

# Ambient (Clean Energy Coalition) Smart Grid Emerging Technology Roadmap

	Incremental (0 – 3 Years)	Strategic (3 – 10 Years)	Transformational (10+ Years)
TELECOM	<ul style="list-style-type: none"> <li>• Migration of 3G to LTE and rise of small cellular</li> <li>• Ongoing shift of wired to wireless</li> <li>• Tighter integration of comm. and grid / sensor technologies</li> <li>• Telecom evolution will continue to outpace utility adoption</li> <li>• M2M growth</li> <li>• Low bandwidth, high latency</li> </ul>	<ul style="list-style-type: none"> <li>• 3G cellular disappears</li> <li>• Requirements for larger amounts of data</li> <li>• Wired connections migrate to MPLS networks/fiber pushed deeper into networks</li> <li>• Network data load continues to increase</li> <li>• Devices utilize multiple paths/providers rather than a single provider/path.</li> </ul>	<ul style="list-style-type: none"> <li>• Telecom / utilities back-office and customer fulfillment integration</li> <li>• Migration of 4G to 5G cellular</li> <li>• Increased telecom capability evolves from nice to have to required as utility, healthcare, transportation become dependent on data</li> <li>• High band width, very low latency</li> </ul>
GRID DEVICES	<ul style="list-style-type: none"> <li>• Centralized intelligence</li> <li>• Initial development of the tools and control schemes to manage the distribution system</li> <li>• Self-healing and IVVC focus</li> <li>• DER “low” mkt penetration</li> </ul>	<ul style="list-style-type: none"> <li>• Central intelligence combined w/ local/distributed intelligence</li> <li>• Ops driven by analytics &amp; automation</li> <li>• Shift to modularity and interoperability</li> <li>• Adoption of telecom techniques for grid management</li> <li>• DER “medium” penetration</li> </ul>	<ul style="list-style-type: none"> <li>• Centralized intel combined with widespread local/distributed intel</li> <li>• Ops highly automated</li> <li>• All devices have 2-way comm., memory, and processing capabilities</li> <li>• Hierarchical control of field devices</li> <li>• DER “high” penetration</li> </ul>
INFORMATION TECHNOLOGY	<ul style="list-style-type: none"> <li>• Competing, proprietary standards</li> <li>• Software is largely centralized and siloed</li> <li>• Architecture is centralized</li> <li>• Message bus limited to data center</li> <li>• “Big data” is big issue</li> </ul>	<ul style="list-style-type: none"> <li>• Standards and interoperability focus</li> <li>• Software less centralized and siloed</li> <li>• Architecture shifting to distributed</li> <li>• Limited field message bus</li> <li>• New tools for mining data for intel</li> </ul>	<ul style="list-style-type: none"> <li>• Applications and architecture fully distributed</li> <li>• Silo functionality largely gone</li> <li>• Data mining and analytics becomes core competency</li> </ul>
REGULATORY	<ul style="list-style-type: none"> <li>• Approval contingent on annual review, pilot</li> <li>• Rate base business model</li> <li>• Regulatory confusion about data, disaggregation, privacy</li> </ul>	<ul style="list-style-type: none"> <li>• Benefits proven for “low hanging fruit.”</li> <li>• Some regulation/mandates re: privacy, data, operational functionality.</li> <li>• Business model shifting from rate base to services-focused.</li> </ul>	<ul style="list-style-type: none"> <li>• Regulatory maturity</li> <li>• Business model is full retail competition / disaggregation</li> </ul>