



ie | Roadmap

interactive energy Roadmap  
to secure control systems

# Energy Sector Control Systems Working Group

## Annual Report 2008

Prepared for

Electric Sector Coordinating Council  
Oil and Natural Gas Sector Coordinating Council  
Energy Government Coordinating Council

Critical Infrastructure Partnership Advisory Council



May 2009

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## 1. Background

In January 2006, the U.S. Department of Energy (DOE) in partnership with the U.S. Department of Homeland Security and Natural Resources Canada released the *Roadmap to Secure Control Systems in the Energy Sector*, a detailed strategy for protecting control systems used in the electric, oil, and natural gas sectors. The Roadmap was developed and guided by energy sector asset owners and operators and representatives from the government, academia, vendors, and other stakeholders. The Roadmap provides a strategic framework designed to help align public and private programs and investments to achieve a common goal in a timely and efficient manner. The Energy Roadmap sets forth a vision to design, develop, install, and maintain control systems that can survive an intentional cyber assault without loss of critical functions by 2016.

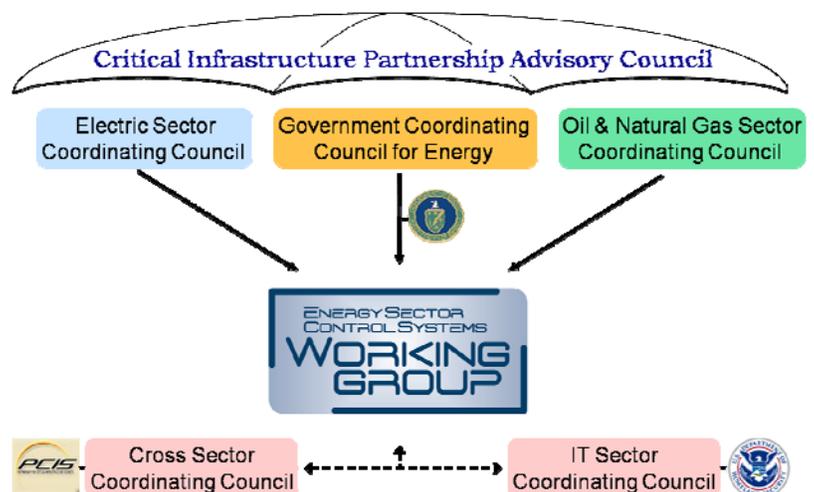
Since its release, several organizations have stepped forward to support and help implement the Roadmap. In June 2006, the North American Electric Reliability Council's (NERC) Critical Infrastructure Protection Committee (CIPC) unanimously voted to endorse and support Roadmap implementation. The Roadmap's goals and milestones have also been incorporated into the *Energy Sector-Specific Plan*, developed and regularly updated by the Energy Government Coordinating Council (GCC) and the Electric and Oil & Gas Sector Coordinating Councils (SCCs) in accordance with the National Infrastructure Protection Plan. Furthermore, more than 60 active control system security projects have been mapped by 21 organizations in government and industry to align with specific Roadmap goals, challenges, and priorities using a web-based tool called the interactive energy Roadmap (ieRoadmap).

Several companies have also implemented projects that align their distinct skills, capabilities, and resources with the goals and milestones in the Roadmap. However, to ensure the vision is achieved, a leadership structure was needed to identify, organize, resource, and track the diverse activities and how they relate to achieving the Roadmap milestones. As a result, a public-private coordinating entity was formed to provide the required oversight, collaboration, and decision making to fully capture the benefits of these efforts.

## 2. Charter

The Energy Sector Control Systems Working Group (see Figure 1) formed in December 2007 to provide advice and guidance to help implement the Energy Roadmap. The efforts of the Working Group are designed to foster private and public collaboration to improve control systems security in the energy sector.

**Figure 1. Energy Control Systems Working Group Organization**



### 3. Goals

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For 2008, the Working Group developed a work plan to:

1. Identify and implement practical, near-term activities that are high priority for the industry
2. Promote the value to the industry of achieving the goals of Roadmap
3. Recommend critical areas for public and private investment
4. Measure progress toward Roadmap goals and milestones

The Working Group goals for 2008, its first year of operation, were to increase the awareness and engagement of owners and operators in the Energy Roadmap and help baseline the current landscape of control systems security projects in the energy sector.

### 4. Accomplishments

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#### Goal : Near-term Activities

To determine and implement the high-priority activities for 2008, the Working Group held a series of conference calls and its first planning meeting in St. Louis, Missouri, in March. During the planning meeting, the Working Group determined the following activities to implement the Work Plan:

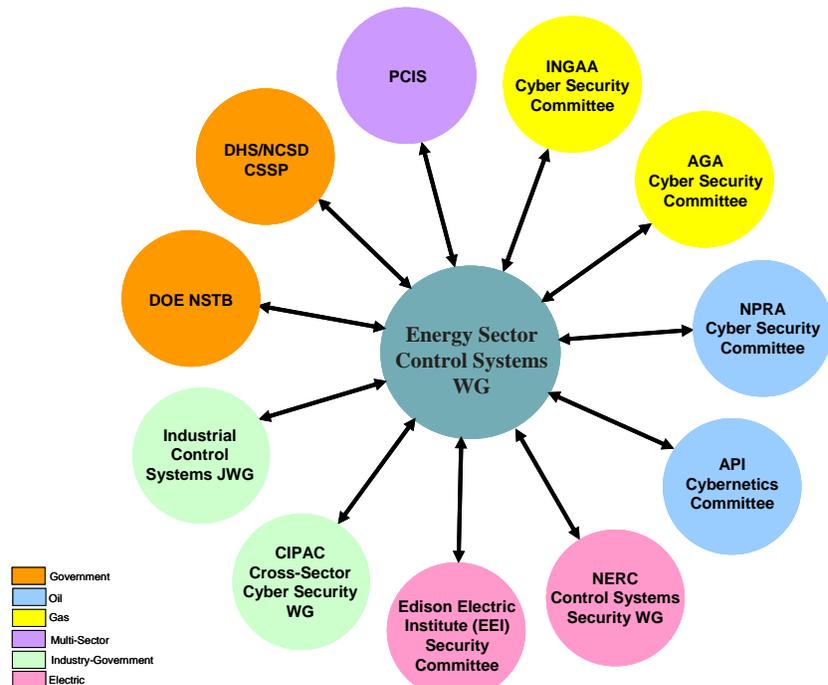
- Conduct an industry project workshop in May 2008 to gain insight on the breadth and depth of current research activities and benchmark progress toward achieving Roadmap goals.
- Collaborate via conference calls, quarterly and on an as-needed basis, to plan, implement, and track ongoing activities.
- Participate as reviewers in the DOE Office of Electricity Delivery and Energy Reliability's (OE) National SCADA Test Bed (NSTB) program peer review to help DOE research stay aligned with Roadmap goals and provide greater impact.
- Brief executives, asset owners and operators, and other stakeholders at industry conferences and association/working group meetings; as a baseline, each Working Group member should brief organizations they currently participate in (see Figure 2).
- Meet face-to-face once a year to review and assess progress and plan for the next year of activities.

## Goal : Promotion of Roadmap Value

Starting with its existing network (Figure 2), the Working Group engaged energy sector stakeholders at 10 industry forums, wrote two periodical articles and one newsletter, and built an Energy Roadmap network of more than 1,400 contacts.

Listed below are more details on these accomplishments:

**Figure 2. Energy Control Systems Working Group Connections**



- Briefed more than 100 executives at two venues, including the NERC Cyber Summit in September 2008 and the Federal Utility Partnership Working Group Meeting in November 2008, where a member served as an Energy Security Panel member.
- Briefed asset owners, government, and researchers at eight forums, including the Edison Electric Institute meetings in March and September 2008; the Oil and Natural Gas SCC meeting in August 2008; the Process Control Systems Forum meeting in August 2008; the American Gas Association meeting in September 2008; the International Pipeline Security Forum in October 2008; the SANS SCADA Security Summit in February 2009; and the DistribuTECH meeting in February 2009.
- Wrote two articles for periodicals, including “[On the Road to Cyber Security](#),” released in June 2008 in *Automation World* with a circulation of 65,000, and “[Faced with Cyber Threat, the Energy Sector Responds](#),” released in February 2009 in *The CIP Report*, an internationally distributed monthly electronic newsletter by the Critical Infrastructure Protection Program at the George Mason University School of Law.
- Built a list of contacts, including 62 Roadmap partners and 1,400 power systems stakeholders.
- Developed and released the inaugural edition of [ieRoadmap News](#), a quarterly electronic update on Roadmap activities, to contact list in February 2009.
- Enhanced online collaboration on the interactive energy Roadmap (ieRoadmap) website, by moving to a more searchable location ([www.controlsystemsroadmap.net](http://www.controlsystemsroadmap.net)) and adding new content ([calendar](#), [documents](#), [useful links](#), [news items](#), tool for researchers to [link to the ieRoadmap](#) from their own sites, [newsletter](#), [peer review](#), [working group information](#)).

## Goal : Investment Recommendations

To provide near-term recommendations on private and public research, the Working Group released one report and contributed to two other important peer review efforts. Listed below are more details on these accomplishments:

- In May 2008, the Working Group held its first-ever [ieRoadmap Workshop](#) in Chicago, Illinois. At the two-day workshop, project leads from 23 industry projects presented their work to about 50 participants, including asset owners, vendors, researchers, program managers, and members of the Working Group. Working Group members reviewed the projects and provided feedback on each project's alignment with the Roadmap vision and goals. The workshop also provided a forum to increase industry awareness and improve industry uptake of each developing technology or service. As a result, project leads:
  - Explored additional end uses for their research
  - Developed targeted communications materials
  - Contacted asset owners to bring in as potential project partners and advisors

To read more about the reviewer recommendations and feedback from the project leads, view the [ieRoadmap Workshop Summary Report](#).

- In June 2008, Working Group members participated in Sandia National Laboratories' [Cyber Attacks on Control Systems: Evaluating the Real Risk Workshop](#). A group of more than 40 owners and operators, national laboratory experts, and stakeholders from the energy sector attended the workshop, which aimed to encourage discussion and suggestions on ways in which Sandia's risk analysis capabilities can be refined to be better applied throughout the sector. Working Group recommendations can be found in an internal Sandia report, *Cyber Attacks on Control Systems: Evaluating the Real Risk 2008 Workshop Summary Results*. Sandia is acting on these recommendations and is continuing to use Working Group members as advisors to further enhance Sandia's risk analysis capabilities.
- In October 2008, the Working Group served as the review team for DOE's 2008 Visualization and Controls Peer Review. At the two-day workshop, project leads from 18 NSTB projects presented their work to about 40 participants, including asset owners, vendors, researchers, program managers, and members of the Working Group. Key recommendations include:
  - National laboratory researchers should find ways to shorten the time between research and production.
  - OE should raise the priority of the NSTB funding, especially for labs who can accelerate technology transfer.
  - While many projects have mechanisms for connections to the asset owners and vendors, some projects still need to build or strengthen these connections.

Overall, reviewers found that the accomplishments and results of NSTB are quite strong and represent a huge value and return on investment. To read more about the reviewer recommendations, view the [Visualization and Controls Peer Review Public Document](#).

## Goal: Roadmap Progress

To assess progress in securing energy control systems, the ESCSWG has launched two initiatives:

- In April 2009, the ESCSWG completed its Roadmap Partnership Analysis. Designed to gain insights on industry collaboration to secure control systems, 16 interviews were conducted with a cross-section of stakeholders from electric and natural gas utilities, commercial vendors, researchers, and energy industry groups (see Appendix A for more about the interviewee perspectives and recommendations). Key findings include:
  - Energy owners and operators, system vendors and integrators, laboratory researchers, and government programs have used the Roadmap in their collaborative efforts as a vehicle to drive action, guide investments toward a common vision and goals, and accelerate product development to produce tangible results.
  - The ESCSWG should improve the Roadmap in several dimensions. Key recommendations include increasing granularity to guide standards development, such as NERC CIP and Smart Grid interoperability standards; expanding measures to address the needs of the oil and natural gas sector, small utilities, Smart Grid, and other emerging issues; and creating incentives to justify investments and reward partners for their contributions.
- The Roadmap Accomplishments project is using the ieRoadmap website, a key mechanism for tracking progress. The 2008 work plan was designed to gain a better understanding of how well the ieRoadmap projects are addressing Roadmap challenges and identify gaps in Roadmap efforts. To date, 41 of the 65 ieRoadmap projects have been reviewed for alignment. Results of these project evaluations are being used in the 2009 Roadmap Accomplishments project to baseline the current landscape of control systems security projects in the energy sector and will be completed in September 2009.

## 5. Key Findings

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Over the past year, the ESCSWG has found:

- Private sector partners have limited time and/or resources to invest in partnership activities that do not provide meaningful and clear benefits to the firm. In addition, government demands on their time appear to be growing while the workforce is being streamlined.
- Limited time and resources are the major barriers to achieving all of the Roadmap's milestones.
- While there is evidence that some of the seven near-term milestones have been partially or fully achieved, others have shown little progress. For example, most information protection and sharing issues between the U.S. government and industry have not been resolved.
- Without effective information sharing, the energy sector lacks the evidence to build a compelling business case to increase private investment in control system security—another near-term Roadmap milestone.
- There are a number of innovative projects under way that directly support the goals of the Roadmap, as shown in the [ieRoadmap Workshop Summary Report](#) and the [Visualizations and Controls Peer Review Public Document](#).
- More review and assessment is needed to better understand the interrelationships and impacts of the more than 60 projects under way.

- Researchers with high success rates are engaging the appropriate stakeholders in the electric, oil, and natural gas sectors during product development.
- The rapid pace of change in cyber and Smart Grid technologies, infrastructure requirements, and threat environments has created a new set of challenges that must be addressed.
- A focused effort is needed to bring groups of energy sector asset owners together to act as advisors to R&D and commercialization projects in several key functional areas.

### **Recommendations:**

To sustain momentum and address emerging needs, the Working Group should pursue a mix of planning, analysis, and facilitative activities in 2009 that includes reaching out to subject matter experts, developing new mechanisms for collaborative research, and evaluating the Energy Roadmap framework.

With the tremendous investment in Smart Grid technologies and grid modernization efforts, the Working Group should consider the impact of these initiatives as we move forward with working group efforts, the Roadmap, and advising industry research projects.

## **6. Initiatives for 2009**

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The Working Group goals for 2009 are to update the Energy Roadmap, continue increasing the awareness and engagement of owners and operators in Roadmap-related activities, and measure progress with the control systems security projects in the energy sector. The 2009 work plan includes:

- Roadmap Update – working with all stakeholder groups in the energy sector, the Energy Roadmap will be updated in four phases:
  - Spring/Summer '09 – Over-the-Horizon Analysis: Convene subject matter experts to discuss the control systems security challenges the energy sector may face over the next 10 years and recommend potential end states and milestones to overcome them.
  - Spring/Summer '09 – Roadmap Gap Analysis: Determine the gaps in goals and priorities over the past three years, as well as the new end states; provide a technical analysis, using Pacific Northwest National Laboratory, on the interrelationships of ongoing research.
  - Summer '09 – Roadmap Update Workshop: Convene a broad section of energy sector stakeholders to clarify end states and milestones drafted as a result of the over-the-horizon and gap analysis activities.
  - Fall '09 – Revised Control Systems Roadmap: the ESCSWG and Roadmap Update participants will release a revised *Roadmap to Secure Control Systems in the Energy Sector* that more specifically addresses the security needs of today's control systems environment, such as Smart Grid technologies, increasingly sophisticated adversaries, and emerging standards requirements.
- Roadmap Launch – develop and implement Energy Roadmap '09 outreach strategy with a comprehensive communication plan and roll out strategy.
- Roadmap Accomplishments – evaluate improvements to control systems security in the energy sector, align results according to the new Roadmap framework, and establish a baseline for future improvements in control systems security.

- Matchmaker Initiative – develop mechanisms to link control systems security projects in the public and private sector with appropriate end-user project partners to increase project validation, ensure projects create an applicable end product, and introduce end users to forthcoming technologies:
  - Convene one or more Advisory Boards of public- and private-sector control systems security experts to advise research projects in specific control systems security areas, such as substation automation. Advisory Boards will ensure that projects are relevant, advance Roadmap goals, have adequate plans for collaboration and technology transfer, and are technically robust.
  - Create an online Matchmaking Tool that allows both project leads and end users to sign up and be matched based on the knowledge and level of effort needed to advance control systems security research; launch in Fall '09.
- Publish *ieRoadmap News* in Summer, Fall, and Winter '09.
- Conduct 2<sup>nd</sup> annual ieRoadmap Workshop in Winter '09.
- Further engage CEOs, asset owners, researchers, and government staff through continued briefings, advisory group participation, and personal outreach.
- Engage in standards development activities, such as NERC CIP and Smart Grid interoperability standards.
- Broaden focus and target outreach efforts to enhance security in the oil and natural gas sectors.
- Conduct monthly planning calls and hold more as needed.
- Leverage time at the Roadmap Stakeholder Review to conduct annual Working Group meeting.

## 7. ESCSWG Membership

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The Working Group currently includes 13 control systems experts from the public and private sectors who were designated by the Electric SCC, the Oil and Natural Gas SCC, and the Energy GCC. As a Critical Infrastructure Partnership Advisory Council (CIPAC) working group (see Figure 1), the activities and discussions of the ESCSWG are protected from public disclosure and are exempt from the Federal Advisory Committee Act (FACA, P.L. 92-463).

Dave Batz, Alliant Energy  
 Stuart Brindley, IESO Ontario  
 Page Clark, El Paso Corporation  
 Steve Elwart, Ergon Refining Inc.  
 Eric Fletcher, NiSource  
 Tom Flowers, Flowers Control Center Solutions,  
 LLC (formerly of CenterPoint Energy)  
 Ed Goff, Progress Energy  
 Morgan Henrie, Alyeska Pipeline

Hank Kenchington, DOE Office of Electricity  
 Delivery and Energy Reliability  
 Doug Maughan, DHS Science & Technology  
 Directorate  
 Seán McGurk, DHS National Cyber Security  
 Division  
 Dave Norton, Entergy Corporation  
 Dave Scheulen, BP

## Appendix A: Roadmap Partnership Analysis

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The Roadmap Partnership Analysis engaged 16 energy stakeholders representing asset owners and operators from the electric, oil, and natural gas sectors, commercial entities, researchers, and industry associations in 30-40 minute discussions. The conversations focused on their experiences with using the Energy Roadmap, any internal or external changes in their organization's approach to security, and the resulting value or benefits. The following are excerpts from the discussions; for more perspectives see Table 1 and for more information on the participants see Table 2:

- “Largely [the Roadmap is] the catalyst that spurred everything: it took away the silos to work toward common goals, got us talking together, and [made the] jump across government and industry.” - *Tom Glock, Arizona Public Service*
- “We incorporated the vision, the milestones, and the goals into our product development. The Roadmap has driven SEL design and helped add \$5 million in research efforts.” - *Sharla Artz, Schweitzer Engineering Laboratories*
- “Basically the whole security landscape has gotten better as far as what is available... the fact of the matter is that there is a lot out there to help organizations that wasn't there just three years ago.” - *Frederick Curry, Energen Corporation*
- “Decision makers need to hear a credible and consistent message about securing control systems and they will listen.” - *Jim Mlachnik, Southwest Gas*
- “Having written need statements—the challenges and all that—provided something we could bring to the researchers and say ‘Here's industry telling us what their needs are.’” - *Ron Trelue, I3P*

While the above testimonials demonstrate the value the Energy Roadmap has delivered, there were stakeholders who said they have not spent any effort in the Roadmap process and instead, have been focusing an intense amount of resources on implementing compliance measures to meet NERC CIP Standards CIP-002-1 to CIP-009-1, which were approved by the Federal Energy Regulatory Commission (FERC).

### Recommendations

Participants also discussed the weaknesses of the control systems security process. Recommendations to the ESCSWG to improve the Energy Roadmap and public-private partnership include:

- Increase Energy Roadmap granularity to guide standards development, such as NERC CIP and Smart Grid interoperability standards.
- Incorporate risk mitigation measures into the Energy Roadmap for securing the Smart Grid.
- Ramp up outreach efforts to the oil and natural gas sectors and include more measures in the Energy Roadmap to address their needs.
- Increase engagement with smaller utilities.
- Make information sharing an Energy Roadmap priority and provide actionable steps for overcoming trust issues and sharing info directly with other utilities.
- Address skill loss from an aging workforce: increase training, invest in developing employee expertise, encourage staff to work with vendors.

- Create new incentives to help utilities make capital investments in infrastructure upgrades.
- Recognize companies performing Roadmap-aligned projects or implementing technologies developed.
- Develop a sound business case to help executives and vendors justify security improvements.

## Recognition

When it was published in 2006, the Energy Roadmap broke new ground on how the energy sector worked with government to reduce cyber risks. Several organizations recognized the value of the Roadmap and endorsed it.

- In June 2006, the North American Electric Reliability Council’s (NERC) Critical Infrastructure Protection Committee unanimously voted to endorse and support Roadmap implementation.
- In 2007, the National Infrastructure Advisory Council (NIAC) hailed this Roadmap as a model and recommended that all sectors develop a similar roadmap.
- In 2008, the Water Sector Coordinating Council prepared a control systems roadmap based on the results and structure of the Energy Roadmap. Other critical infrastructure sectors are also developing roadmaps to secure their control systems.

**Table 1. Energy Sector Perspectives on the Impacts of the Roadmap**

Roadmap Impact on Public-Private Partnership	Individual Perspectives
<b>Vehicle to Drive Action by Public and Private Partners</b>	<p>“The Roadmap spurred us to really encourage vendors to use the [National SCADA] Test Bed.” It helped vendors figure out what they should be doing to understand security and begin assessing their existing security posture and that of their users to find areas of improvement. “Some vendors have found security as a source of revenue.”  - Bill Winters, Arizona Public Service</p> <p>“[The Roadmap] helped me to understand that, ‘Look, guys, we’re not alone here. This is an industry-wide thing—here’s a bunch of experts, and they got together and looked and recognized [these issues.]’”  -Anonymous</p> <p>“Largely it’s the catalyst that spurred everything: it took away the silos that exist in any company, and enabled us to work toward common goals. The Roadmap got us talking together, and [made the] jump across government and industry.”  - Tom Glock, Arizona Public Service</p> <p>“Decision makers need to hear a credible and consistent message about securing control systems and they will listen.”  -Jim Mlachnik, Southwest Gas</p> <p>“The Roadmap showed that it was not just techies and operators. [We could say] ‘Look at what industry and government laid out together’—and we could use this to encourage APS management to make the investment.”  - Scott Bordenkircher, Arizona Public Service</p>

<b>Roadmap Impact on Public-Private Partnership</b>	<b>Individual Perspectives</b>
	<p>“[The Roadmap] is a collaborative tool helping to bring industries together to address today’s and tomorrow’s security issues, and it will provide an initial step for an organization that is a little behind in considering security.” - Madhava Sushilendra, Electric Power Research Institute</p> <p>“The Roadmap has been applied very well by DOE in their NSTB programs and other R&amp;D programs by providing clarity and an emphasis of practical deliverables in the commercial and asset owner spaces.” - Dale Peterson, Digital Bond</p> <p>“I see a tremendous value for this in that it provides a place for industry and all the vendors that are involved in this to get on the same page about what our priorities are, and what that does is it helps to ensure that we are working toward a common set of objectives rather than working at cross purposes.” -Laura Hussey, Edison Electric Institute</p>
<b>Guidance toward Common Vision and Goals</b>	<p>“I still believe it is probably the best guidance out there for the energy sector for what they need to do to secure their systems. I really don’t believe that there is anything that replaces that document.” -Frederick Curry, Energen Corporation</p> <p>“The Roadmap offers a ‘cookbook’ kind of approach that helps lay out for people the sequence of steps to help them formulate a better individual plan.” - Laura Hussey, Edison Electric Institute</p> <p>“I think what the Roadmap has successfully done is organize the thoughts. It’s easy to say ‘here we are.’ It’s not quite as easy to say ‘where do I want to be?’ So the hard part is to say ‘OK, how do I get from where I am today to where I want to be tomorrow?’ That’s where the planning and the guidance that the Roadmap has brought to the industry [comes in].” - Rhett Smith, Schweitzer Engineering Laboratories</p> <p>“In addition to the long-term view the Roadmap provides to organizations like Digital Bond and the R&amp;D community, its focus on end-user value and functionality are its greatest assets.” -Dale Peterson, Digital Bond</p> <p>“I think it’s a good reference for framing communications and conversations in general, of what’s going on in industry.... It is just as relevant and as valuable today, and probably more so, and will continue to be down the road.” -Bob Mathews, Pacific Gas &amp; Electric Company</p> <p>While the 10-year end states will shift before the 10 years is up, “I would say that looking at the 5-10-year set of milestones has probably been more effective, because a lot of those things that were in that timeframe are things that we are bringing out to the market now.” -Paul Skare, Siemens</p> <p>“It’s a whirlwind pace in DC, and that’s why the Roadmap is critical. With everything going on, we need to not lose sight of the industry needs and the good work that is being done.” - Sharla Artz, Schweitzer Engineering Laboratories</p>

Roadmap Impact on Public-Private Partnership	Individual Perspectives
<p><b>Accelerated Product Development to Produce Tangible Results</b></p>	<p>“Basically the whole security landscape has gotten better as far as what is available... the fact of the matter is that there is a lot out there to help organizations that wasn’t there just three years ago.”  <p style="text-align: right;">-Frederick Curry, Energen Corporation</p> <p>“The reason we were able to do Bandolier was because we got funding for it—it was something we <i>wanted</i> to do. The reason we got funding for it was because the Roadmap had a specific requirement that Bandolier addressed.”  <p style="text-align: right;">- Dale Peterson, Digital Bond</p> <p>“We incorporated the vision, the milestones, and the goals into our product development. The Roadmap has driven SEL design and helped add \$5 million in research efforts.”  <p style="text-align: right;">- Sharla Artz, Schweitzer Engineering Laboratories</p> <p>“Having written need statements—the challenges and all that—provided something we could bring to the researchers and say ‘Here’s industry telling us what their needs are.’”  <p style="text-align: right;">-Ron Trelue, Trelue Consulting</p> <p>“What it has helped the most is framing the existing initiative to be able to point at the specific tasks. It brought into focus a little more clearly some of the other existing DOE-initiated programs and it allowed you to see both where things overlapped and where things fit together in the future, which didn’t exist prior to that from my point of view.”  <p style="text-align: right;">-Paul Skare, Siemens</p> <p>“When I was crafting projects to address those issues with respect to the Secure DNP3 SCADA communication protocol, ieRoadmap was available. After reviewing it, it was apparent that the deliverable of the project readily fit into the Roadmap’s goal for 2010, and helped me in promoting the work in the industry. [The Roadmap] provided validation, and also provided me with the opportunity for collaboration.”  <p style="text-align: right;">- Madhava Sushilendra, Electric Power Research Institute</p> </p></p></p></p></p></p>
<p><b>Moving Forward</b></p>	<p>While not prescriptive or a standards document, the Roadmap could be developed to guide standards just as it currently guides R&amp;D. “I think what the Roadmap does for us as an industry potentially in the standards development world is set out what our core principles are, so that when we are writing standards we say, ‘In the big picture scheme of things, what we are trying to accomplish is this. How does this get us there?’ All the standards development processes could be working toward a common set of objectives so that we don’t end up again with standards that are at cross purposes.”  <p style="text-align: right;">- Laura Hussey, Edison Electric Institute</p> <p>“It’s not about the current Roadmap, it’s about what I think the roadmap could evolve into, which I understand is the whole purpose of this project: take it to the next level. Fix what was wrong with it and put in things that maybe we didn’t need before, things we didn’t realize we needed five years ago.”  <p style="text-align: right;">- Scott Mix, North American Electric Reliability Corporation</p> </p></p>

**Table 2. Roadmap Partnership Analysis Participants**

**Asset owners – Electric**

**Scott Bordenkircher**

*IS Account Manager*

*Arizona Public Service*

Bordenkircher is vice president of the Siemens EMA Customer Association (SECA).

**Tom Glock**

*Director of Power Operations*

*Arizona Public Service*

Glock was an original Roadmap contributor, and is responsible for his utility's transmission and distribution operations. He is vice chair of the NERC Critical Infrastructure Protection Committee.

**Bill Winters**

*Senior System Consultant*

*Arizona Public Service*

Winters is a member of the CIPC Cyber Standards Review Drafting Team and an associate of the NERC Control Systems Security Working Group.

**Bob Mathews**

*Pacific Gas & Electric Company*

Mathews was an original Roadmap contributor, and is a member of the NERC Critical Infrastructure Protection Committee and chair of the WECC Critical Infrastructure and Information Management Subcommittee.

**Asset owners – Oil and Natural Gas**

**Frederick Curry**

*Director, IT Risk Management*

*Energen Corporation*

Curry was an original Roadmap contributor, and is a member of the American Gas Association (AGA) SCADA Security Subcommittee. He is responsible for IT risk management, including data security, user provisioning, disaster recovery, software quality assurance, data privacy, and compliance.

**Jim Mlachnik**

*Supervisor of SCADA Systems*

*Southwest Gas Corporation*

Mlachnik was an original Roadmap contributor.

**Commercial Entities**

**Sharla Artz**

*Director of Security and Energy Policy*

*Schweitzer Engineering Laboratories (SEL)*

Artz establishes and maintains close working relationships with government officials, contributes knowledgeable insight for sound public policy decision-making, and advocates on technology and business-related issues.

**Dale Peterson**

*Founder and Director*

*Digital Bond*

Peterson is currently leading the Bandolier project, which is developing

a set of best practice audit files for numerous vendor systems to compare against a utility's control system configuration. Peterson's research focus is on adding SCADA intelligence to IT security solutions, and he contributes to the ieRoadmap.

**Rhett Smith**

*Development Manager*

*Schweitzer Engineering Laboratories (SEL)*

Schweitzer participated in the original drafting of the Roadmap, and Smith is currently leading the DOE-funded Hallmark project, which is commercializing the Secure SCADA Communications Protocol to ensure valid device-to-device communication.

**Paul Skare**

*Director of Security and Deployment for Energy Automation and Power Distribution*

*Siemens*

Skare was an original Roadmap contributor, and has helped Siemens partner with the National SCADA Test Bed.

**Researchers**

**Madhava Sushilendra**

*Senior Project Manager, Power Delivery and Utilization*

*Electric Power Research Institute (EPRI)*

Sushilendra focuses on the development of secure energy management systems, distribution management systems, generation, and end-user applications and is actively involved in technical research activities for IntelliGrid, AMI-SEC and Smart Grid demonstration activities. He contributes to the ieRoadmap.

**Ron Trelue**

*Trelue Consulting*

Trelue is an advisor to the Institute for Information Infrastructure Protection (I3P) Survivability and Recovery of Process Control Systems project research team. Ron continues to be involved in Energy Roadmap activity and is responsible for maintaining updated information about the I3P PCS project tools on the ieRoadmap website. Ron was managing several efforts in control system security at Sandia National Laboratories prior to his retirement in 2006.

**Industry Groups**

**Laura Hussey**

*Manager of Security, Infrastructure & Operations*

*Edison Electric Institute (EEI)*

Hussey staffs the EEI Security Committee and is an ex officio member of the Electric Sector Coordinating Council.

**Scott Mix**

*Manager of Infrastructure Security*

*North American Electric Reliability Corporation (NERC)*

Mix has worked with NERC CIP standards development and speaks to industry on CIP compliance issues. He is a founding member and NERC Staff Facilitator of the NERC Control Systems Security Working Group.

**Two Anonymous Participants**



