

The Integrated Grid

Pilot Projects

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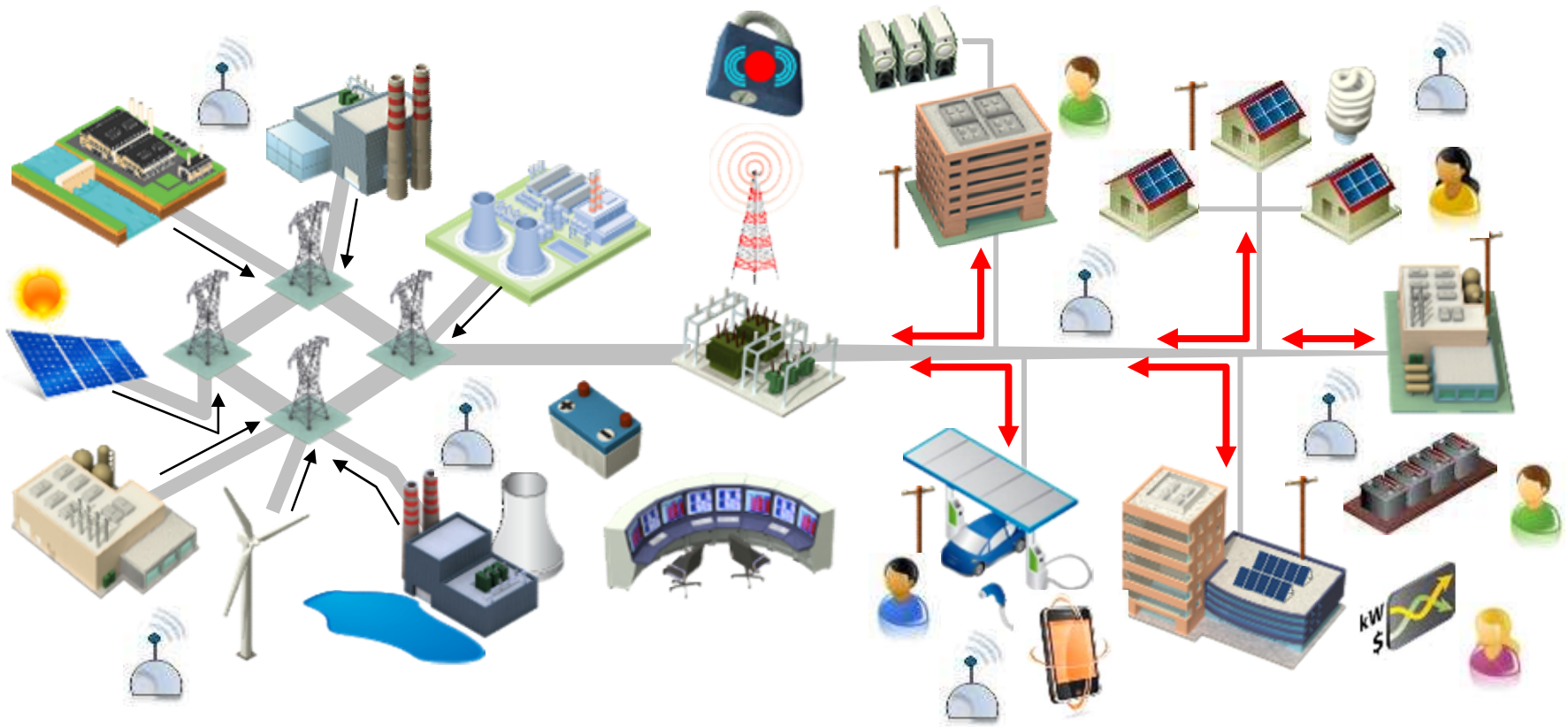
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Electric Power Research Institute



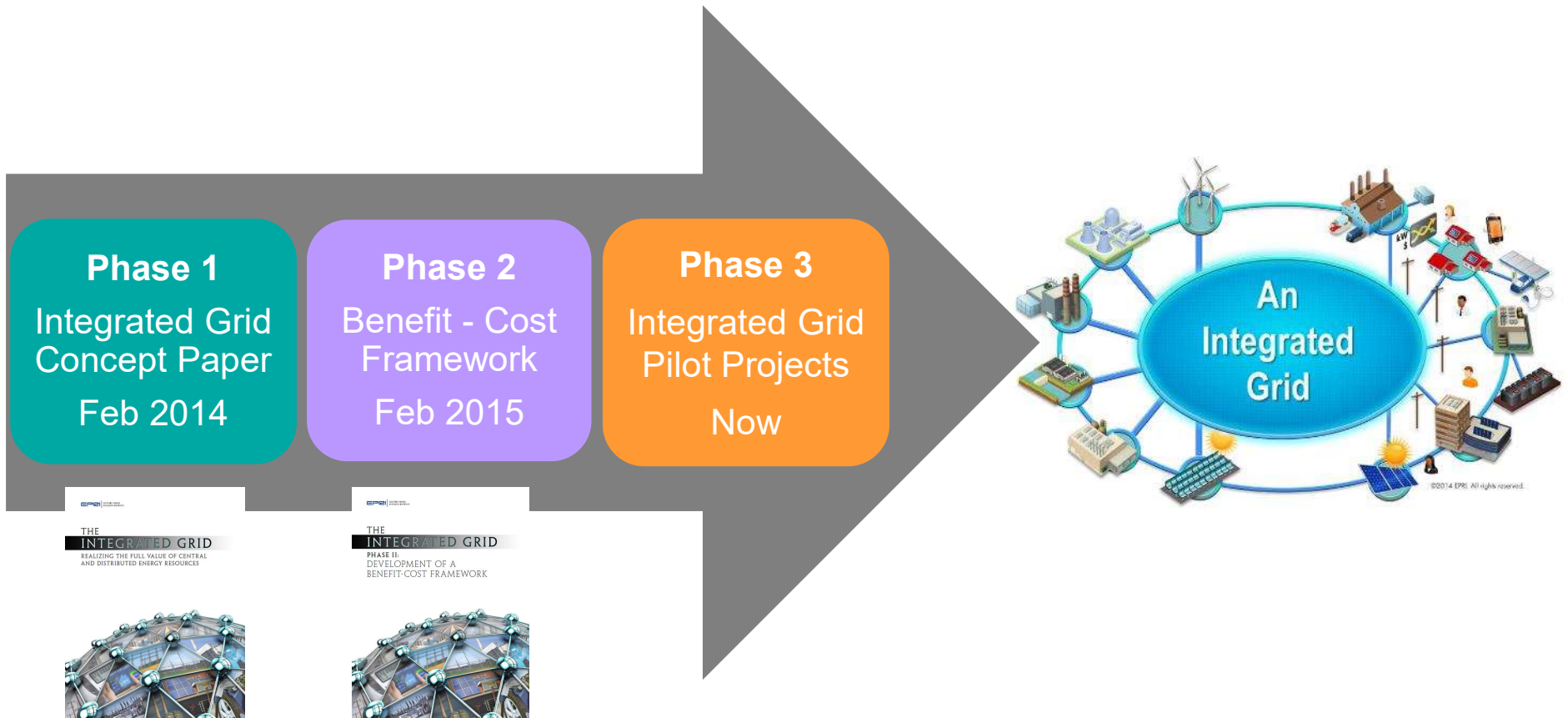
Integrated Grid: The Vision



Power System that is Highly Flexible, Resilient and Connected and Optimizes Energy Resources

Developing Foundation for an Integrated Grid

Join the community - <http://integratedgrid.epri.com/>



Extensive Industry Coordination in all Phases

Define Integrated Grid Concept

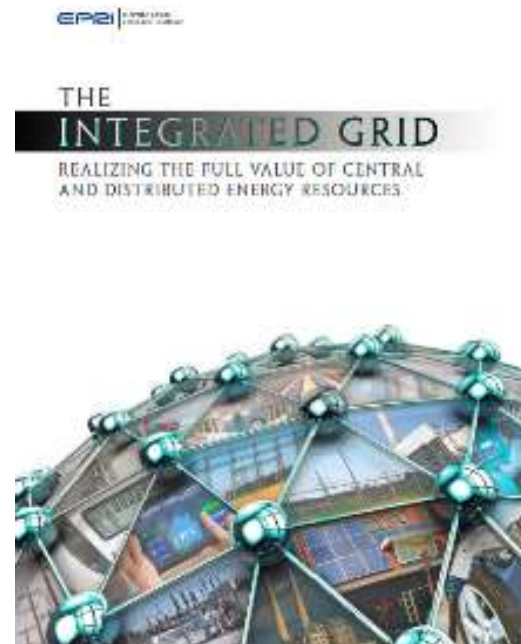
Phase I
2014

Phase 2
2015

Phase 3
2015 - 2018

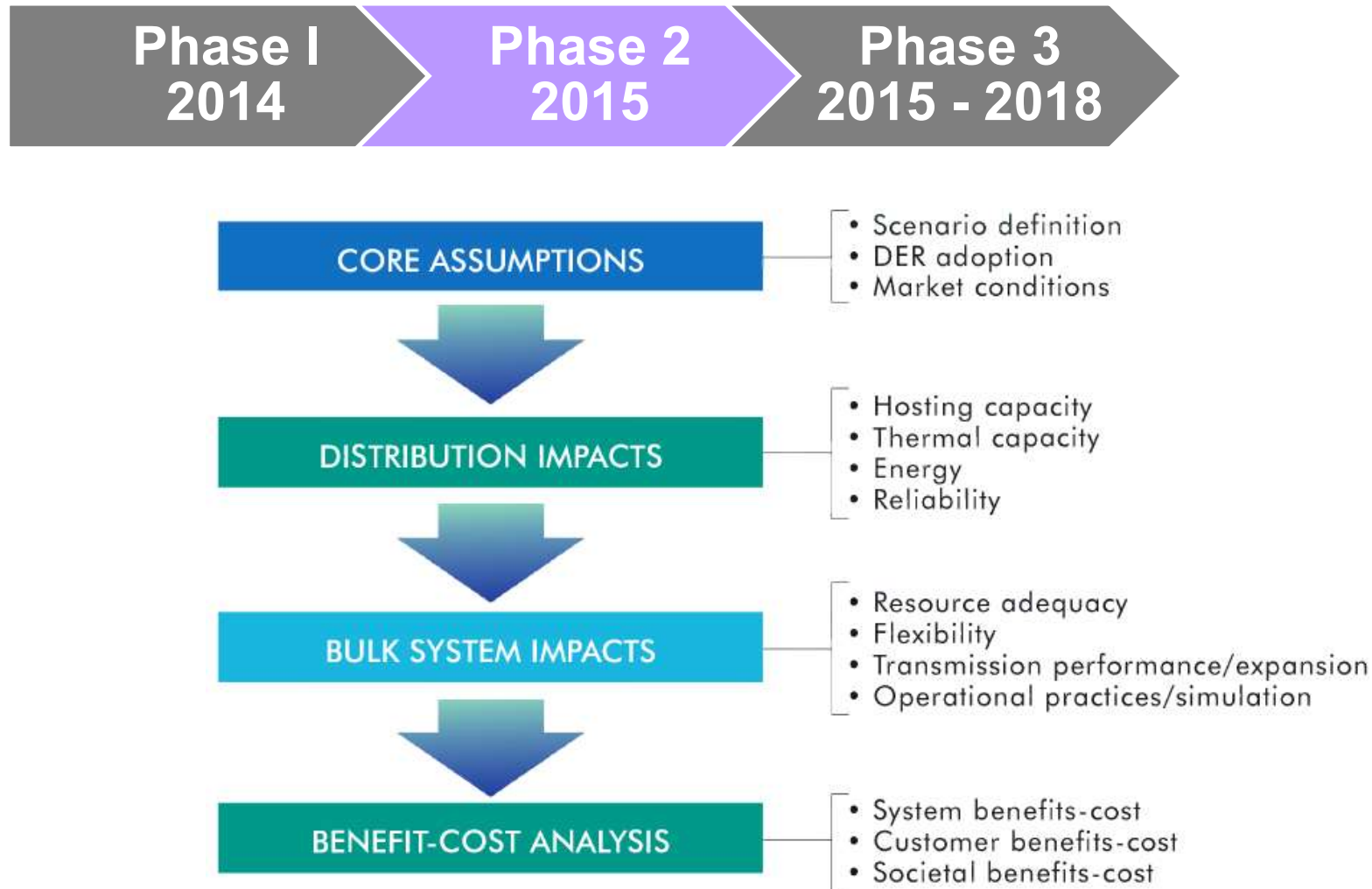
Integrated Grid Concept Paper

- How will power systems evolve with DER growth?
- Can we capture the benefits of both central and distributed resources?
- How do we fairly, thoroughly and transparently evaluate costs?



Key attributes on an integrated approach

Develop Benefit-Cost Framework

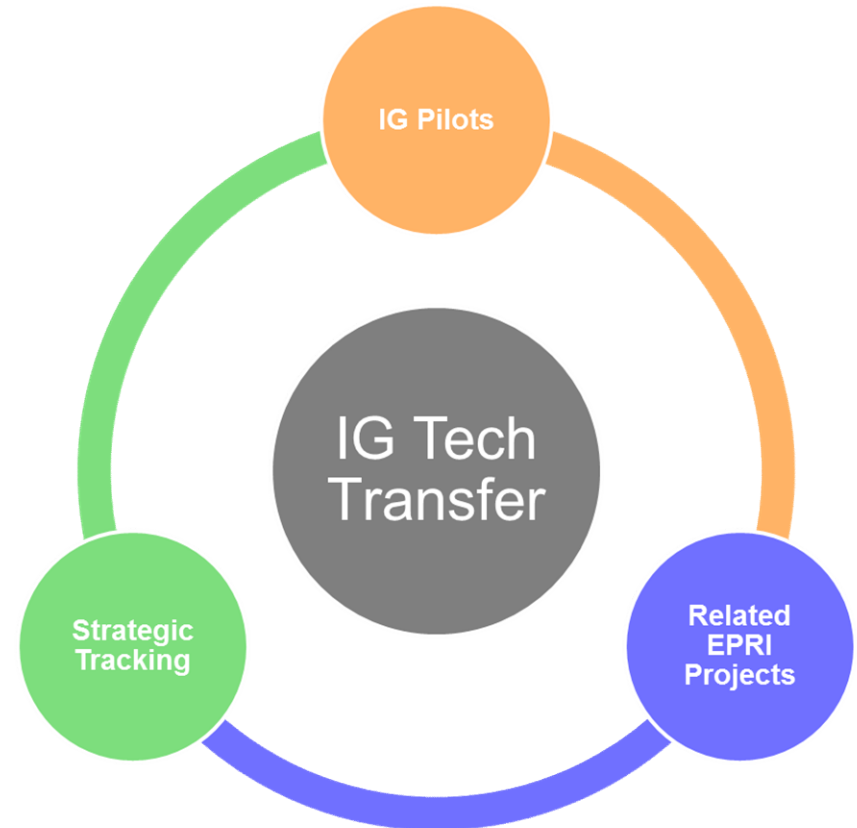


Assess the impacts to improve system planning and operation







Put the Framework to the Test



- For planned or existing technology deployments
- Evaluate the capability of DER in different field scenarios
- Analysis that is consistent & repeatable to understand integration
- Assess costs and benefits of integrating DER



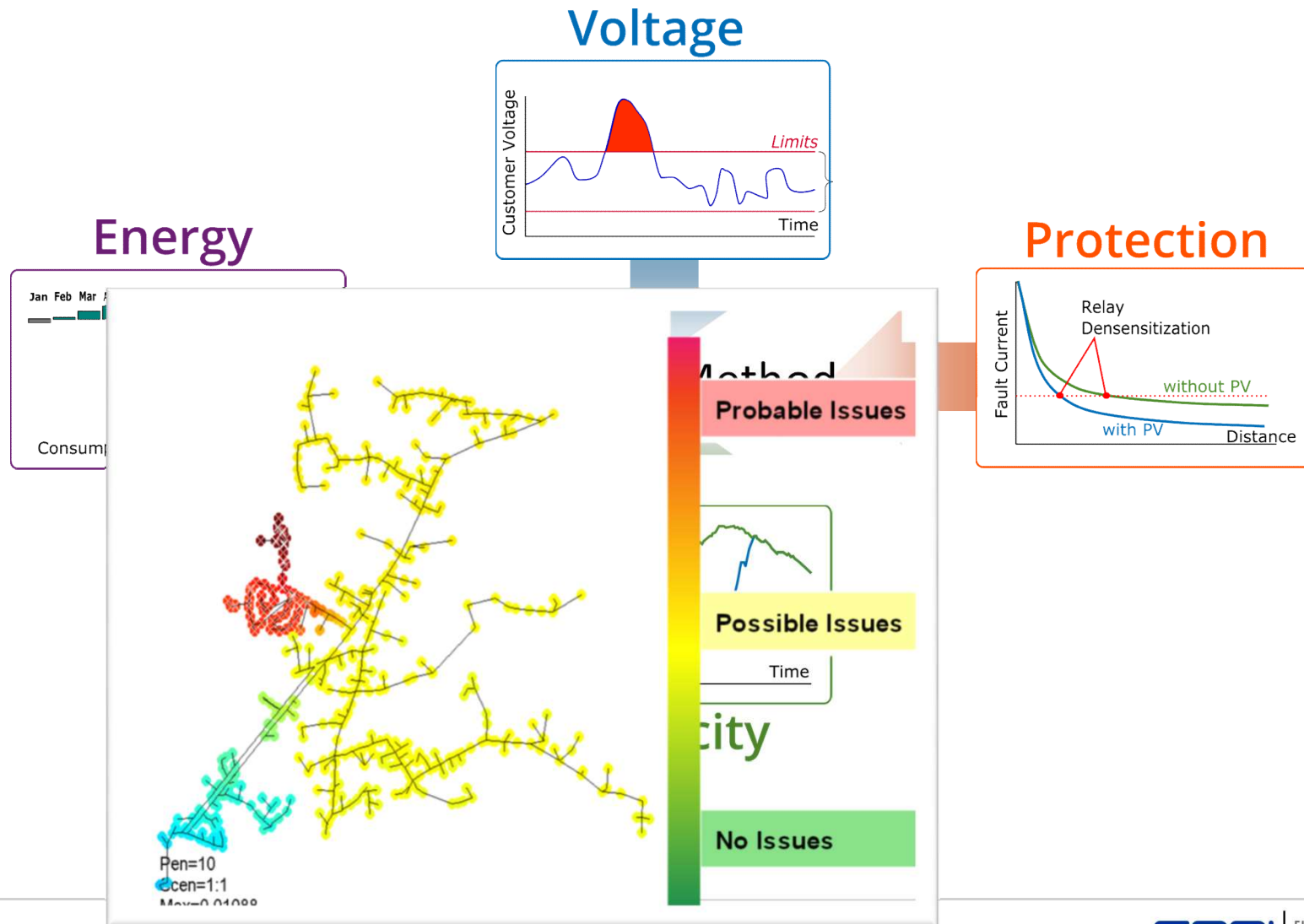
Pilot Projects Underway

Projects							
Demonstrations	SRP Residential Smart Inverter						
	AEP I&M Clean Energy Solar						
	Alliant Energy Star Power						
	APS Utility Owned Residential PV						
	Entergy PV + ES						
	Hoosier Utility Scale PV						
	NYPA/CenHud SUNY New Paltz						
	NYPA/ConEd CUNY SHINES						
	TVA Integrated Value						
	LGE Energy Storage Demo						
	NCEMC Microgrid						
	Xcel Energy ES Grid Modernization						
Analysis before Demo	WeEnergies Microgrid						
	HydroOne Imapct & Value of ES						
	SCE Distributed ES Valuation						
	PECO/Exelon Microgrid						
	KCPL EV Infrastructure						
	ConEd Energy Storage Valuation						

What We're Learning...

- Where can DER be located for the greatest benefit?
- How to ensure that DER will be available to support the larger grid when necessary?
- What are the gaps between theory and practical implementation?

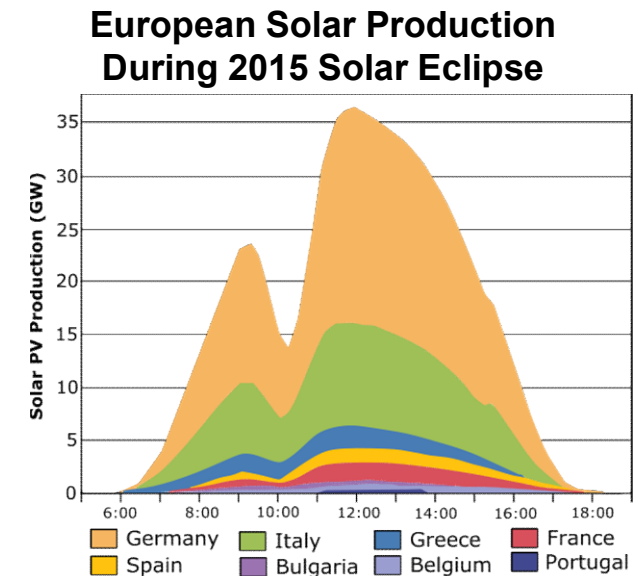
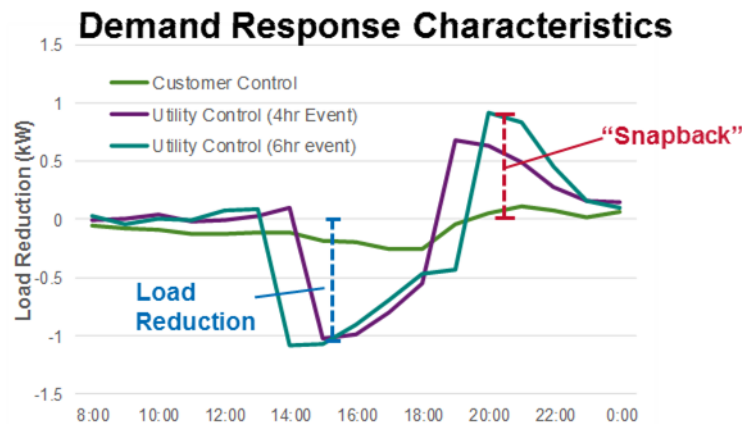
Planning for DER Support to Distribution



DER Effectiveness Depends on Uncertain Variables

How to reduce uncertainty in DER support?

- Forecasting
- Understanding customer behavior



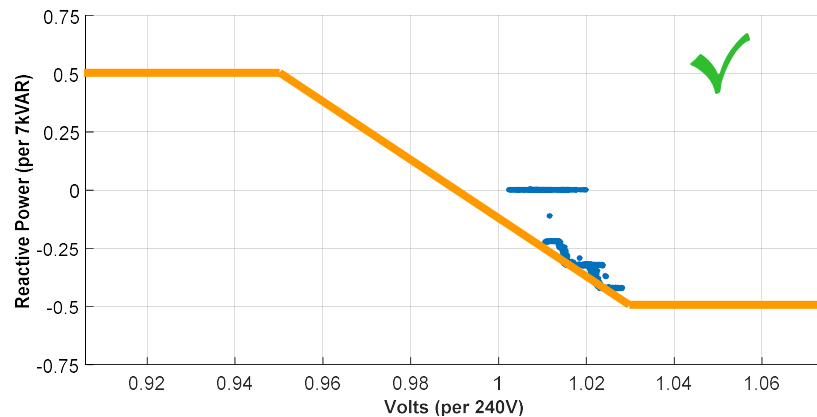
Data courtesy of ENTSO-E

DER Effectiveness Depends on Technology Readiness

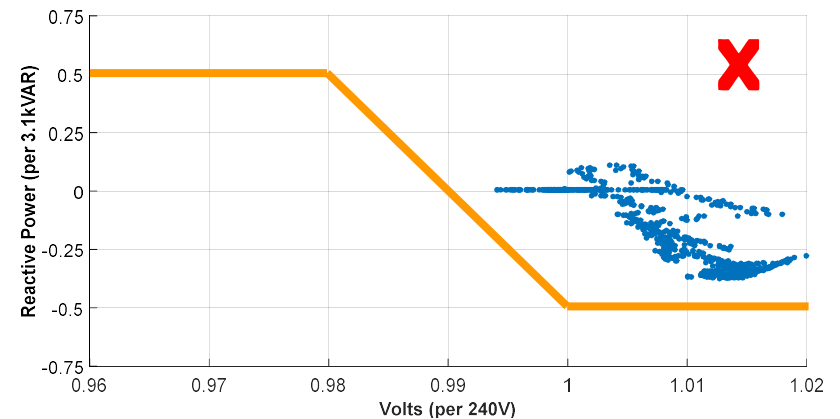
How to improve performance of inverters?

- Understanding grid support
- Standards for accuracy

Inverter follows assigned volt-var curve

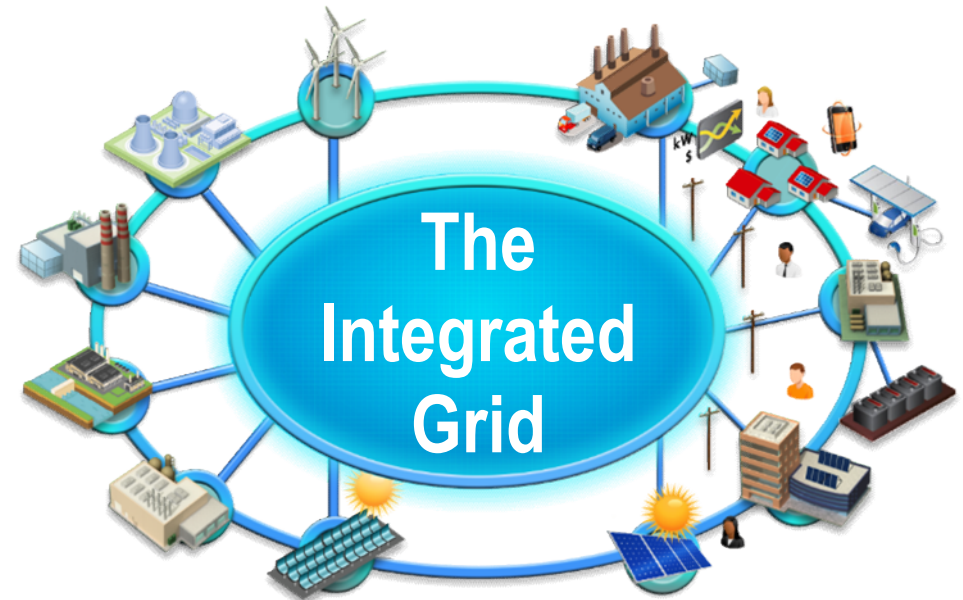


Inverter doesn't follow volt-var curve



Summary

- Planning improvements still necessary to understand when and where DER can be a resource
- Rubber meets the road when it comes to utilities leveraging distributed resources
- Utility hands-on experience is vital to technology readiness



<http://integratedgrid.epri.com/>

Want to utilize all resources...but challenges still exist!



Together...Shaping the Future of Electricity

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