



Achieving Net Zero Safer and Faster with Real-Time Grid Stability Measurement

Reactive Technologies WECC Regional
Grid Stability Measurement Project

Jack Joyce

Reactive Technologies
Executive Director, Americas

Duncan Burt

Reactive Technologies
Chief Strategy Officer

About Reactive Technologies

Cleantech company directly enabling **NET ZERO**
in power grids – real time grid stability analysis

1st

World 1st
Breakthrough Services

250+

granted patents
across 34 countries

\$33M

USD capital raised for
next 5yrs of growth

Global presence with **HUGE IMPACT**

10-30%+

extra grid capacity for
more renewables
integration unlocked

~18M

tonnes of CO2 saved
annually in UK alone

~5.5%

of total UK CO2
emissions eliminated annually

Supported by...



Breakthrough
Energy

BGF



res

equinor

accenture

TOSHIBA

FINANCIAL TIMES
Tech Champions 2023

Winner: Energy



BNEF
pioneers
2022

BloombergNEF

Energy Transition
Changemakers



Trusted
by...



台灣電力公司
TAIWAN POWER COMPANY



We enable **transmission and distribution** grid operators to measure **grid stability** to accelerate the transition to a low-carbon grid.



To Tackle Global Grid Challenges



“As the penetration of wind and solar on the system increases, operation of the system becomes significantly more complex. The **power system is being operated closer to its known limits** more frequently, with increasingly variable and uncertain supply and demand, and **declines in system strength and inertia.**”



“Zero carbon operation of the electricity system means a **fundamental change to how our system was designed to operate**; integrating newer technologies right across the system... **using new smart digital systems** to manage and control the system in real-time.”

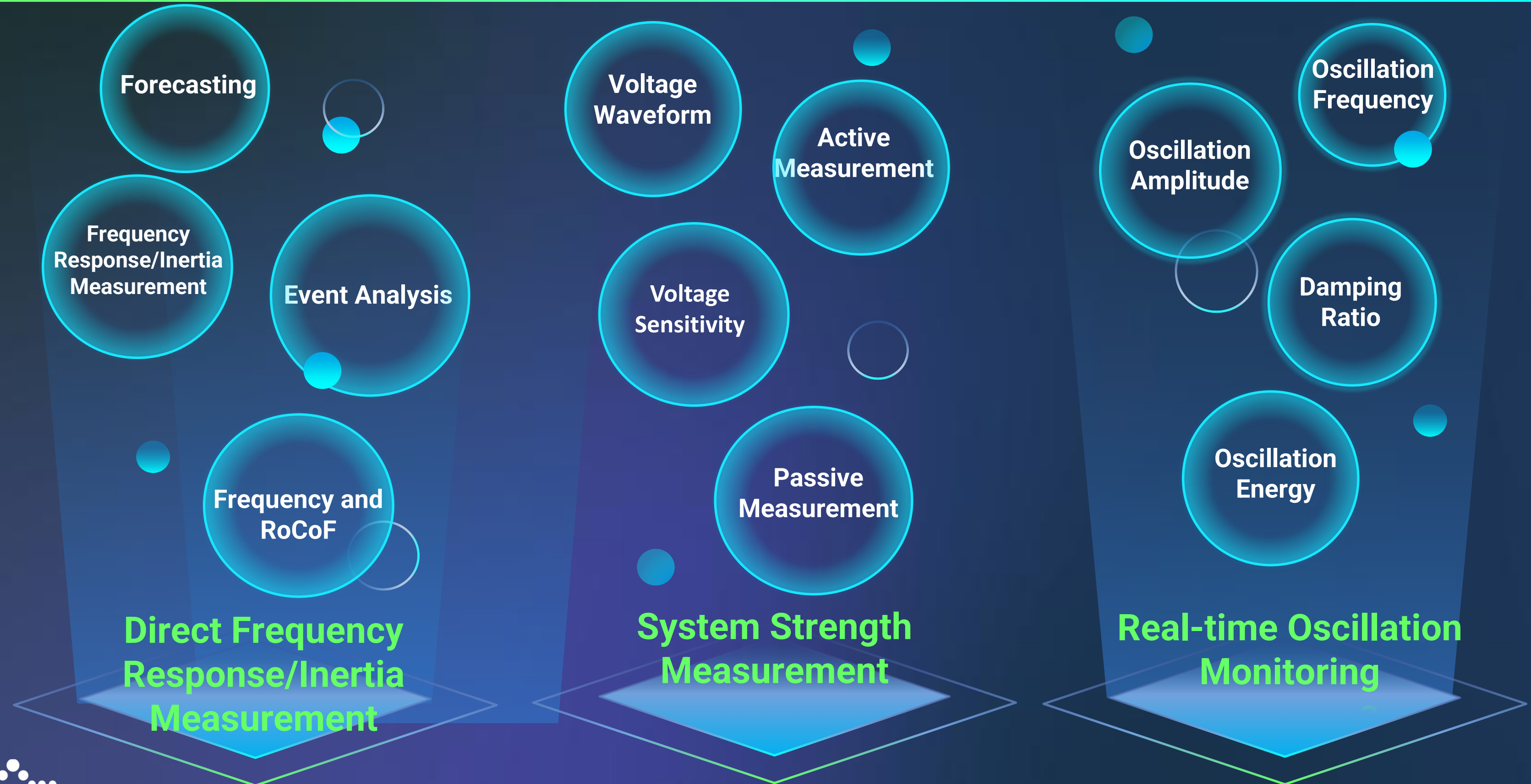


“It is recommended that system operators perform **inertial measurements** to get an **accurate, real-time** view of inertia levels to replace guesswork and conservative estimates.”



“Decreasing levels of inertia – as a result of the large-scale integration of renewable sources – **pose long-term challenges to frequency stability of the transmission system, with possible impacts on the resilience of the future system.**”

What We Offer



High-Definition Grid Data Captured with High Accuracy

A paradigm shift in the measurement & analytics of **grid stability**.



XMU – Grid IoT.

Unlocking the power of edge computing.



- High speed 48kHz sample rate
- High resolution A/D conversion (16-bit)
- High Accuracy GPS time fleet sync (PPS)
- Adaptive sampling rate (edge comp.)
- Adaptive DSP filtering (edge comp.)

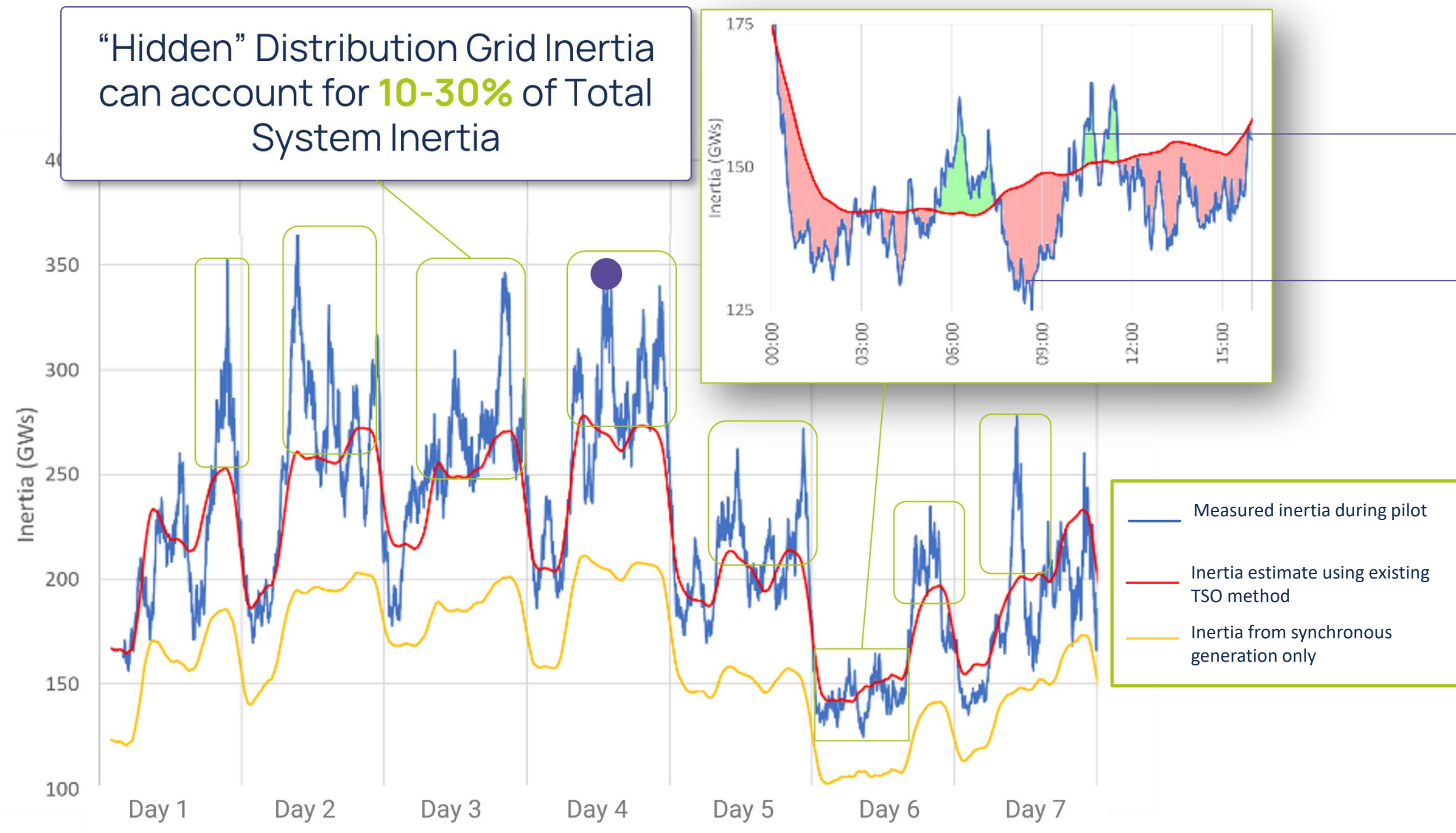


- Remote device management
- Low own cost / high performance
- Easy installation @ 'grid edge'
- 120 volts



- Designed by Reactive Technologies
- High performance data acquisition functionality
- Control functionality
- Low cost / high perf HW architecture
- Compact size 12.2 x 10.7 x 3.4cm / 300grams

From models to **direct measurement**.



Green area: Most of the time, inertia is **underestimated**, demonstrating potential for less RE curtailment and less balancing spend.

Red area: At times of overall low inertia, inertia level is **overestimated**, bearing highest security risk.

Direct inertia measurement helps to...

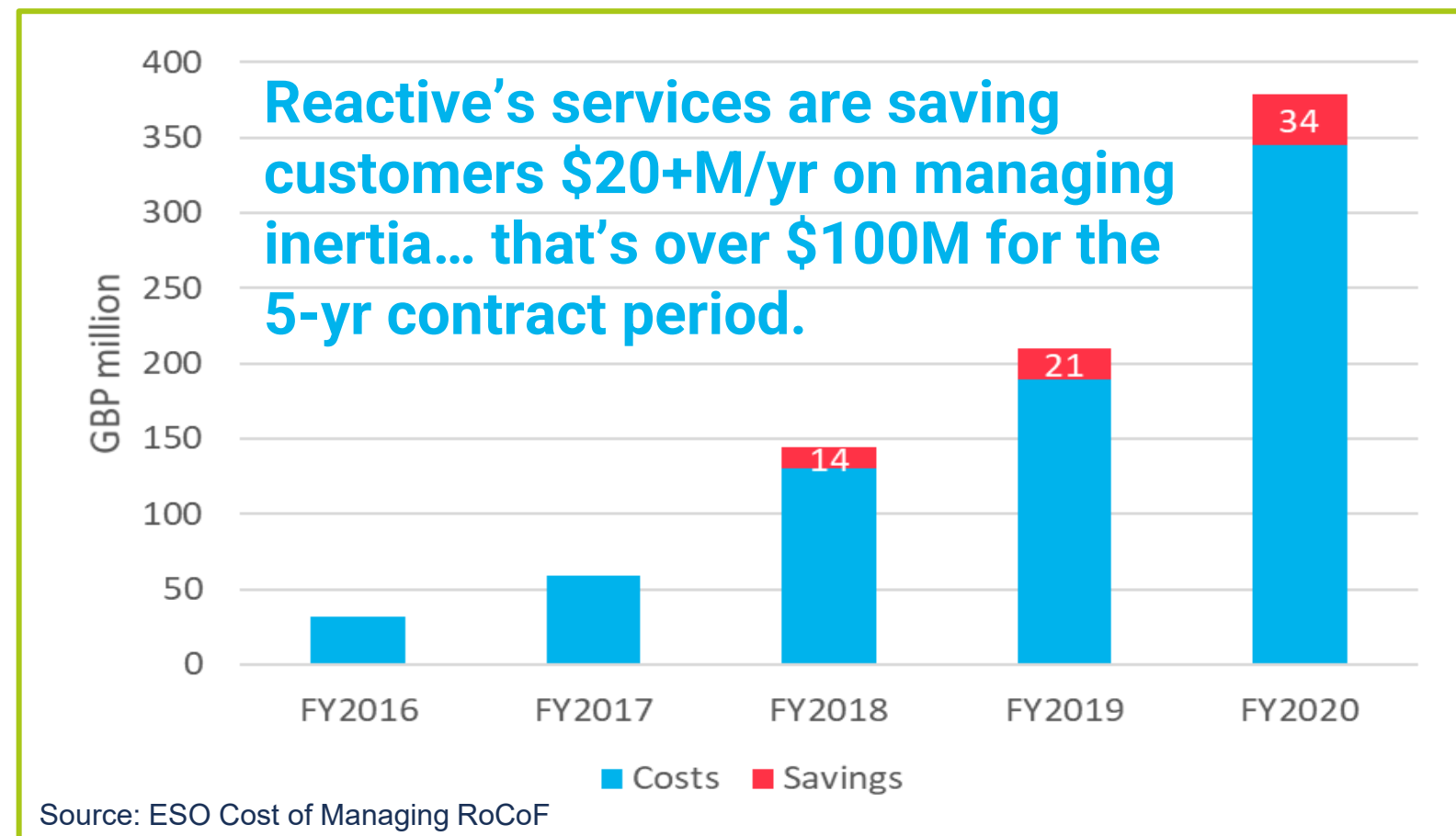
- Identify low inertia risk
- Reduce RE curtailment
- Optimize balancing measures



Project SIM: The Case Study of National Grid UK

Inertia Measurement is core to NGENSO's Zero Carbon Plan... Wish they had this 2-3 years ago!!

Inertia Measurement is Saving ~10% of the Cost of managing decreasing inertia in the UK



National Grid ESO's goal of zero carbon operation by 2025 requires direct inertia measurement being in place

- **Commercial Services Operational** – exceeding expectations
 - Rapidly deployed, stand-alone secure IT service
 - Faster Renewable Integration
 - Data now used in Control Room for real-time optimization
- **Results show:**
 - ~80% time **Measured inertia >10-30+% higher** than estimates (minimize/optimize inertia procurement)
 - ~20% time **measured inertia is lower** than estimated inertia (evaluate system operational risk)
- **Reactive's inertia data to be used by NGENSO to establish a market for inertia in 2025**
- **NGESO ROI <1 year**

“Inertia will become much more important in the years to come, I think today it is taken for granted... Inertia is at the heart of everything we do”

Fintan Slye
Director, UK System Operator at National Grid ESO



WECC Regional Grid Stability Measurement Project

Project Overview

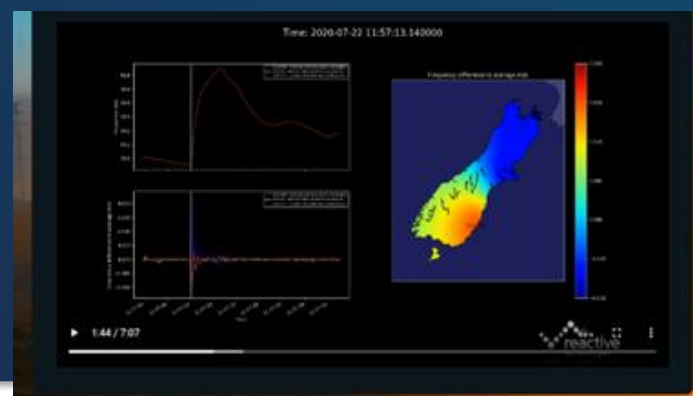
Minimal Input Required



Phase 1

Initial Measurement Enablement (1-2 Months)

- RT to install 10-15 XMU across WECC region with **Collaborating Utilities/RC's**
- **Initiate Measurement Analytics**
 - Frequency Visualization
 - Event Monitoring
 - Regional RoCoF
 - Spot Inertia
 - Oscillations



Nothing

Frequency/Event Monitoring

Phase 2

Expand XMU Deployment

- Utility Investment for service territory (~10-15 XMUs)
- ~\$200K per utility

RC Integration/Collaboration

- Integrate PMU/SCADA & Demand data
- Enhance measurement analytics



Measurement Accuracy

Phase 3

Introduced Regional BESS Modulation

- Selected & collaborative host
- 3-5 locations

Initiate Inertia Measurement

- Grid Stability
- Markets Assessment
- Asset Management

- **RC Investment for Services**

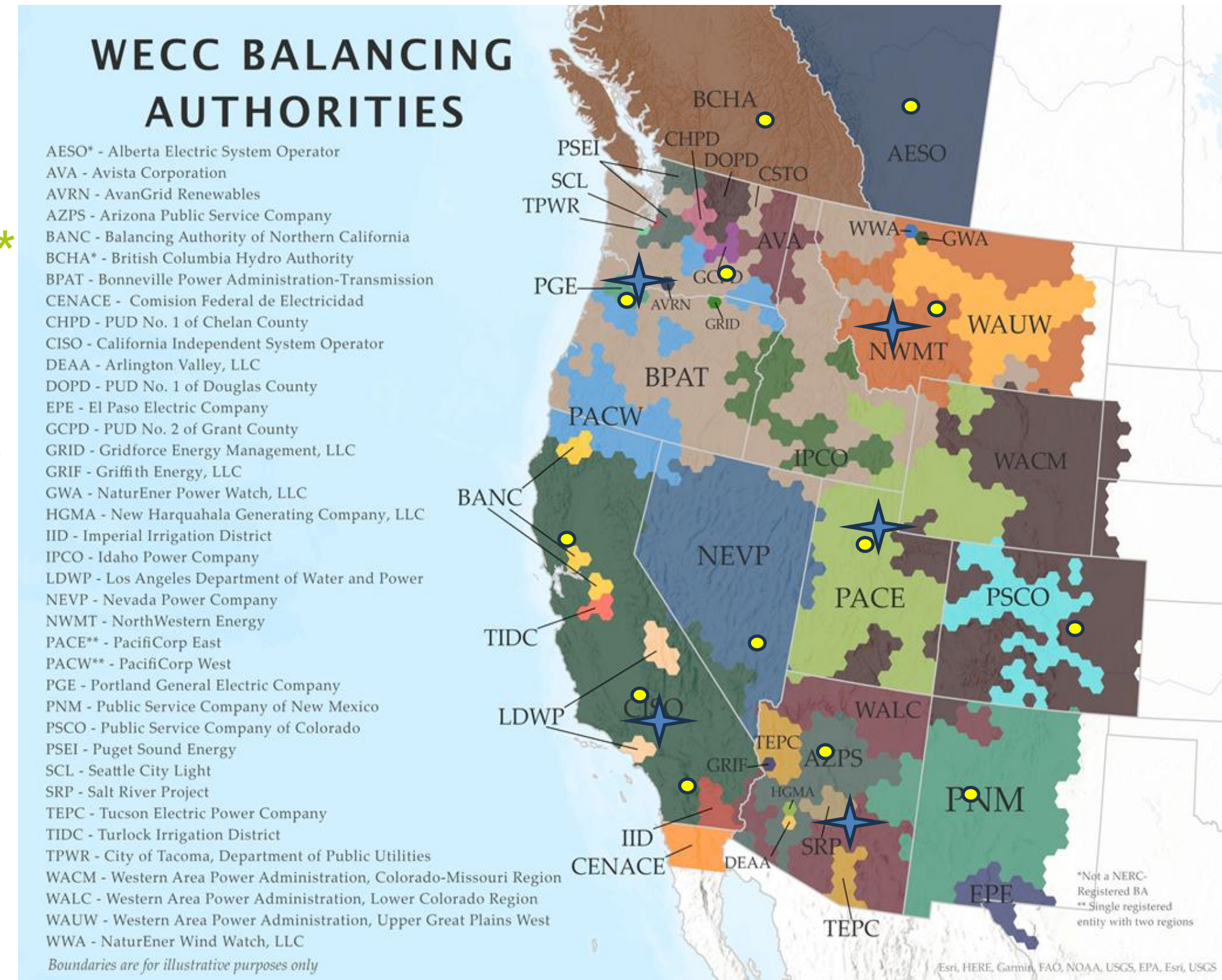


Measurements & Forecasting

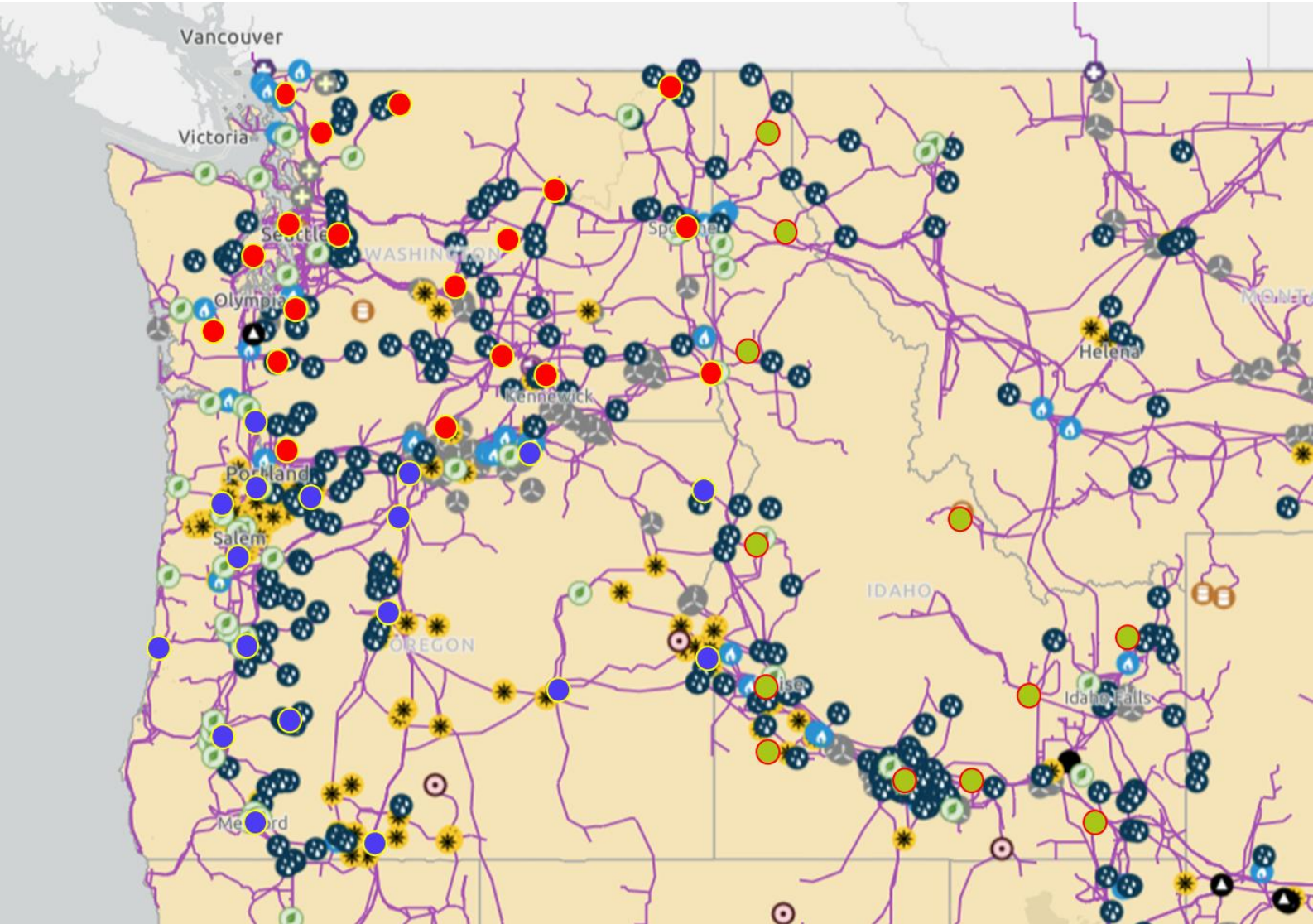
WECC Regional Grid Stability Measurement Project



- Initial XMU Deployment (10-13) ●
- Planned Collaborating Utilities Recommendation
 - Pacific Northwest: Portland Electric*/PacifiCorp*/BPA*
 - CA: SCE*/SDGE*/PG&E*
 - APS*/PacifiCorp*/Nevada Power/SRP
 - Canada: BC Hydro/AESO
 - New Mexico(PNM) – Montana(TBD) – Colorado(Xcel?)(* attended CAISO workshop)
- ID BESS Modulation for sub-regional projects (TBD) ★
- Potential Impact Reports
 - Grid assessment
 - Market assessment
 - Asset Management Planning

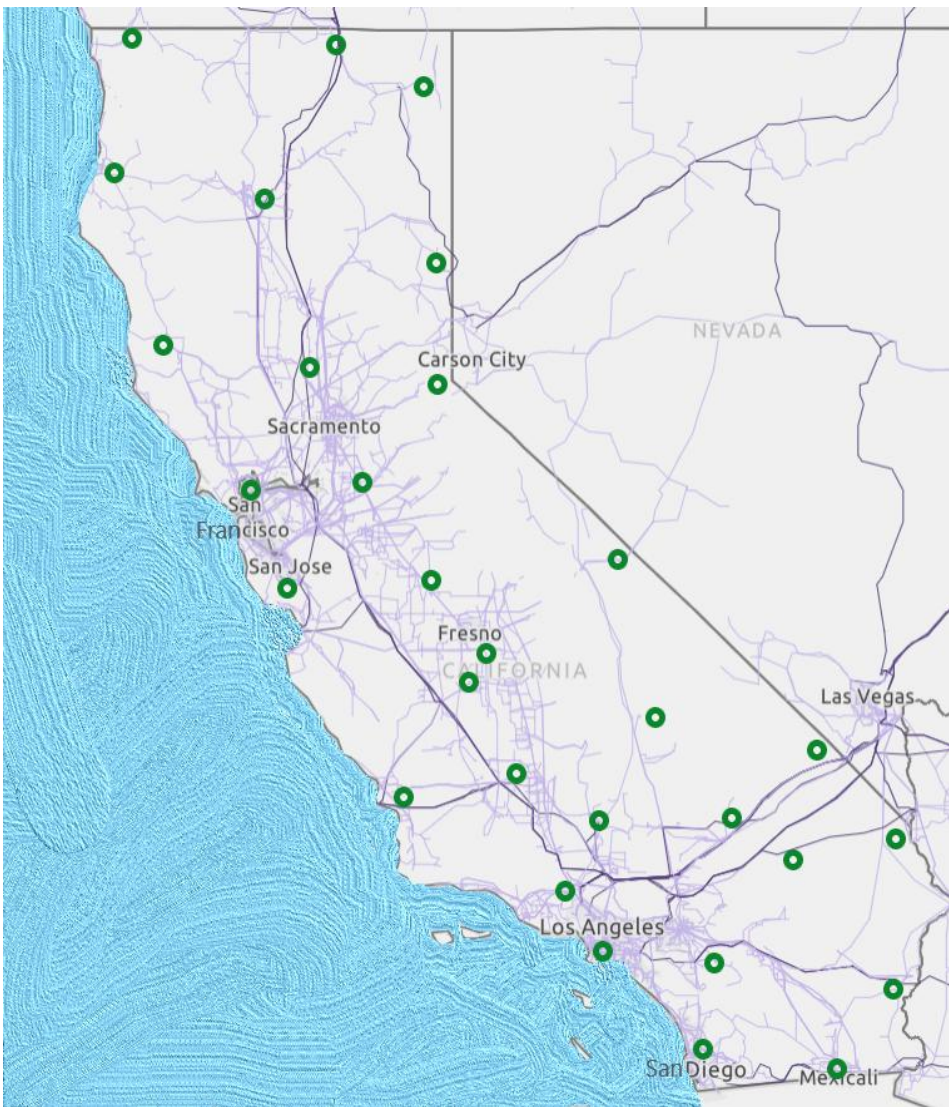


Phase 2 - XMU Expansion - Draft

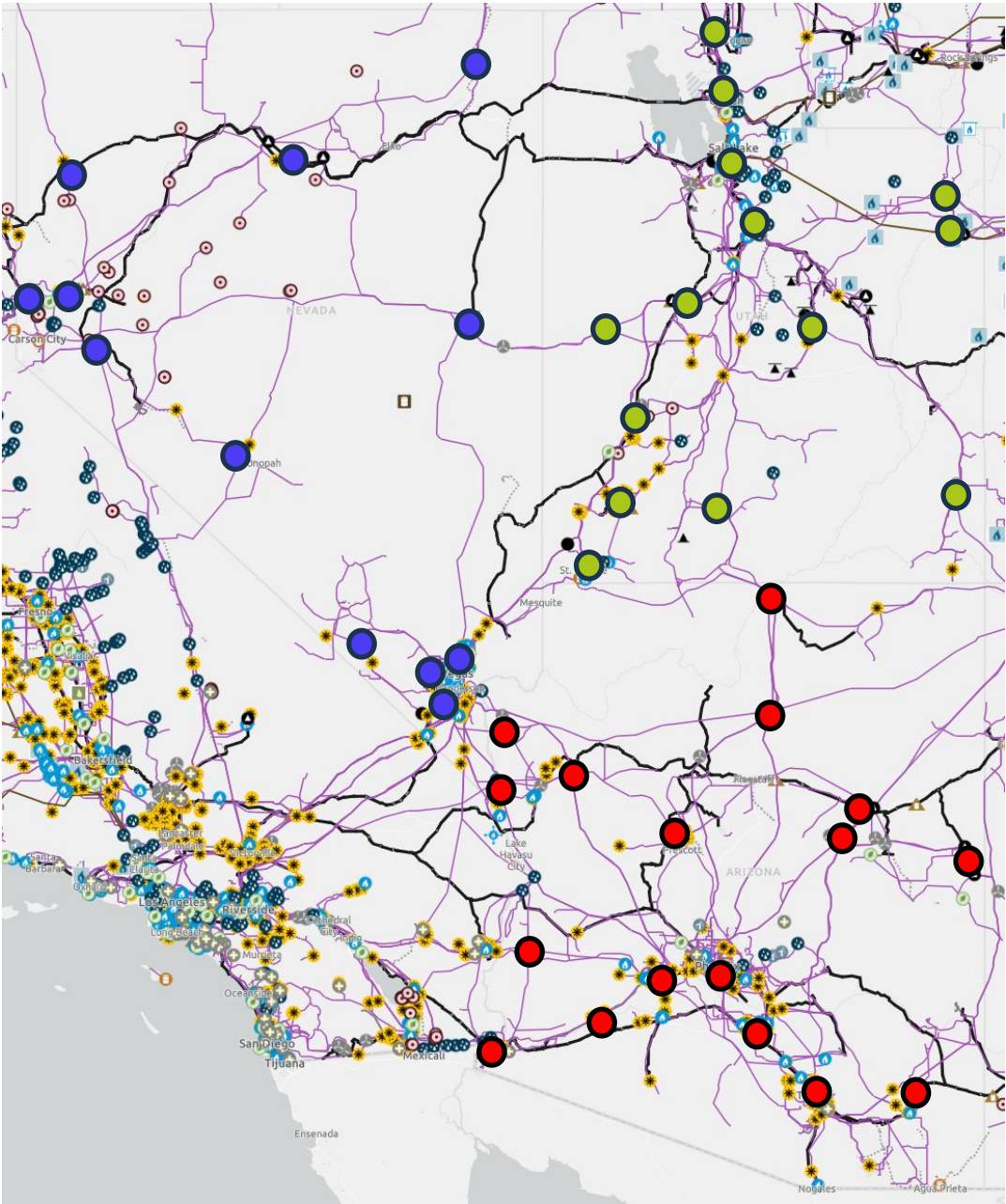


Pacific Northwest 49 XMU

- 19 x Washington
- 18 x Oregon
- 12 x Idaho



CA 30 XMU



Southwest 43 XMU

- 17 x Arizona
- 14 x Utah
- 12 x Nevada

Outcomes

Real-time, accurate, grid stability measurement and operational transparency enables:

- ✓ Maintain Safe and Reliable grid operations within actual frequency response & inertia limits in a coordinated approach across the western interconnect.
- ✓ Model validation & limits evaluation with real time grid data & event analytics
- ✓ Planners can identify potential grid stability issues and provide asset recommendations (such as synchronous condensers and/or battery storage) as to size, locations, and effectiveness to maintain a strong and reliable grid.
- ✓ Use services output to 'program' inverters for real-time grid-forming (FFR) support.
- ✓ Increase renewable penetration while minimizing curtailment and ancillary service cost.
- ✓ Evaluate frequency oscillations across regions

Requested WECC Performance Subcommittee Support

- ✓ Support the increase of monitoring and measurement for regional frequency, oscillation, & inertia performance with Reactive high-resolution Grid Edge IoT devices (XMU's) and Gridmetrix analytics to ensure safe and reliable system operation.
- ✓ WECC Performance Subcommittee requested to collaborate with RT to introduce and invite utilities to host an XMU, provided by RT, at no cost to participating utilities. They are designed for simple installation at an office or depot location using a standard consumer power socket.
- ✓ WECC Performance Subcommittee to facilitate the collaboration and coordination of the RC's in the WECC region and NERC for this project.
- ✓ For complete measurement coverage and analytical efforts, WECC Performance Subcommittee is requested to encourage utilities to consider an investment in deploying additional XMU's in their service territory. RT will provide preferential pricing for this effort.
- ✓ WECC Performance Subcommittee to help identify and support collaborations with utilities interested in demonstrating full-system frequency performance and regional inertia measurement using a modulation source, such as a current utility owned battery or battery in development in partnership with Reactive Technologies.
- ✓ WECC Performance Subcommittee requested to provide technical guidance and business case support throughout the development and implementation of the project, including grid assessments and recommendations.

Contact information

Jack Joyce

Executive Director, Americas

518-316-1145

jackj@reactivetechologies.com

www.reactive-technologies.com

info@reactive-technologies.com

To visit our website, scan
here:

