PNM/EPRI Smart Grid Demonstration

**High-Penetration Photovoltaics
through Grid Automation, Energy Storage
and Demand Response**

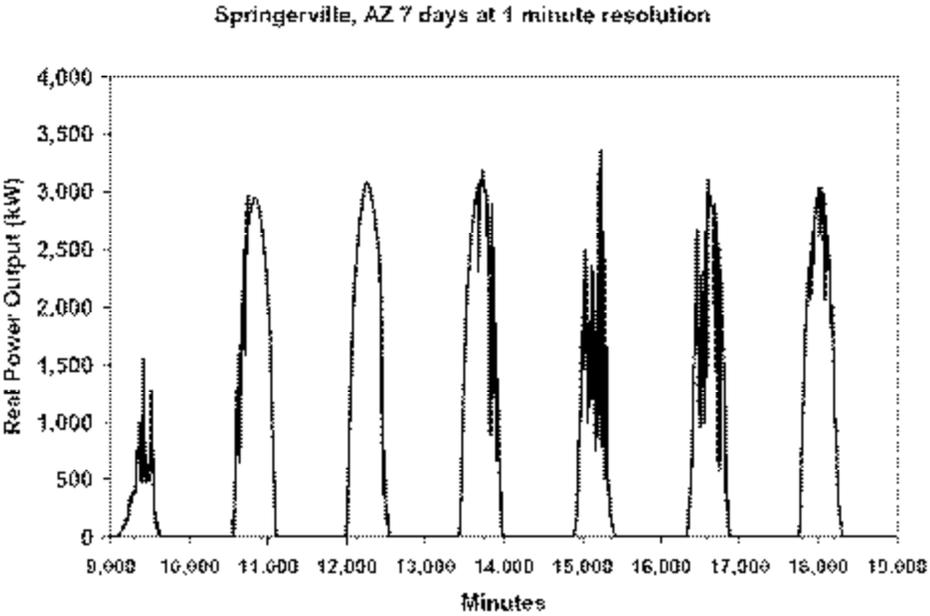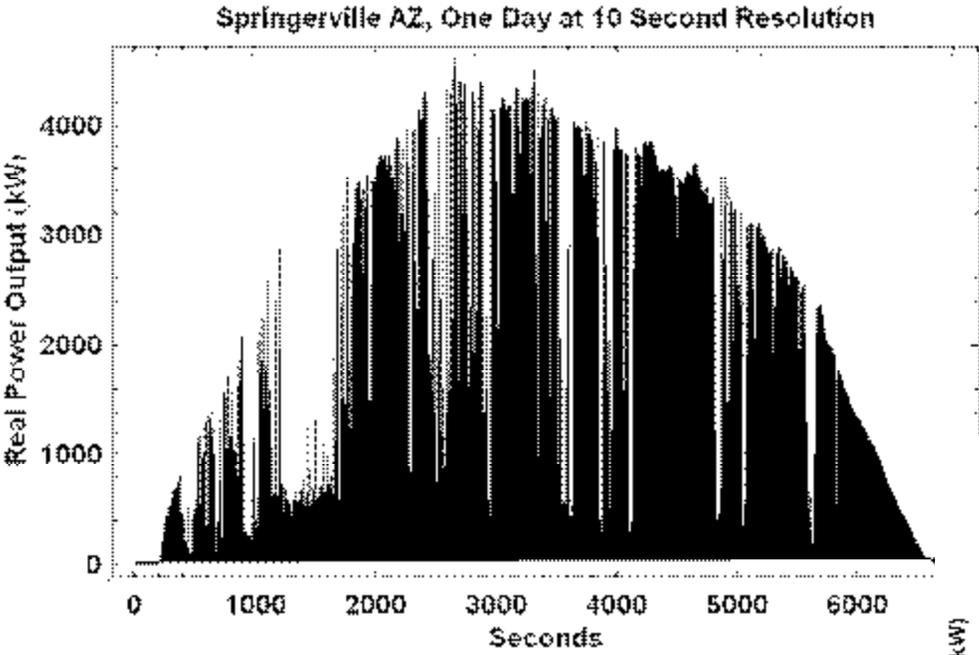*Jon Hawkins, Steve Willard PNM*

Feb 3, 2009

Overview

➢ Project Description

➢ Short Term Schedule

➢ Responsibilities

➢ Funding Initiatives/Mechanisms

➢ Associated projects

➢ Short Term Issues

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PNM Project Objectives

- Data and results will serve to quantify and better define requirements needed to create firm renewable resources

- Results will directly support a nationwide effort to develop the next-generation utility system to further the understanding of critical integration technologies and standards for renewables and energy efficiency

- Target a minimum of 15 percent peak-load reduction at a specific feeder through a combination of substation-sited and residential PV and storage

- Investigate opportunities for further load reduction through use of smart appliances and home area network (HAN) control via advanced metering infrastructure (AMI)

- Reduce greenhouse gas emission through expanded use of renewables

- Uses EPRI's IntelliGrid Architecture as a basis for developing use cases to drive business case development and technology selection
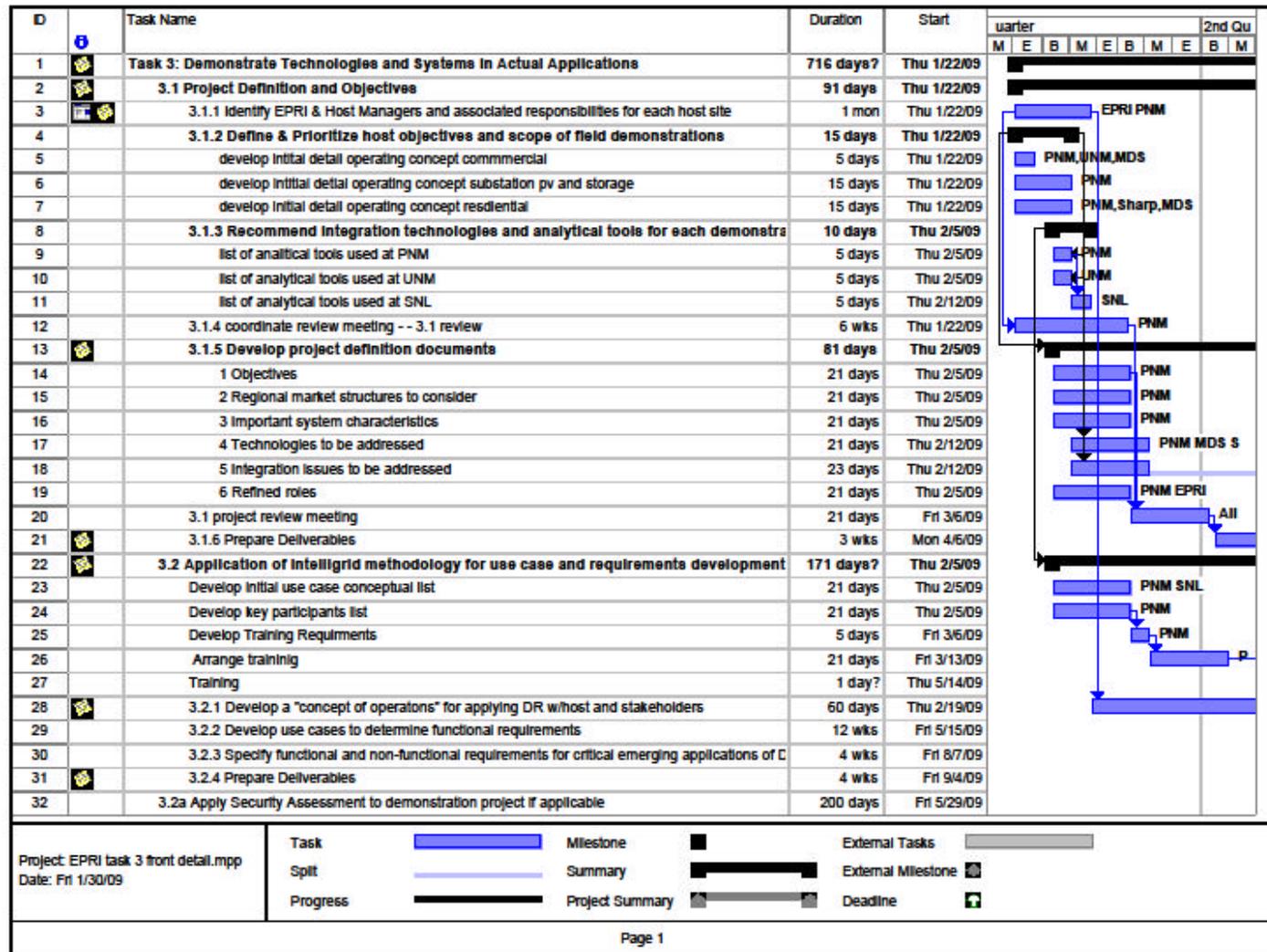
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Project Driver

Springerville AZ, One Day at 10 Second Resolution

Springerville, AZ 7 days at 1 minute resolution

PNM Project Features – What Distinguishes This Project?

- ➢ Pragmatic approach divides project into
  - ▪ Quickly achievable step (substation based PV and storage),
  - ▪ Second, more difficult step that requires standards development and implementation of the smart grid from the substation down to the customer.
- ➢ Makes use of a Greenfield Development Model focused on renewables and efficient energy use (Mesa del Sol)
- ➢ Continues development of Sandia National Labs (SNL)/PNM Smart Inverter research
- ➢ Makes use of SNL demonstration lab and focused expertise to help model and prototype technologies prior to implementation
- ➢ Makes use of latest analytical software tool and analysis developed by EPRI
- ➢ Defines requirements to create a firm peaking PV/DG resource
- ➢ Forms collaborations with leading industry players based on front end technology mapping screened against customer and utility requirements

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Short Term Schedule

ID		Task Name	Duration	Start	
1	🖼	**Task 3: Demonstrate Technologies and Systems in Actual Applications**	716 days?	Thu 1/22/09	
2	🖼	**3.1 Project Definition and Objectives**	91 days	Thu 1/22/09	
3	🖼	3.1.1 Identify EPRI & Host Managers and associated responsibilities for each host site	1 mon	Thu 1/22/09	EPRI PNM
4		**3.1.2 Define & Prioritize host objectives and scope of field demonstrations**	15 days	Thu 1/22/09	
5		develop initial detail operating concept commmercial	5 days	Thu 1/22/09	PNM,UNM,MDS
6		develop initial detial operating concept substation pv and storage	15 days	Thu 1/22/09	PNM
7		develop initial detail operating concept resdiential	15 days	Thu 1/22/09	PNM,Sharp,MDS
8		**3.1.3 Recommend integration technologies and analytical tools for each demonstra**	10 days	Thu 2/5/09	
9		list of analitical tools used at PNM	5 days	Thu 2/5/09	PNM
10		list of analytical tools used at UNM	5 days	Thu 2/5/09	UNM
11		list of analytical tools used at SNL	5 days	Thu 2/12/09	SNL
12		3.1.4 coordinate review meeting - - 3.1 review	6 wks	Thu 1/22/09	PNM
13	🖼	**3.1.5 Develop project definition documents**	81 days	Thu 2/5/09	
14		1 Objectives	21 days	Thu 2/5/09	PNM
15		2 Regional market structures to consider	21 days	Thu 2/5/09	PNM
16		3 Important system characteristics	21 days	Thu 2/5/09	PNM
17		4 Technologies to be addressed	21 days	Thu 2/12/09	PNM MDS S
18		5 Integration issues to be addressed	23 days	Thu 2/12/09	
19		6 Refined roles	21 days	Thu 2/5/09	PNM EPRI
20		3.1 project review meeting	21 days	Fri 3/6/09	All
21	🖼	3.1.6 Prepare Deliverables	3 wks	Mon 4/6/09	
22	🖼	**3.2 Application of intelligrid methodology for use case and requirements development**	171 days?	Thu 2/5/09	
23		Develop initial use case conceptual list	21 days	Thu 2/5/09	PNM SNL
24		Develop key participants list	21 days	Thu 2/5/09	PNM
25		Develop Training Requirments	5 days	Fri 3/6/09	PNM
26		Arrange traininig	21 days	Fri 3/13/09	P
27		Training	1 day?	Thu 5/14/09	
28	🖼	3.2.1 Develop a "concept of operatons" for applying DR w/host and stakeholders	60 days	Thu 2/19/09	
29		3.2.2 Develop use cases to determine functional requirements	12 wks	Fri 5/15/09	
30		3.2.3 Specify functional and non-functional requirements for critical emerging applications of D	4 wks	Fri 8/7/09	
31	🖼	3.2.4 Prepare Deliverables	4 wks	Fri 9/4/09	
32		3.2a Apply Security Assessment to demonstration project if applicable	200 days	Fri 5/29/09	

Task	▬	Milestone	■
Split	....	Summary	▬▬
Progress	▬▬	Project Summary	
		External Tasks	
		External Milestone	
		Deadline	

Project: EPRI task 3 front detail.mpp
Date: Fri 1/30/09

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Short Term Schedule

➤ Intelligrid Based Use Case Analysis will define the system architectures - envisioning

- Roughly define number and description of Use Cases
- ID internal players
- Arrange training with EPRI
- Conduct Workshops

➤ Create "Analytical Tool Kit"

- OpenDSS
- Other distribution modeling tools (from PNM and SNL)
- Commercial building modeling
- Residential load modeling

➤ Coordinate next Advisory Council Meeting

- Summer 09
- Tour of Sandia Labs DETL Facility
- Combine with EPRI Inverter Mftr Summit

➤ Contractual structure development

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Responsibility Matrix

Draft EPRI/PNM Smart Grid Project Responsibilities Matrix

Task_Name	Primary Proj	Research Le	Key Support	Minor Support
Smart Grid				
Task 1: Overall foundation work	EPRI			PNM
Task 2: Integration Technologies & Systems				
2.1 Develop architecture reference design for DR Integration	EPRI			PNM
2.2 Develop Information Exchange Model to support System Operations	EPRI			PNM
2.3 Develop Communication Interfaces and Control Algorithms for DR	EPRI		SNL	PNM
2.4 Develop Aggregation Methods and Tools	EPRI			PNM SNL
2.5 Develop DR Controller Requirements	EPRI		SNL	
2.6 Lab Trials of Common Critical Integration Technologies	EPRI		SNL	
Task 3: Demonstrate Technologies and Systems in Actual Applications				
3.1 Project Definition and Objectives	PNM	SNL UNM	EPRI MDS	
3.2 Application of Intelligrid methodology for use case and requirements developme	PNM	EPRI	EPRI	
3.2a Apply Security Assessment to demonstration project if applicable	PNM	EPRI	SNL	
3.3 Economic Analysis	PNM	SNL	EPRI	PNM
3.4 Candidate Technology Selection	PNM MDS	SNL UNM	EPRI SNL	
3.5 Laboratory Assessment of Technologies	SNL	SNL UNM	PNM EPRI	
3.6 Detailed Application Plan for Field Demonstrations	PNM	EPRI	ALL	
3.7 Field Data Collection and Assessment	SNL	SNL UNM	MDS PNM EPRI	

Alignment with Funding Initiatives

➢ State of NM Green Grid Initiative

- Bring significant Federal R&D investment to NM
- Develop new smart grid technologies that could lead to clean manufacturing of Green Grid components in NM
- Bring VC investment into NM to build out the first statewide Green Grid system in the U.S
- Current legislation

➢ City of Albuquerque/Federal Stimulus - EECBG Funding

- Parking structures with PV
- Moving to PHEV and Battery for firm peaking

➢ Other Federal Stimulus

- Latest EAC Report – Congressional Request -- Smart Grid Regional Demonstration Initiative and the Smart Grid Investment Matching Grant Program authorized under EISA 2007

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Alignment with Funding Initiatives

Fed Stimulus Funding Targets ($B)
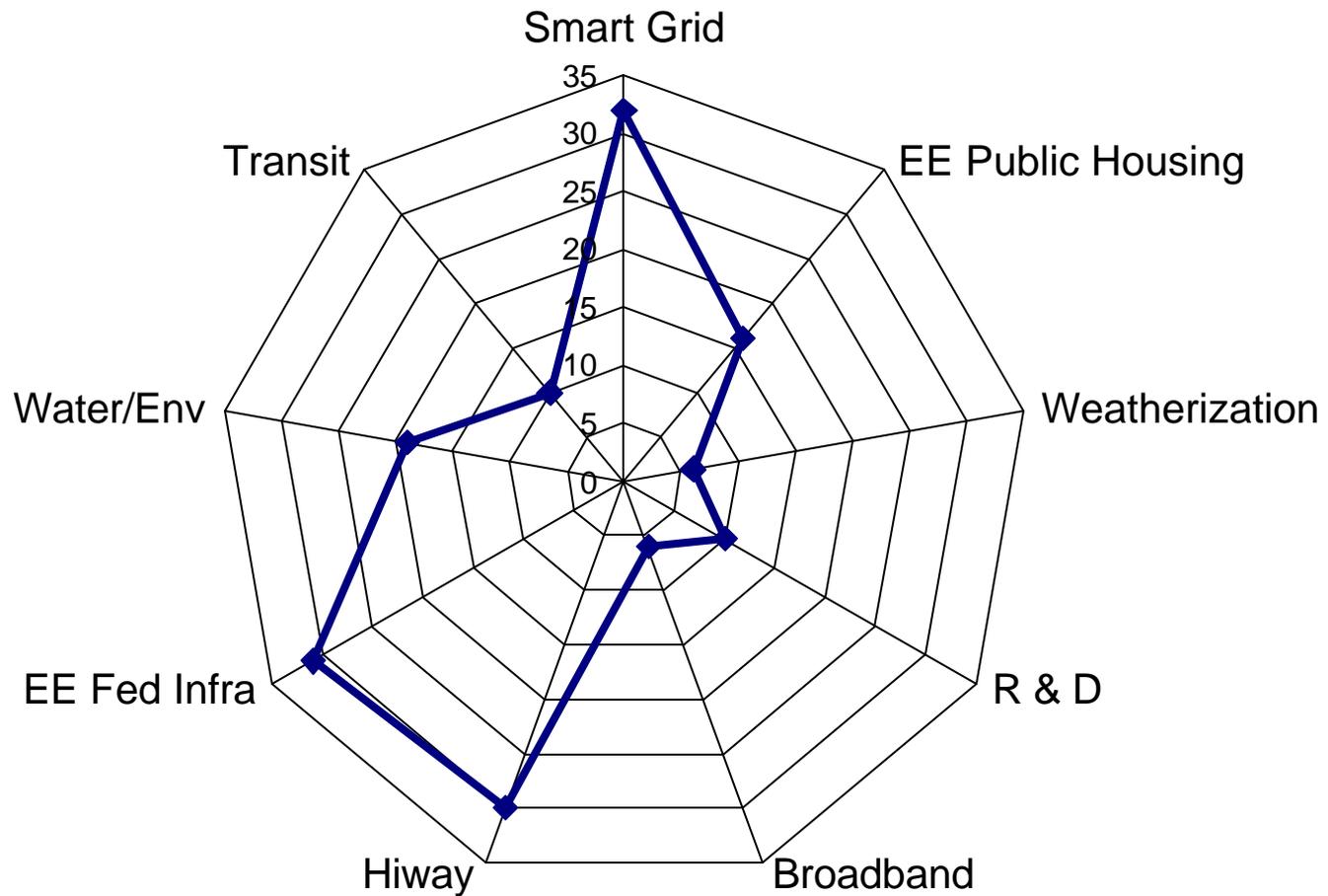
Associated Projects

- Zero Energy Solar Photovoltaic Housing Development (ZESPHD) – DOE Solar Showcase
  - Awarded by DOE in 2008
  - Tiger Team is being led by Sandia National Labs
  - Funds the study of up to 750 kW of Solar on the first 300 homes at Mesa Del Sol

- EPRI/PNM/SNL Supplemental
  - Distribution scale new tech battery with PV and external input signal
  - Shift PV output 2 hours based on external signal to inverter
  - Drafting test plan - Sandia Labs DETL Facility
  - Other interested parties
  - Funding will determine size/duration of test
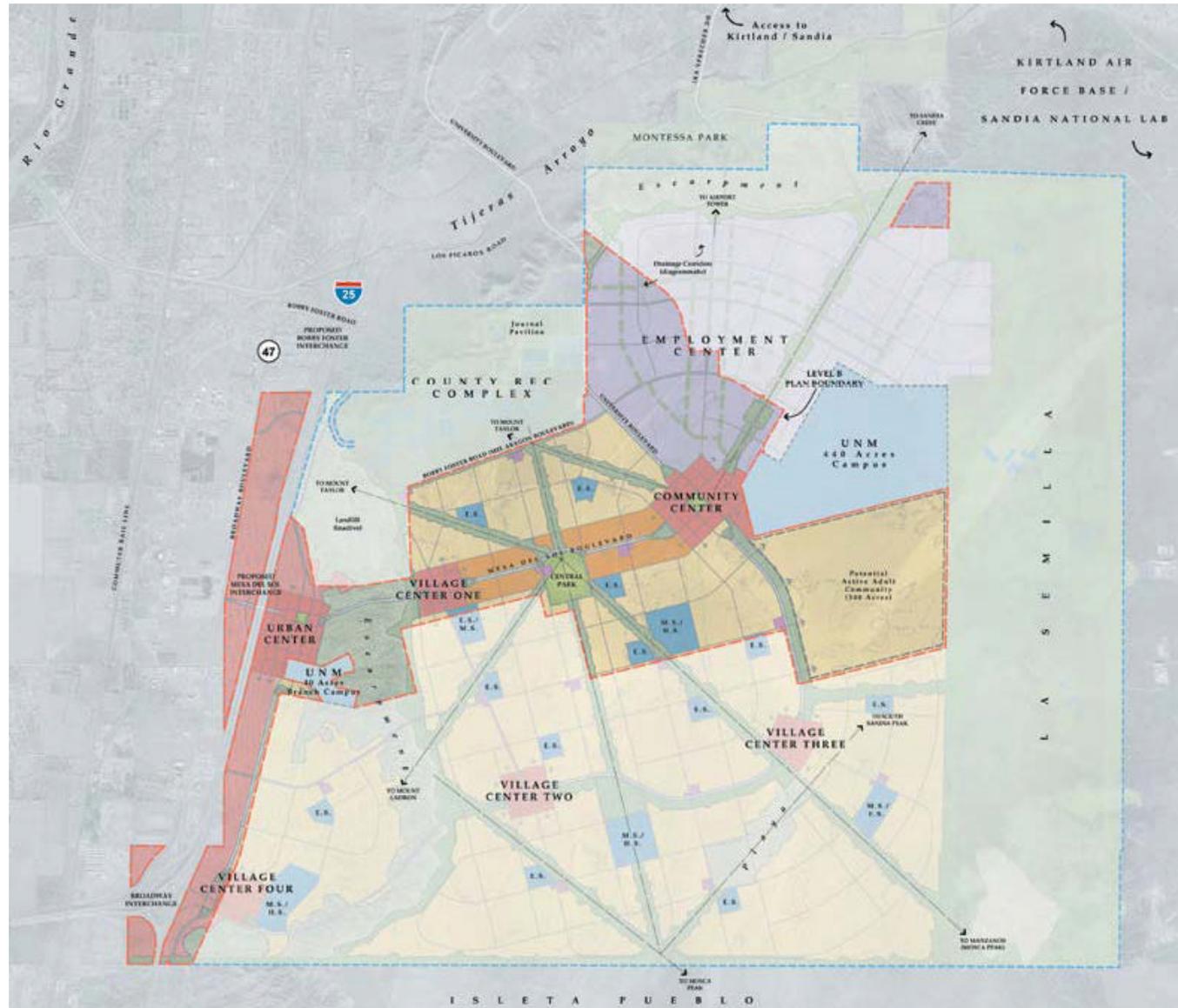
- DOE SEGIS & SEGIS-ES
  - Link through Sandia Labs

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Short Term Issues

- ➢ Definition of Smart Grid - Managing Political/Public Expectations

- ➢ Contract Structure

- ➢ Technology Management/Stimulus Package - "measure passed by the House Energy & Commerce Committee that allows only companies whose products use Internet-based communications to receive federal technology grants"
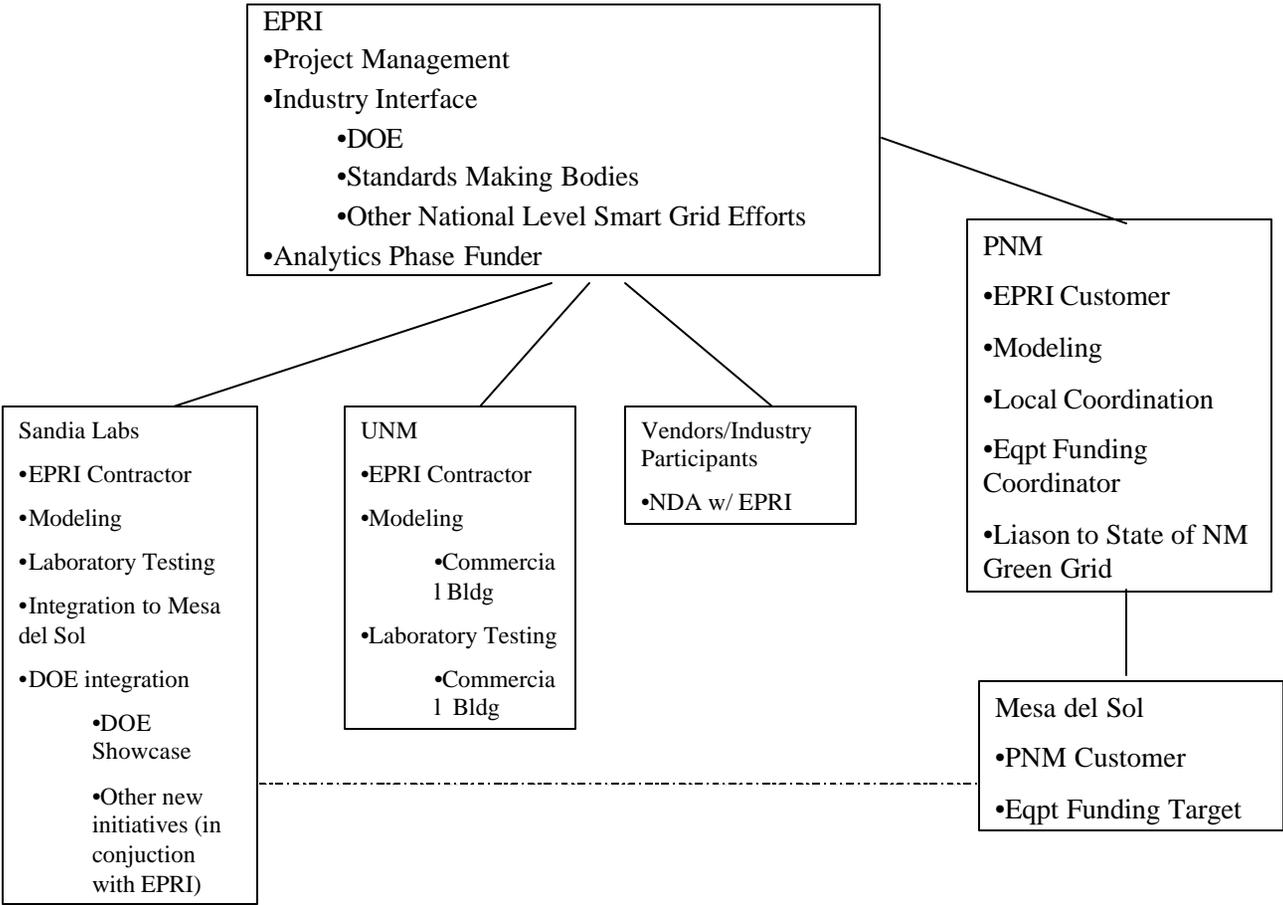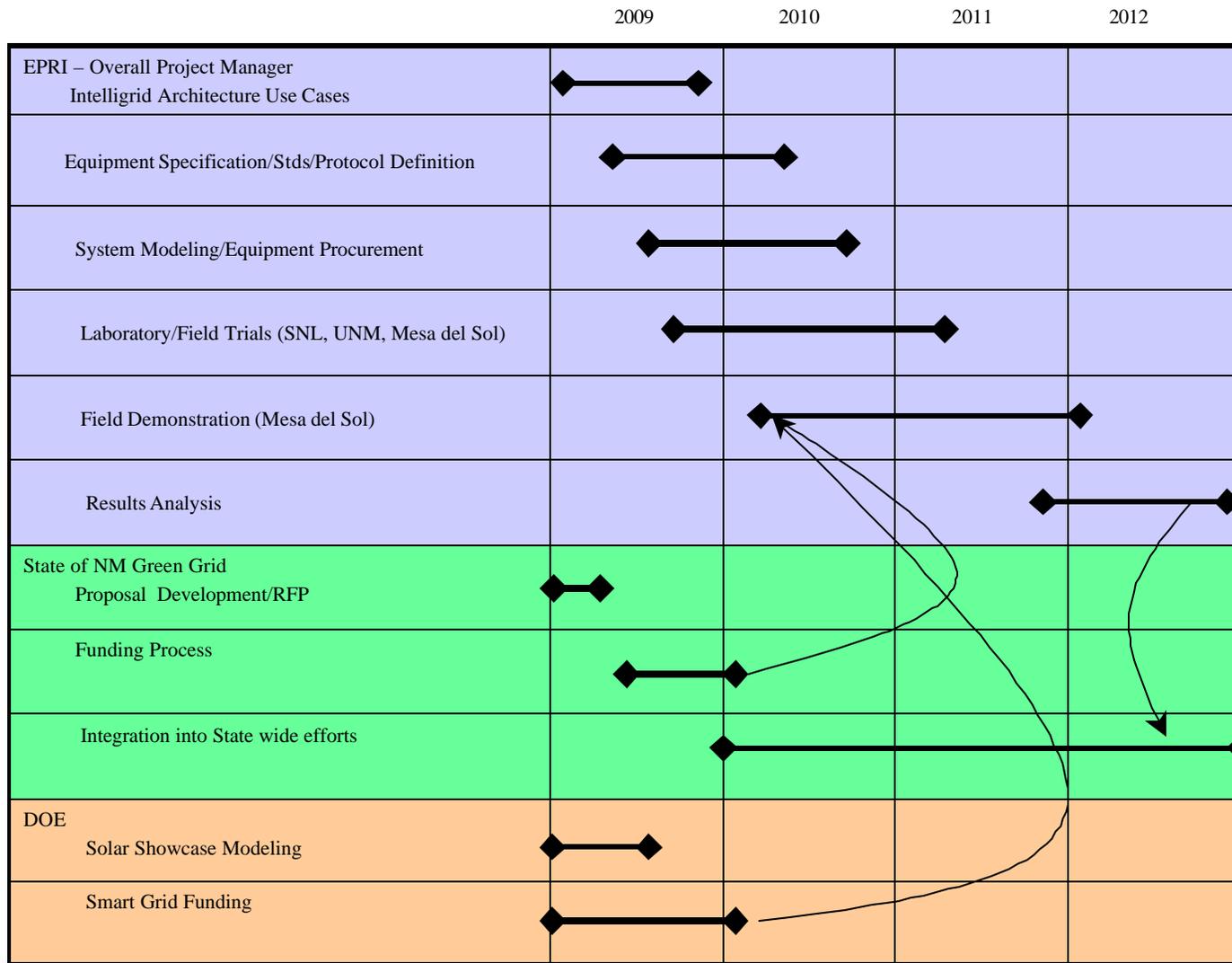
- ➢ Need to speak in a unified voice

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Supplements

Mesa del Sol Master Plan

Responsibilities Matrix

EPRI/PNM Smart Grid Project Management
Structure – 01 22 08

EPRI
- Project Management
- Industry Interface
  - DOE
  - Standards Making Bodies
  - Other National Level Smart Grid Efforts
- Analytics Phase Funder

PNM
- EPRI Customer
- Modeling
- Local Coordination
- Eqpt Funding Coordinator
- Liason to State of NM Green Grid

Sandia Labs
- EPRI Contractor
- Modeling
- Laboratory Testing
- Integration to Mesa del Sol
- DOE integration
  - DOE Showcase
  - Other new initiatives (in conjuction with EPRI)

UNM
- EPRI Contractor
- Modeling
  - Commercial Bldg
- Laboratory Testing
  - Commercial Bldg

Vendors/Industry Participants
- NDA w/ EPRI

Mesa del Sol
- PNM Customer
- Eqpt Funding Target

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Project Timeline Integrates with Other Funding Initiatives

|	2009	2010	2011	2012
EPRI – Overall Project Manager Intelligrid Architecture Use Cases	◆———◆			
Equipment Specification/Stds/Protocol Definition	◆——————◆			
System Modeling/Equipment Procurement	◆———————◆			
Laboratory/Field Trials (SNL, UNM, Mesa del Sol)	◆——————————◆			
Field Demonstration (Mesa del Sol)		◆——————————◆		
Results Analysis			◆————————◆	
State of NM Green Grid Proposal Development/RFP	◆—◆			
Funding Process	◆———◆			
Integration into State wide efforts		◆——————————————◆		
DOE Solar Showcase Modeling	◆———◆			
Smart Grid Funding	◆———◆			

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Distributed Energy Technologies Laboratory is the centerpiece of Sandia's efforts

- **Configurable testbed where new hardware integrations can be tested and optimized**
- **Simulation of precise daily load profiles to represent several different microgrids:**
  - **A single residence (with multiple loads)**
  - **Multiple residences**
  - **One or more commercial buildings**
  - **A mix of these situations (non-balanced loads)**
- **Addition of generators and motor loads to the microgrid to simulate real life situations**

Sandia's Distributed Energy Technologies Laboratory

Sandia National Laboratories

DETL is characterizing next-generation Solar Energy Grid Integrated Systems
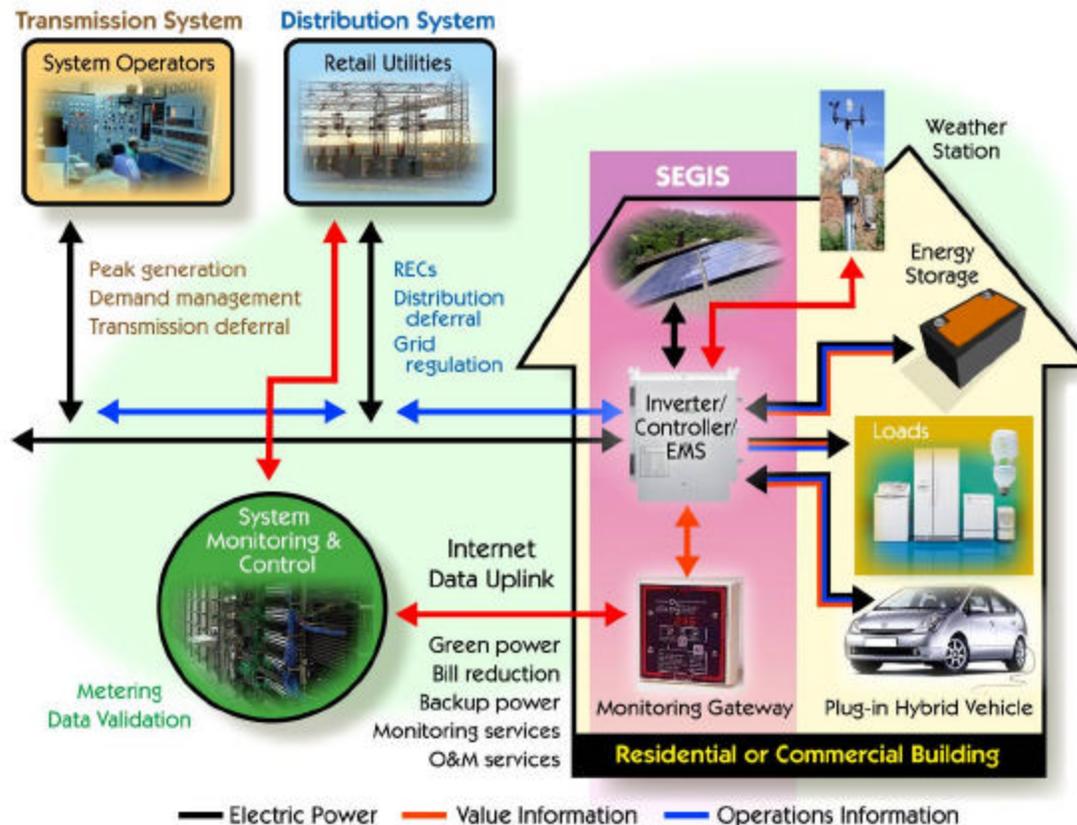
SEGIS is first step to Enabling PV for Higher Penetration into "Smart" Utility Grids, Using Advanced Power Handling, Energy Storage/Management, and System Supervision