NASPI UPDATE
AND TECHNOLOGY ROADMAP

North American SynchroPhasor Initiative
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NERC Operating Committee Meeting
December 13, 2011

NASPI North American SynchroPhasor Initiative

Overview & Objective

- Why we care about phasor technology
- What's going on today with phasor technology?
  - Synchrophasor-related Smart Grid Investment Grant projects
- When can you get great phasor tools for operations?
  - Prerequisites for real-time phasor data applications
  - Critical digression – phasor communications networks (aka, it's about systems, not devices…)
  - NASPI's expectations for applications readiness
- In closing
  - What NASPI's doing
  - How can we help you?
  - How can you help us?

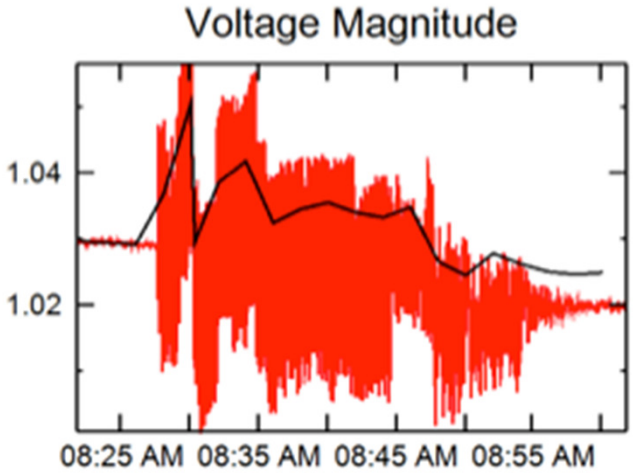
Objective – manage your expectations re phasor technology and ask for your help

Why care about phasor technology?

Because it will help improve grid reliability by providing new solutions and insights for grid operators and planners

Because it can directly address most of NERC's reliability priorities.

OG&E voltage event
Black line = SCADA voltage trace
Red trace = phasor data showing oscillations



Why NERC cares about phasor technology

NERC and Committee Priorities and Goals	Phasor Technology Role
NERC President's Priority Issues • Misoperation of relays and control systems • Human errors by field personnel • Changing resource mix • Integration of new technologies • Prepare for high-impact, low frequency events	• Identify relay mis-operation and events • Monitoring & situational awareness • Assist operator response • Improve system, plant, dynamic models • Back up & complement SCADA systems
NERC Operating Committee Priorities • Voltage stability • Human error • Seams issues • Coordination of outages	• High-speed monitoring for wide-area situational awareness • Data analysis for fast operator decision support tools
NERC Planning Committee Priorities • Reliability assessments • Technical planning analyses • Event analysis • NERC alerts • Transmission system protection • Frequency response • Model validation	• Time-synchronized, accurate, detailed data on actual grid events and normal system behavior for event analysis and model validation • Identify system dynamics • Mine data to design limits, alerts • Identify and understand frequency response and oscillatory behavior

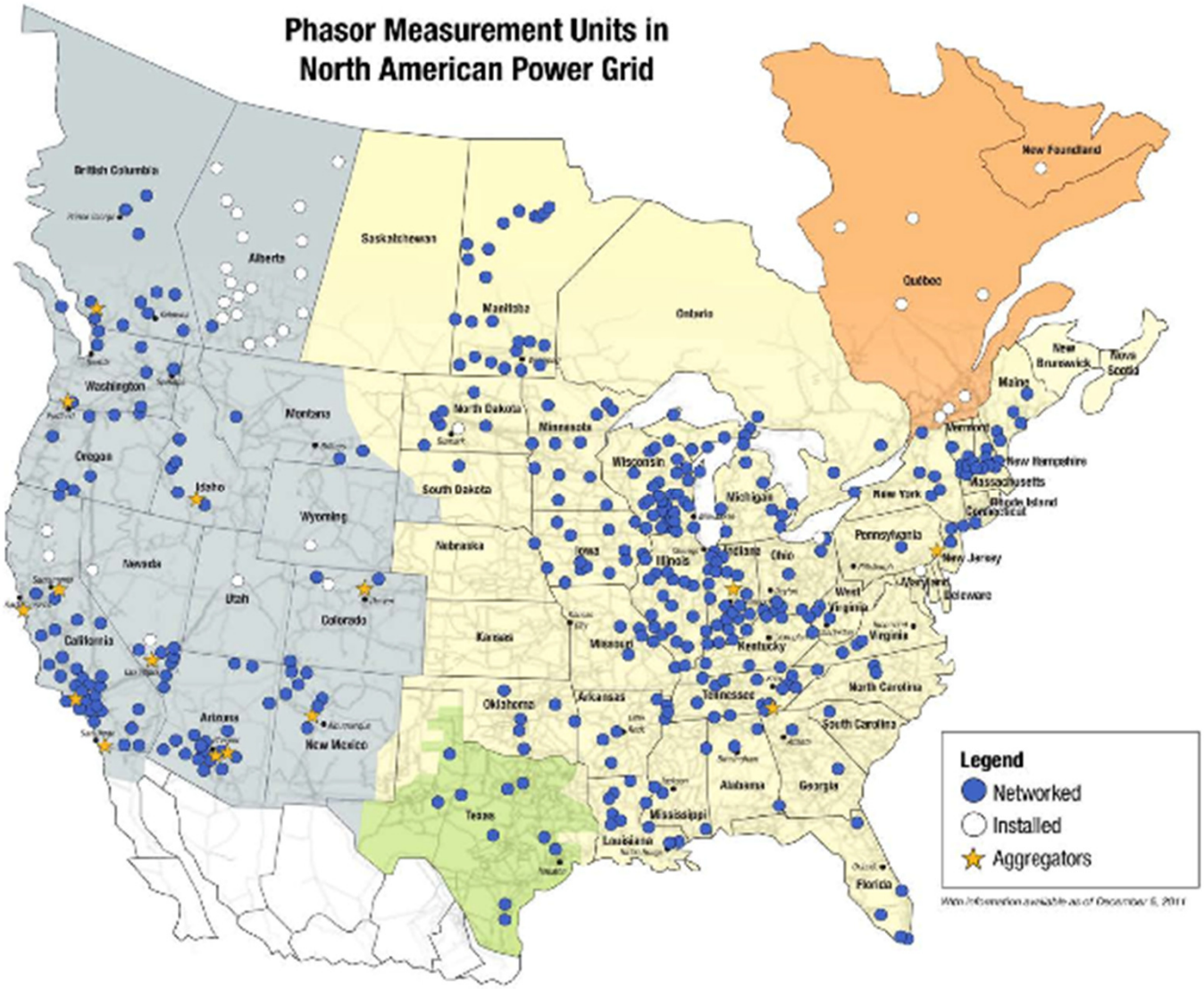
Smart Grid Investment Grants
Synchrophasor Projects – 2010 - 2013

Project lead	Project investment (federal and private) ($1,000)	# Transmission owner partners	Total PMUs by 2014
American Transmission Co. (*2 grants)	$ 25,550 *	1	45
CCET (ERCOT -- * regional demo grant)	$ 27,419 *	3	23
Duke Energy Carolinas	$ 7,856	1	104
Entergy Services	$ 9,222	1	45
FP&L (* regional demo grant)	$ 578,963 *	1	45
ISO New England	$ 8,519	7	39
Midwest Energy	$ 1,425	1	7
Midwest ISO	$ 34,543	10	165
New York ISO	$ 75,712	8	39
PJM	$ 27,840	12	81
WECC	$ 107,780	18	439

PMU Update

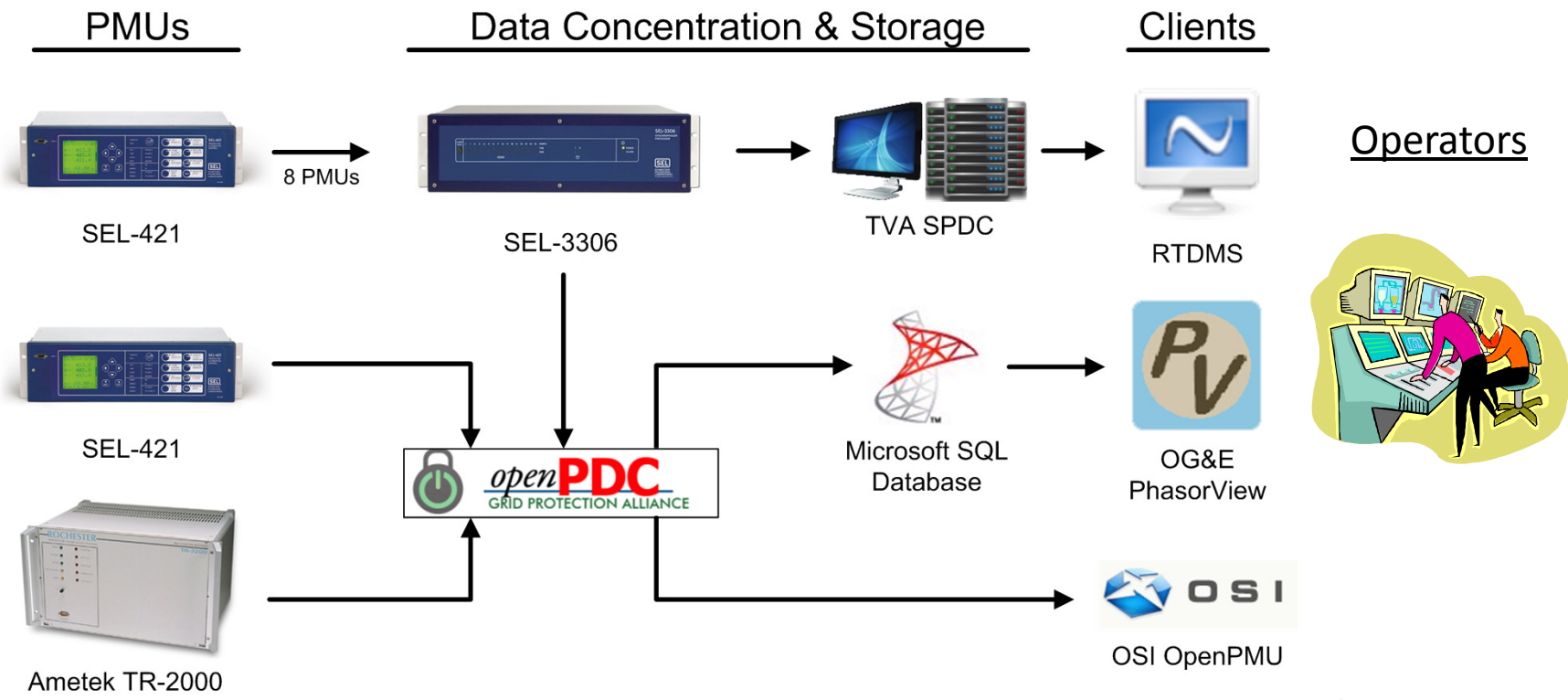
- Current PMU count – well over 200 installed (11/11)

- After SGIG build-out (2014) – about 1,000 networked



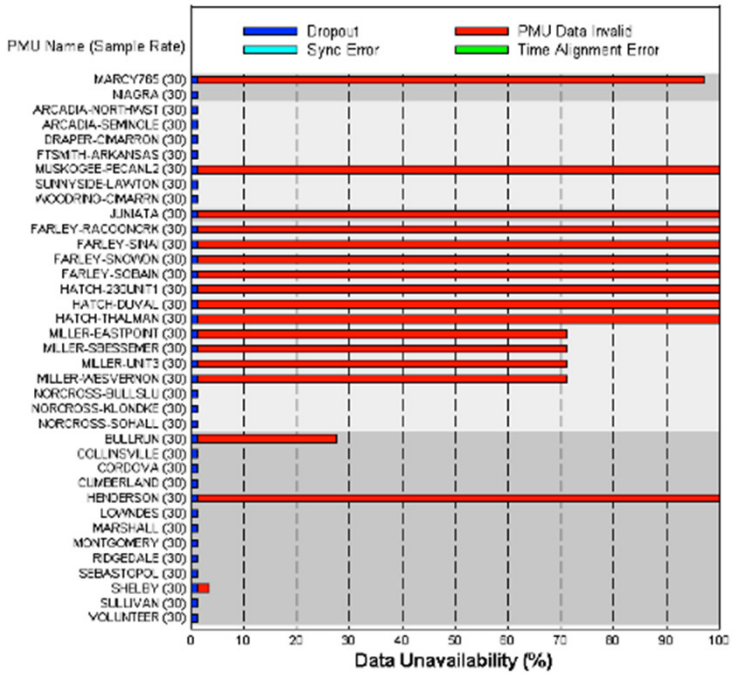
Typical synchrophasor system from PMU to operator

OG&E:

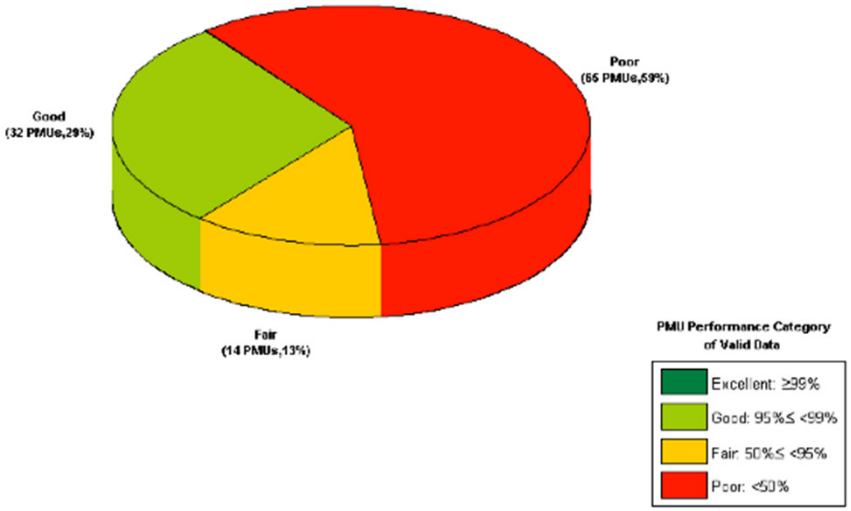


Communications – the Achilles' heel of phasor systems

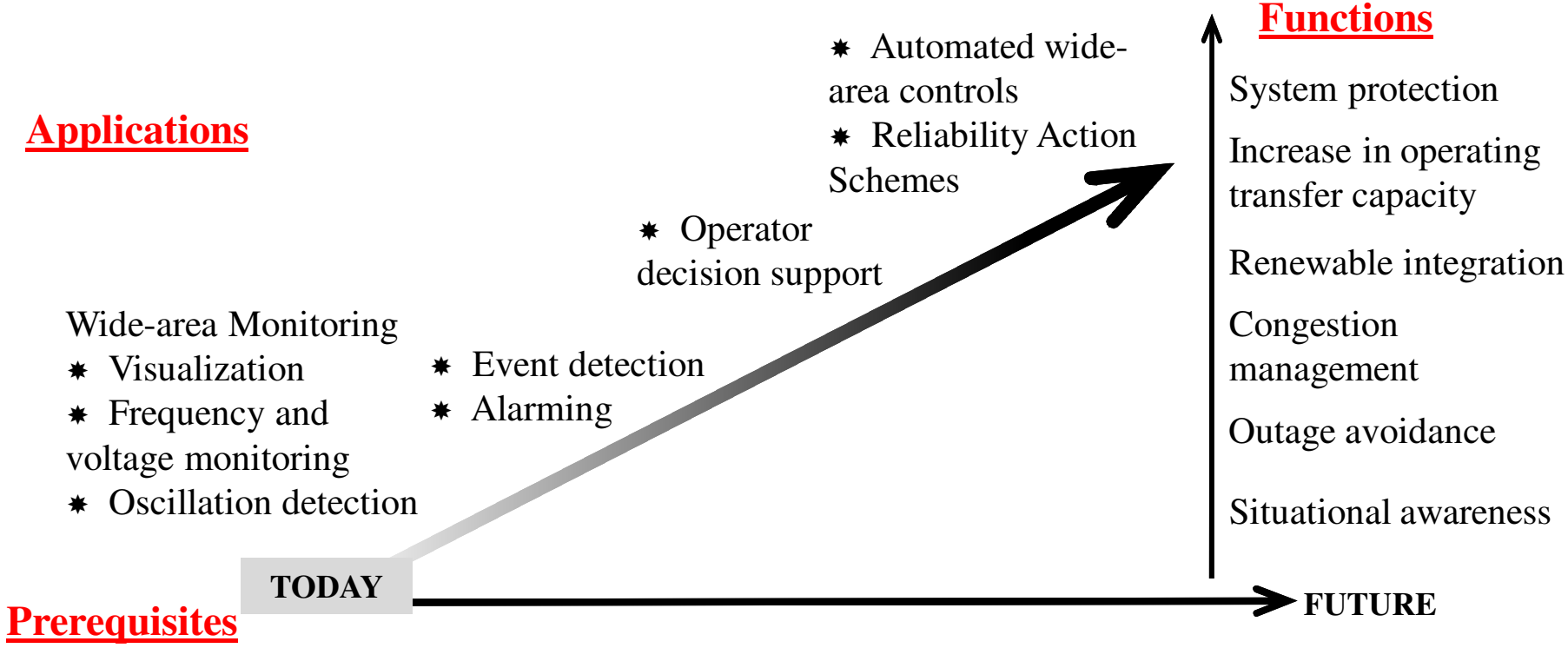
Without solid communications networks, real-time phasor data aren't delivered up-stream to the data concentrator, applications and operators.



Out of 111 networked eastern PMUs, only 29% were delivering >95% data on 12/9/11 – most poor-performing PMUs due to communications problems.



REAL-TIME SYNCHROPHASOR APPLICATIONS AND THEIR PREREQUISITES



Prerequisites

ANALYSIS	Good data collection	Interconnection-wide baselining	Pattern detection	Model validation – system & elements	System studies
COMMUNICATIONS	Interoperability standards	High availability, high speed	Appropriate physical & cyber-security	Redundant, fault-tolerant	
USERS	Familiarity	NASPI North American SynchroPhasor Initiative	Good visual interface	Training	

SGIG Project Phasor Applications

	ATC	CCET	Duke	Entergy	FPL	ISO-NE	MISO	NYISO	PJM	WECC
REAL-TIME APPLICATIONS										
Wide-area visualization & situational awareness	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
State estimation	✓		✓	✓	✓			✓	✓	
Voltage monitoring			✓	✓	✓	✓	✓	✓	✓	✓
Frequency monitoring and management		✓					✓	✓	✓	
Oscillation detection & monitoring				✓			✓		✓	✓
Event detection		✓			✓		✓	✓	✓	
Alarming & limits					✓				✓	✓
Stability monitoring (local & wide-area)				✓	✓		✓	✓		
Renewables integration		✓	✓				✓	✓	✓	✓
Congestion management						✓			✓	✓
Automated controls										✓
PMU data monitoring		✓				✓				
Islanding detection & restoration				✓	✓					
OFF-LINE APPLICATIONS										
Post-event analysis		✓	✓		✓			✓	✓	✓
Model validation		✓	✓		✓	✓	✓	✓	✓	✓
Controlled system separation								✓		✓
Baseline & pattern recognition				✓			✓		✓	✓

Target Timing of Phasor Applications and Prerequisites

2012

- Majority of new PMUs installed or updated
- Wide-area visualization applications, voltage and frequency monitoring in use
- Many phasor-related technical standards complete

2013

- All SGIG PMUs installed and networked
- Phasor data starts feeding state estimators
- All communications networks and associated data management infrastructure complete and in testing
- Model validation and system studies under way
- Baselining and pattern recognition analysis under way

2014

- Communications networks become production-grade
- Situational awareness applications production-grade
- Renewables integration using voltage and frequency stability monitoring, oscillation monitoring
- Designing system operating limits for alarming
- Early operator support tools in pilot

2015 and later

- Working on automated controls and controlled separation
- Dynamic state estimation

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Bad news and good news

The bad news – synchrophasor applications won't be ready for control room use as fast as you want them

The good news – they'll be ready in 3 to 5 years.

Phasor systems and applications will mature much faster than SCADA and EMS did (30+ years…). Why?

1. Communications, IT, data storage and computational technology are much better today and improve faster
2. Established framework of interoperability technical standards, and accelerated development of new ones
3. Strong, sustained community effort focused on technology improvement and problem-solving
4. Major federal and industry investment in technology R&D
5. Thanks to the first 4 factors, large, early federal and industry investments in technology deployment

What NASPI's doing to accelerate synchrophasor technology maturity

- Sharing users' and vendors' success stories and high-value applications
- Accelerating development of technical interoperability standards
- Focusing and facilitating baselining and pattern recognition research (e.g., oscillation detection) and other R&D
- Early identification of project implementation challenges and community work to develop and share solutions
  - Develop and test PMU device specifications and interoperability
  - Communications network design
  - PMU placement
  - End-to-end data flow and quality
  - Developing requirements for "production-grade" systems
  - Building key software infrastructure (NERC GPA investment)
  - Enhance applications value and operator and user training
  - On the horizon – more technical standards; cyber-security and GPS

How can we help you?

- The OC is identifying its top five areas of interest for phasors and operations, and seeks proof of concept for one (or more?) of those areas, to feed later into standards development.
- What can NASPI help you explore and prove?

How can you help us?

- NASPI Visualization Workshop
  - February 28, 2012, Orlando Hyatt Regency
  - Compare phasor data Wide-Area Situational Awareness applications to consider effectiveness and intuitiveness of “visual vocabulary”
  - Comparing 6-7 vendors/applications against 5-6 grid events
  - Please come, bring an operator, and give us your feedback
- NASPI Work Group Meeting
  - February 29- March 1, 2012, Orlando Hyatt Regency
  - Two sessions on training for synchrophasor apps on 2/29/12
- NASPI Work Group Meeting June 2012 – Success stories and vendor show

We need your participation, feedback and guidance – please tell us what you want to learn about and what works