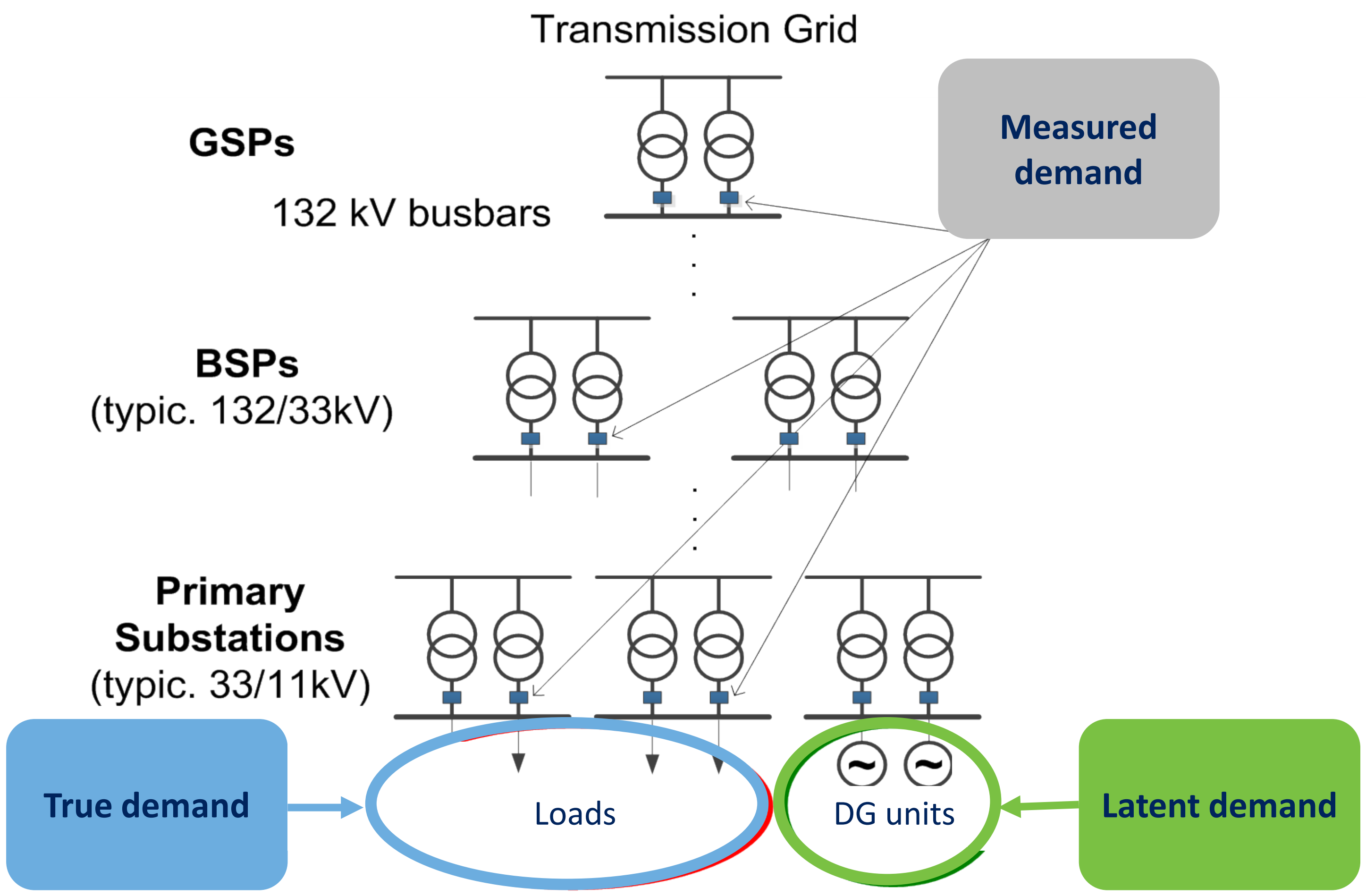
Full half-hourly view of
true MW demand

MW scenarios
learning from the
Demand Scenarios NIA,
with more customer detail

MVAr scenarios
learning from REACT NIA,
for whole DNO network

Prototype tools
for GSP, BSP and
Primary
scenarios

ATLAS – demand definitions



ATLAS – true demand

True demand = Measured demand + Monitored DG exports + Effects of DG on reducing customer demand + Non-monitored DG

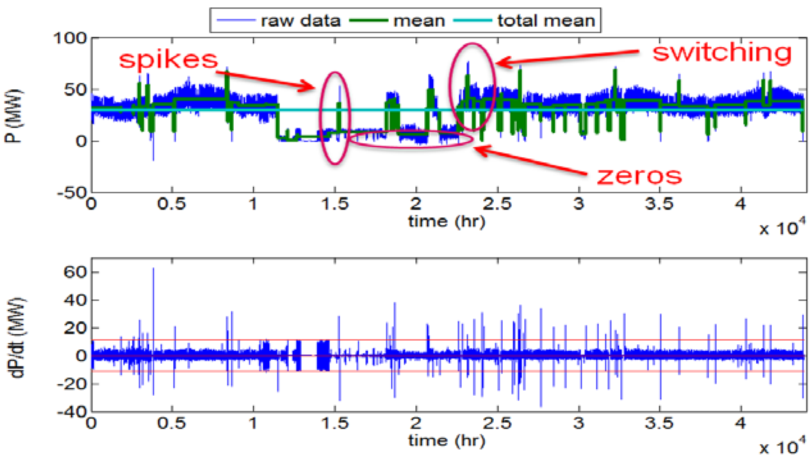
Monitored component of true demand

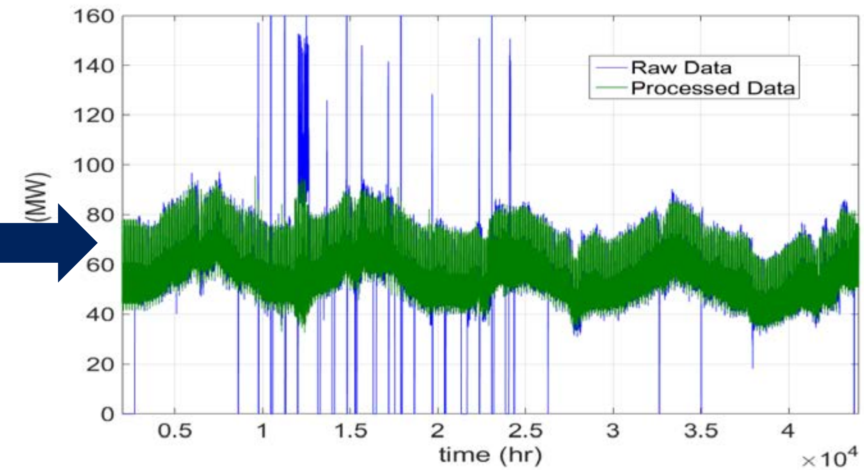
Latent demand

Data processing - monitored component

Identification of data problems

Data corrections
(half-hourly & daily analyses)

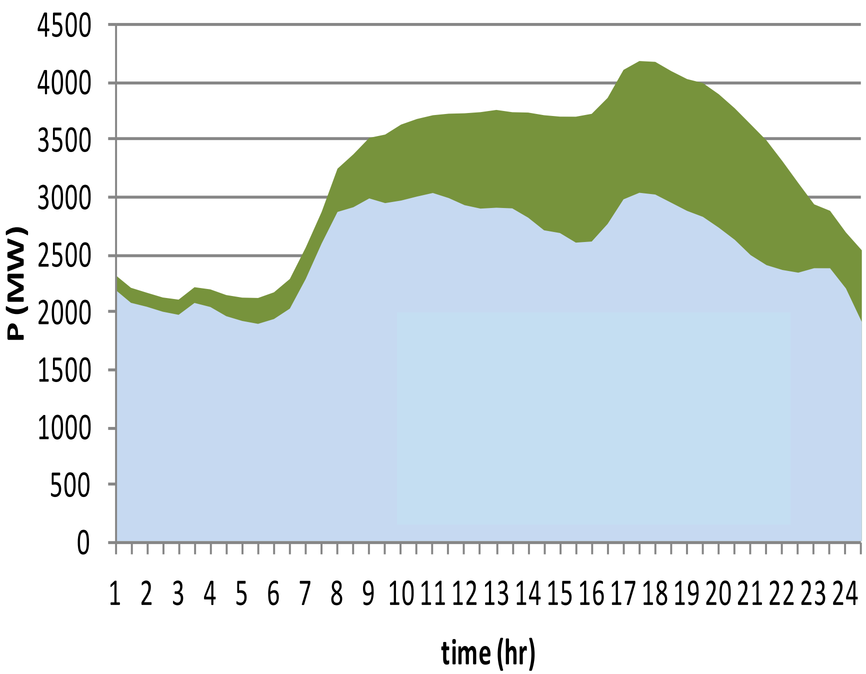




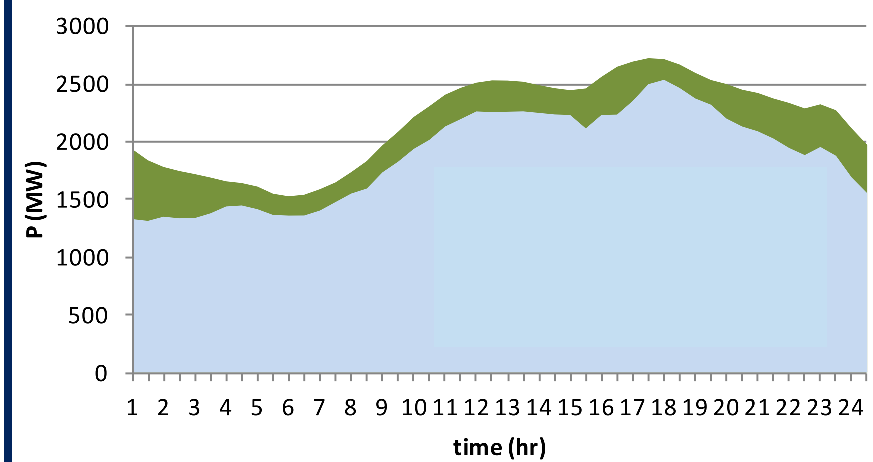
See detailed methodology at www.enwl.co.uk/atlas

Aggregated MW demand across GSPs

Peak true demand (23/11/2016)



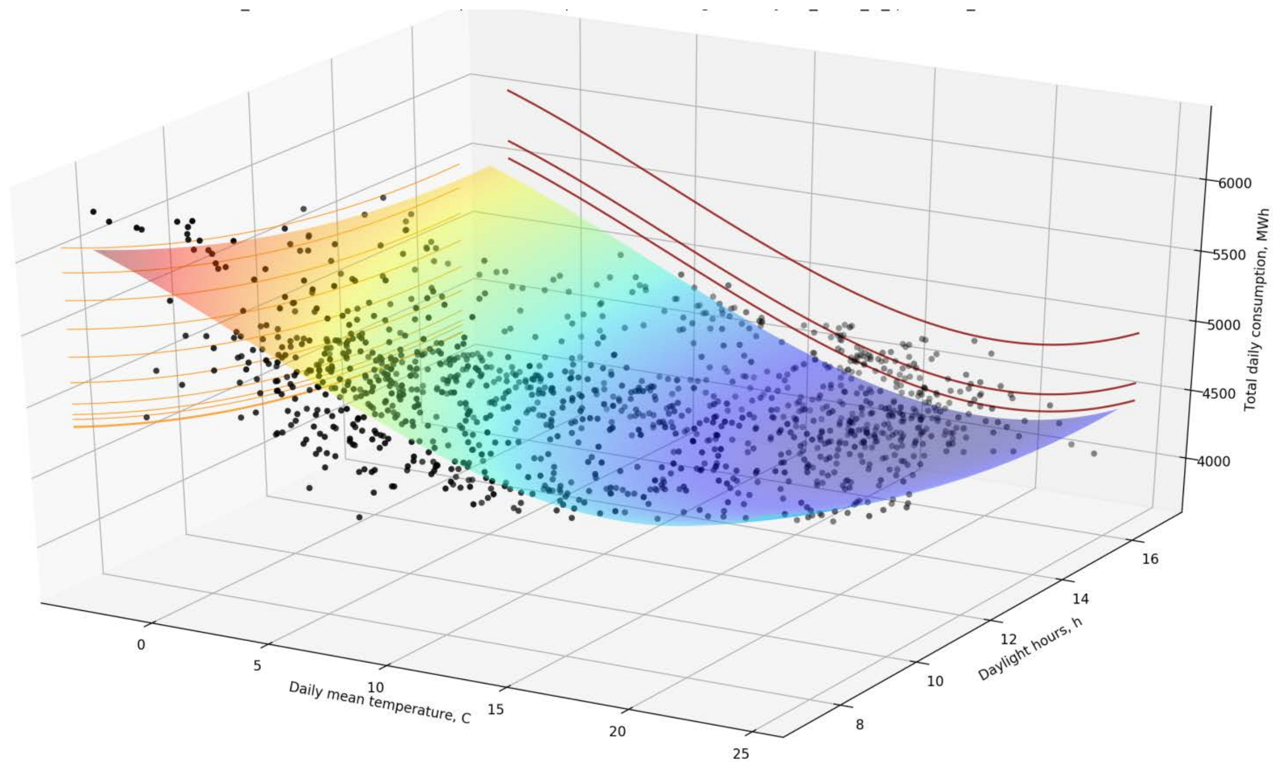
Min true demand (05/07/2016)



Latent demand varies over time

Substation-specific weather correction

Correlate daily weekday demand over five years,
with temperature and daylight hours



Scale half-hourly demand to the historic temperature range of that month

elementenergy

MW forecast model per G&P substation

Baseline of processed half hourly (hh) true demand + database of installed DG

Integrated scenarios approach for all GSPs, BSPs and primary substations

Scenarios presenting peak/average/ min diurnal profiles of demand and generation

Working with Element Energy, extending their work with UKPN and NPG

Model on FY17 baseline used for 2017 scenarios

MW forecast approach

Underlying demand based on 35 customer archetypes matched to substations

Efficiency, demographics, economic activity

Demand Technologies	Generation Technologies	Energy Storage Technologies
Electric vehicles	Solar PV	Domestic storage (with solar PV)
Heat pumps (domestic and I&C)	Wind	I&C storage behind the meter
Air conditioning (domestic and I&C)	Micro and larger CHP	Frequency response
	Flexible generation	
	Other generation	

elementenergy

What does ATLAS add?

1
Full views of true demand and latent demand, linked to measured demand

2
Not just peaks - 48hh per day

3
New weather-correction approach

4
New long-term MW forecast approach

5
Add connections activity

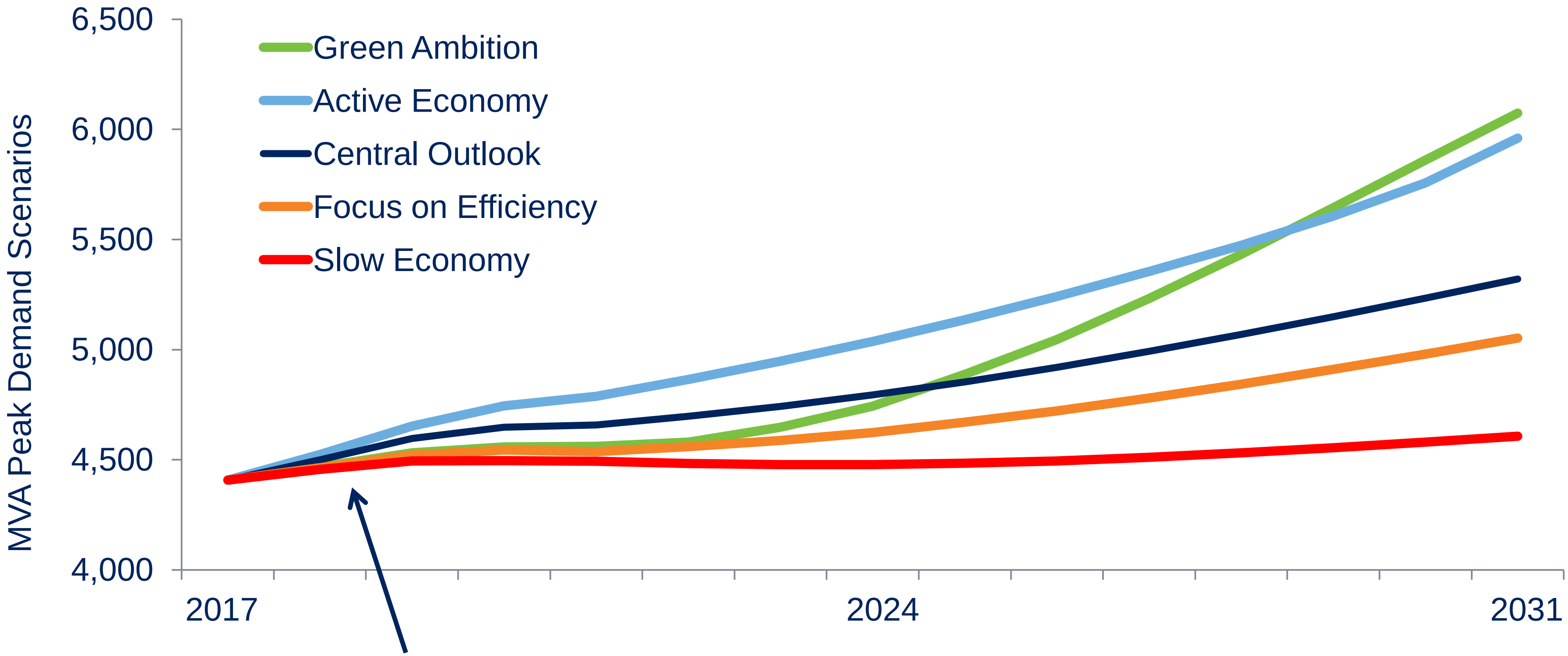
6
New time-series MVAr forecast approach with network modelling

7
Combine MW and MVAr to meet all reporting and planning needs

All prototype development in 2017 – transfer to BAU in 2018

2017 peak true demand scenarios

Using the ATLAS prototype approach

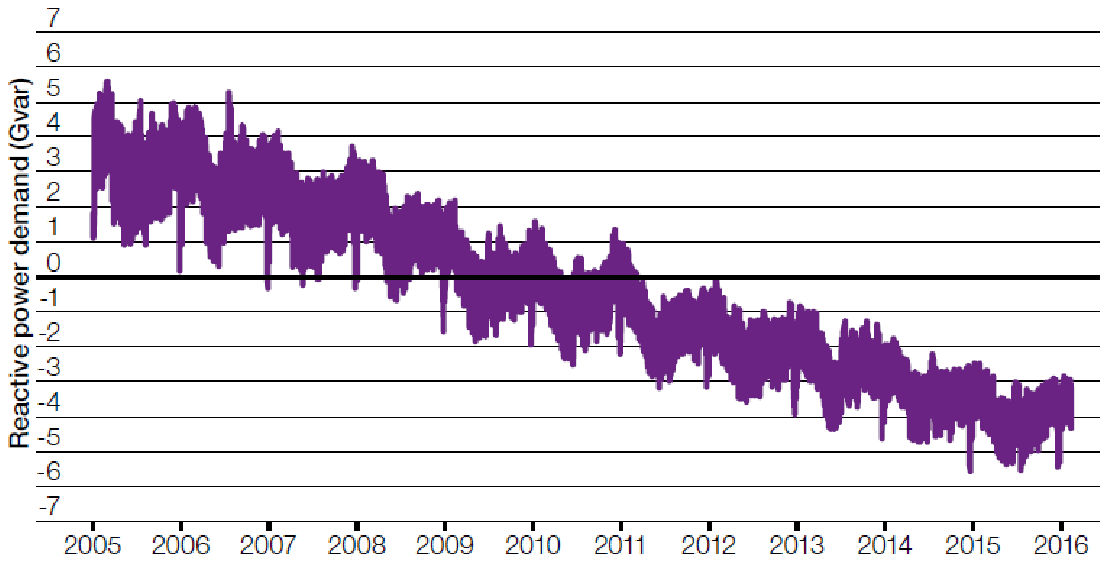


Long-term scenario adjusted for known major demand projects

Use scenarios to make decisions

Inputs	Calculations	Summary metrics
Site demand scenarios Choose timescale etc. Define strategies with up to 3 interventions, including post-fault DSR	Repeat analysis for Strategy A and Strategy B	Cost and risk distributions

Why forecast reactive power?



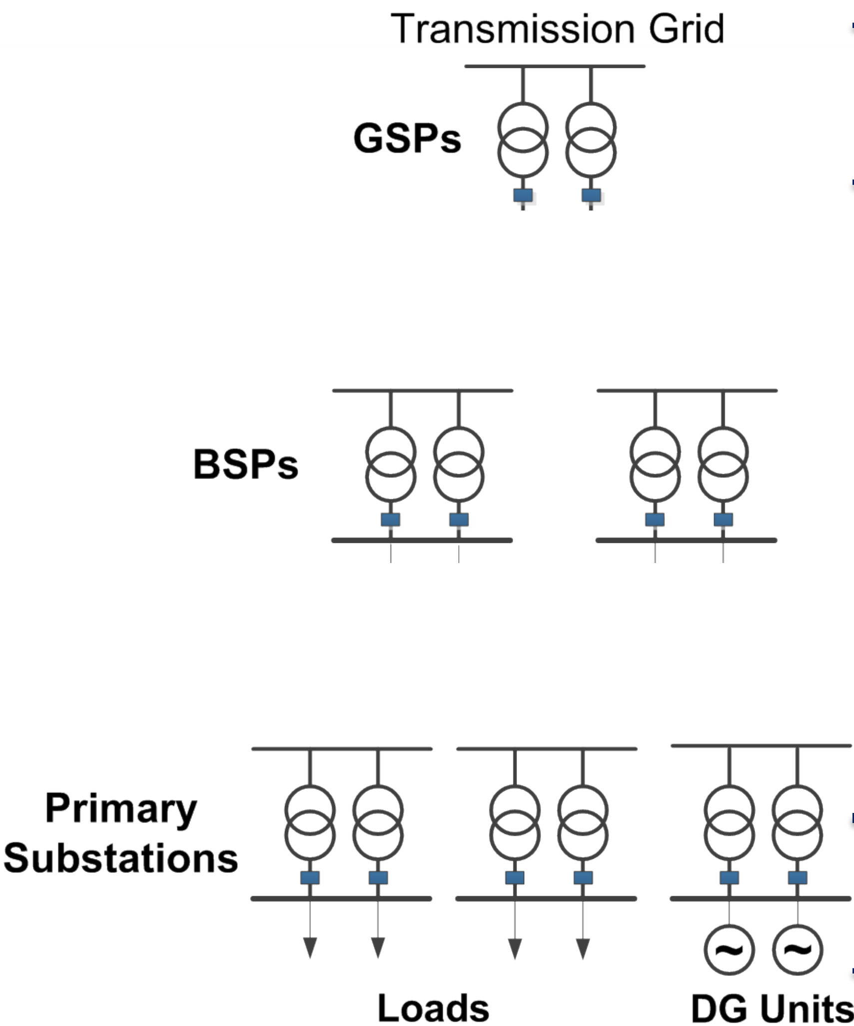
Source:
NG SOF 2016

Declining minimum Q (MVAr) demand from distribution

→ High voltage problem on transmission network

Develop ATLAS method to put scale on future Q exports to transmission

Simplified view of MVAr (Q) flows



Empirical Rule:

$Q_{GSP} = Q_{primaries}$

$+ Q_{EHV\text{-}absorbed} - Q_{EHV\text{-}gains}$

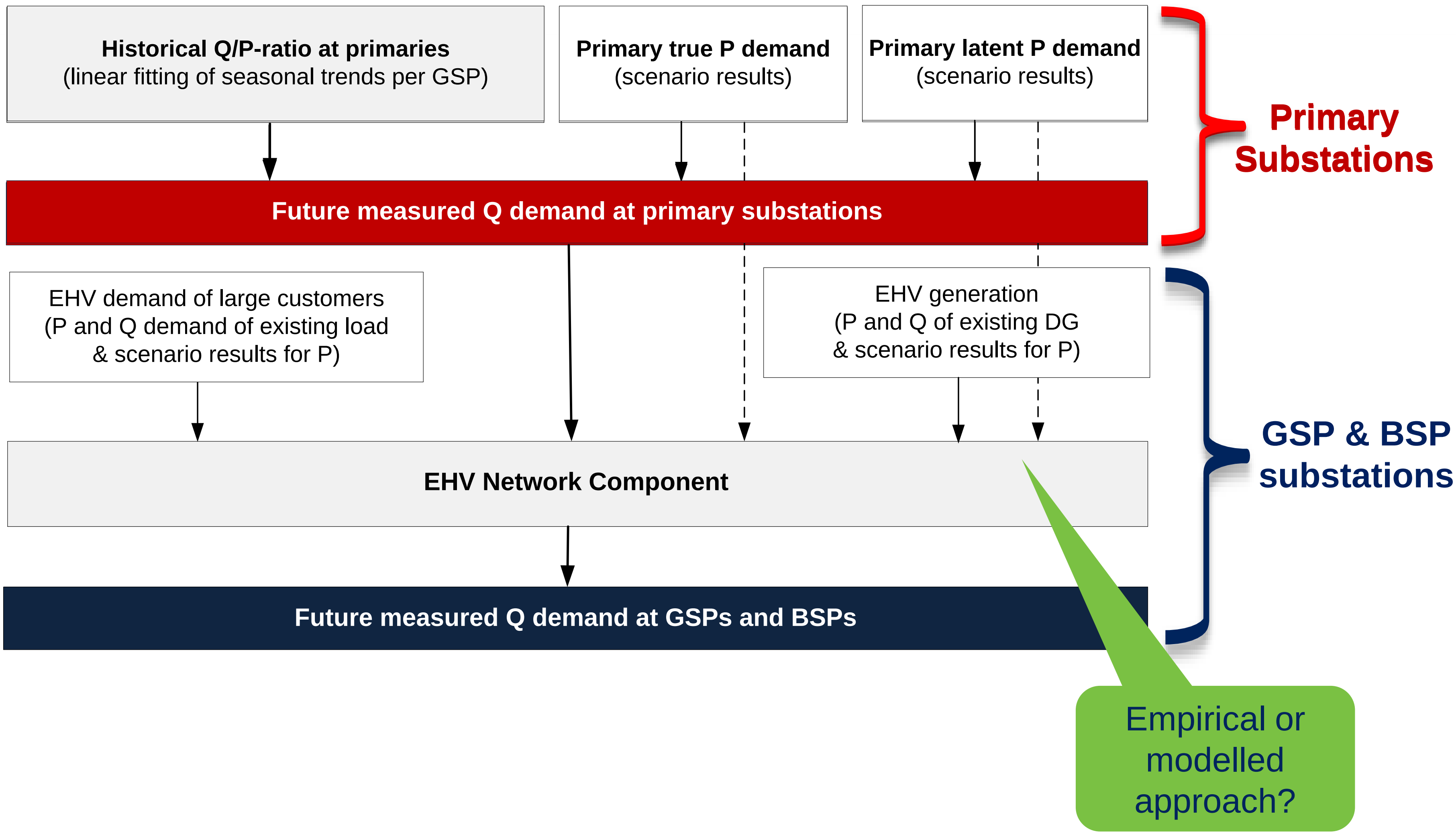
$= Q_{EHV\text{-}absorbed} - Q_{EHV\text{-}gains}$

I^2X

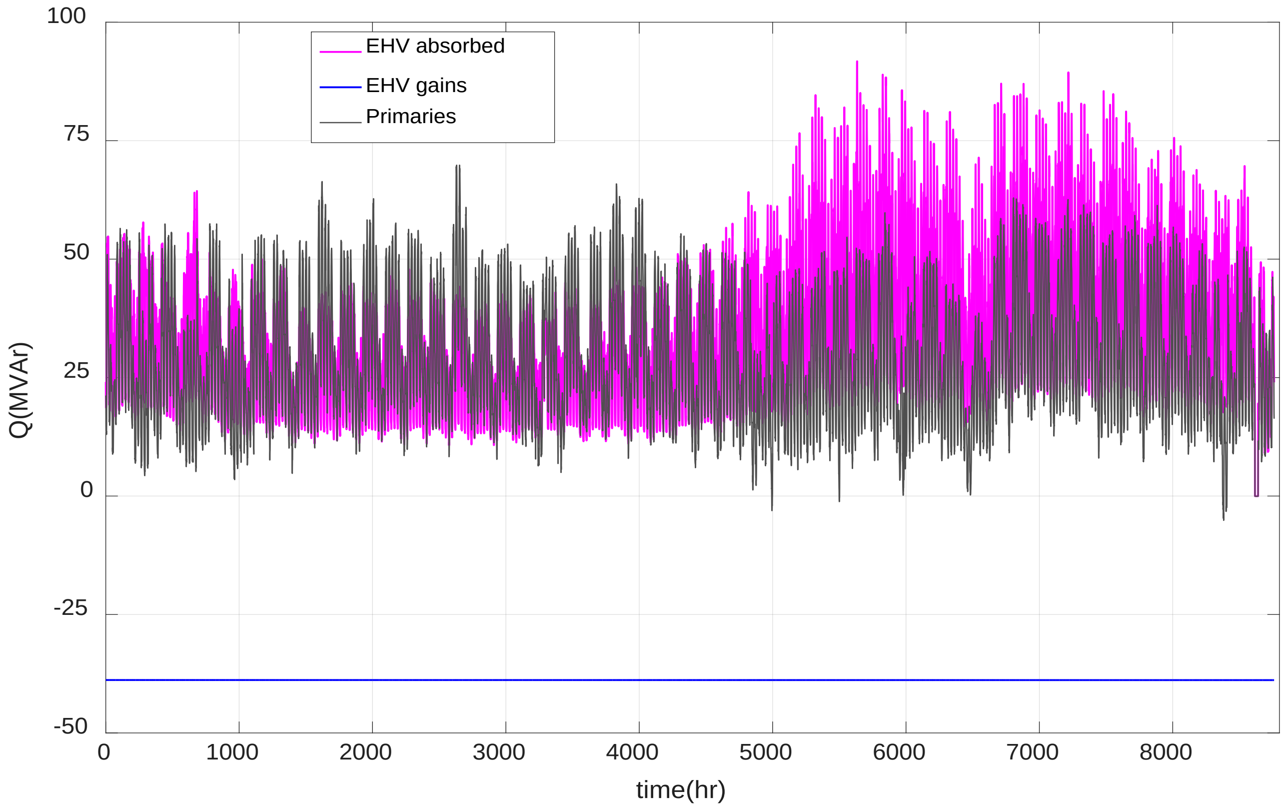
$V^2C'\ell\omega$

$Q_{primaries}$

ATLAS Q Forecasting method



Q forecasting – empirical rule



Q absorption → reduced for more lightly loaded EHV, but not for reverse flows

Q gains → increased when more cables or higher voltage targets are used

Q at primaries → more capacitive primaries (declining Q/P trends)

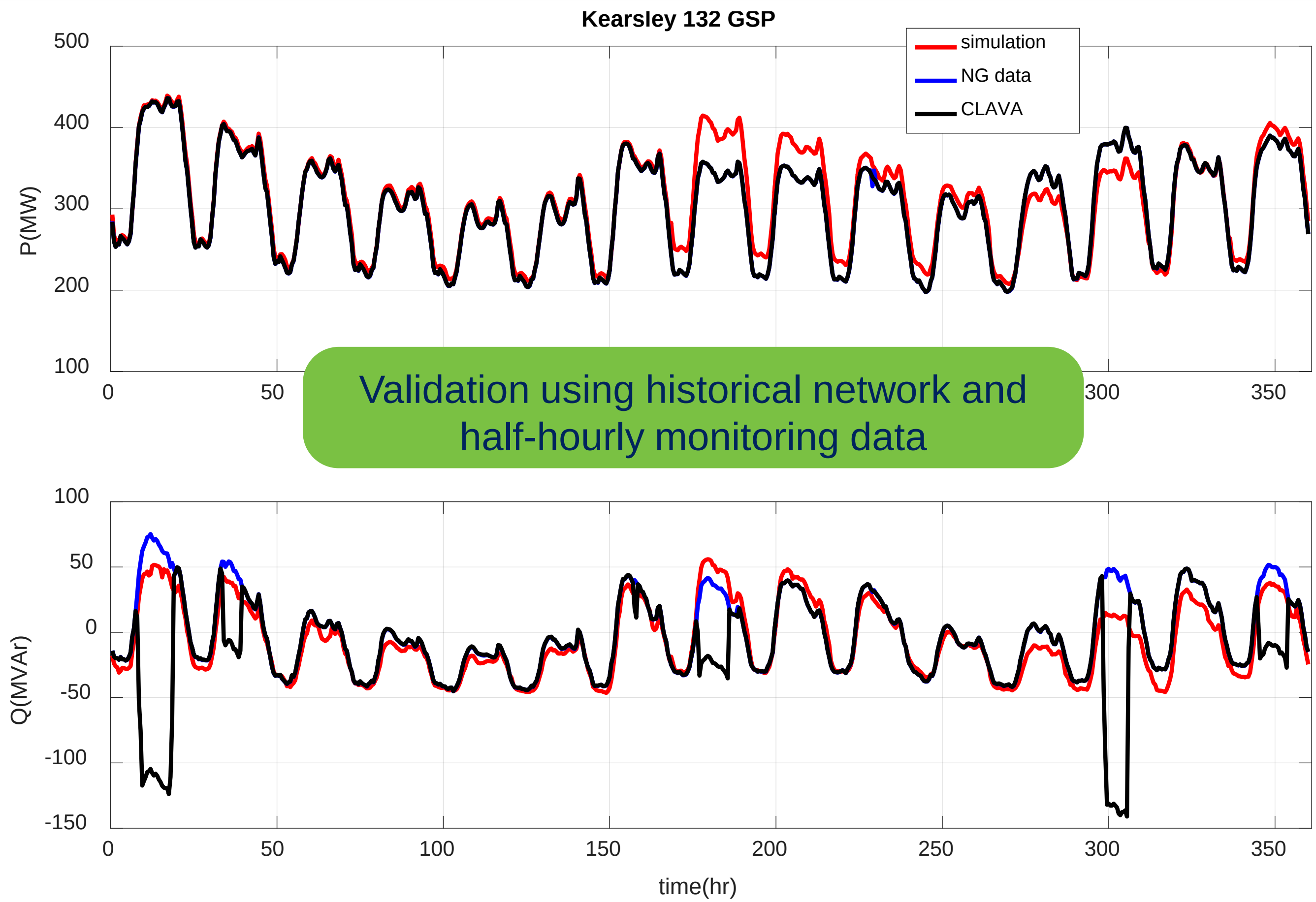
Q forecasting – network modelling

Network Modelling

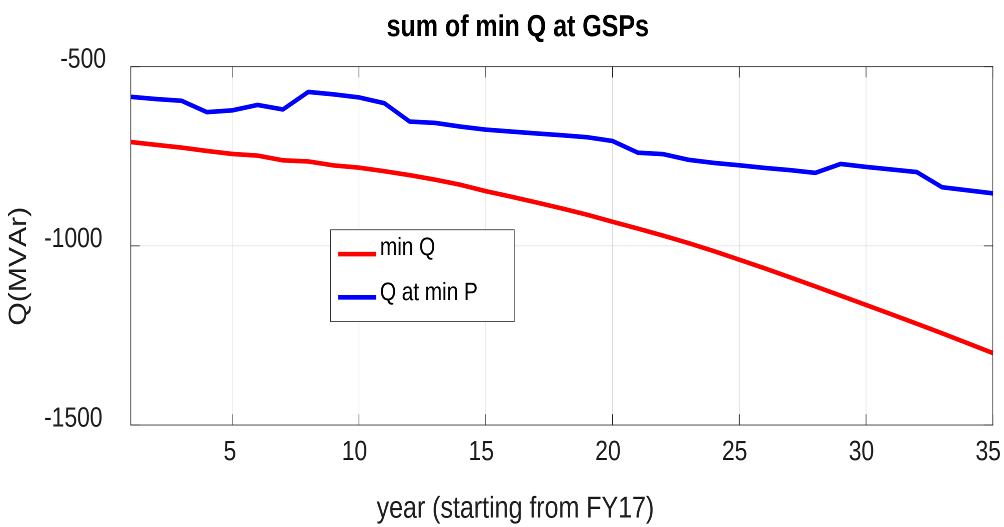
Time-series analyses (i.e. daily simulation using operational aspects)

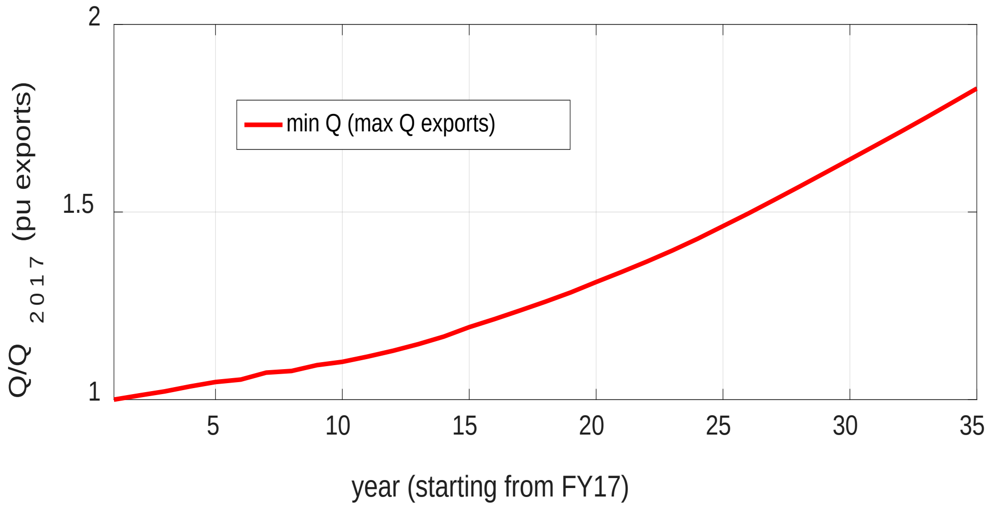
REACT approach... but with enhanced inputs

P and Q profiles at primaries (and BSPs for large customers)



Central Outlook scenario, avg DG output , minimum Q demand = max Q exports





Q exports in this scenario:
+5% in 5 years
+11% in 10 years
+83% in 35 years

But... in reality max Q exports could be even higher in different scenario and with different generation output

Future application of the ATLAS methods

By 2020:

NG as SO will use powers under RfG / DCC to set Q export limits at GSPs, via expanded NOA process

Could add significant costs on DNOs in ED2 period

So next year we will:

Use 2018 scenarios to estimate max Q exports at GSPs

Request NG's expected Q export limits at GSPs / compare to Q export scenarios

Scope interventions to alter max Q in ED2

And in FY20 we will:

Use 2019 scenarios to estimate max Q exports at GSPs

Compare max Q exports in our scenarios to limits per GSP

Create high-level intervention programme for ED2 WJBP

Final months of the project

Available capacity for generation

Thermal and fault level

Scope approach for secondary networks, build on improved baseline data in new NMS

Transition G&P approach to BAU, but keep under review

For more information

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