



# RealEnergy, Inc.

**Development, Demonstration, and Field Testing of Enterprise-Wide  
Distributed Generation Energy Management System  
for**



**National Renewable Energy Laboratory**

*Primary Investigator: Steven Greenberg  
NREL Technical Monitor: Holly Thomas*

*11/30/01*



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## **Introduction**

### **RealEnergy**

RealEnergy is a California based company owned by equity investors from across the state, including CalPERS. The company delivers onsite power to the commercial real estate market. RealEnergy has contracts in place for nearly 10 million square feet of commercial real estate, with 1.7 MW operating and an additional 20 MW coming on line by April of 2002. The firm also controls one of the nation's largest privately owned solar systems.

RealEnergy owns and operates the distributed generation (DG) systems it installs on a client's site for fifteen years. All of these systems use combined heat and power (CHP) technology in order to minimize the environmental impact of generation, to supply the maximum energy and financial savings to the customers, while providing relief to the electricity grid.

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## Introduction

### NREL Subcontract

This subcontract is broken down into two components.

1. Define a state-of-the-art system for control of a distributed network of generation assets. Taking into account the current regulatory and business climate facing the network. RealEnergy has used a three-step approach to complete this component:
    - a. Develop command and control mechanisms for the economic dispatch of energy systems in the California market
    - b. Test the mechanisms developed
    - c. Integrate the processes into the management, control and dispatch of operating generation resources.
  2. Share insights and catalogue various barriers to market entry and interconnection that the company has faced while trying to bring these first group of projects on line.
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## Gant Chart – Grant Progress

### Proposed Project Timeline

Months	1	2	3	4	5	6	7	8	9	10	11	12	13
Quarter	1	1	1	2	2	2	3	3	3	4	4	4	
Date	May	June	July	Aug	Sept	Oct	Nov.	Dec	Jan	Feb	Mar	Apr	
Task 1													
Task 2													
Task 3													
Task 4													
Task 5													
Task 6													
Task 7													
Monthly Reports	15 <sup>th</sup>												
Draft Annual Report												15 <sup>th</sup>	
Final-Annual Report													

### Insights –

All of RealEnergy’s DG projects experienced significant construction delays, postponing the startup and commissioning of most systems by over six months. Without equipment operating in the field, RealEnergy faced serious difficulties in properly testing the necessary hardware and software components that would form the backbone for our command and control algorithms monitoring the network and providing billing information. These construction and permitting problems have been resolved but they impacted RealEnergy’s progress toward the timely completion of Tasks 1 and 2 as well as four of our contracted deliverables. However, with seven individual systems within RealEnergy’s distributed energy network on line by November and the monitoring software and hardware selected and being optimized, the company now has the physical infrastructure and communication systems that will allow move ahead on the NREL contract.



## Gant Chart – Grant Progress (cont.)

### Adjusted Project Timeline

Months	1	2	3	4	5	6	7	8	9	10	11	12	13
Quarter	1	1	1	2	2	2	3	3	3	4	4	4	
Date	May	June	July	Aug	Sept	Oct	Nov.	Dec	Jan	Feb	Mar	Apr	May
Task 1	Dark Blue	Dark Blue	Light Blue										
Task 2	Dark Blue	Dark Blue	Dark Blue	Dark Blue	Dark Blue	Dark Blue	Light Blue	Light Blue	Light Blue				
Task 3			Dark Blue	Light Blue									
Task 4				Dark Blue									
Task 5					Dark Blue	Dark Blue	Dark Blue						
Task 6							Dark Blue	Dark Blue	Dark Blue	Dark Blue	Dark Blue	Dark Blue	
Task 7													
Monthly Reports	Dark Blue	Dark Blue	Dark Blue	Dark Blue	Dark Blue	Dark Blue	Dark Blue	Dark Blue	Dark Blue	Dark Blue	Dark Blue	Dark Blue	Dark Blue
Draft Annual Report												Dark Blue	
Final-Annual Report												Dark Blue	Dark Blue

*Comments –*

The light blue sections reflect RealEnergy’s anticipated time frame for task completion.



## Status – Deliverables

### Base Year

#	Deliverable	Due Date	Status
D-1.1	Monthly Status Reports (October)	Monthly	Completed
D-1.2	Participate and present results at 4 Quarterly Review Meetings (October)	Quarterly	Completed
D-1.3	Draft Annual Technical Progress Report	2/15/02	-
D-1.4	Final Annual Technical Progress Report	3/28/02	-
D-1.5	Report on progress and definition for info for database <b>(TASK 1)</b>	12/31/01	Drafting of the report has begun
D-1.6	Deliver flow chart, list, and descriptions of codes and algorithms <b>(TASK 2)</b>	8/31/01	1/9/02
D-1.7	Deliver report defining the codes and their functionality <b>(TASK 3)</b>	9/30/01	1/9/02
D-1.8	Test report on platform and modeling prior to deployment <b>(TASK 4)</b>	10/31/01	1/9/02
D-1.9	Report on results and analysis of testing <b>(TASK 5)</b>	11/30/01	1/9/02
D-1.10	Final Report <b>(TASK 5)</b>	2/28/02	-
D-1.11	Publicly accessible website presenting actual operational information <b>(TASK 6)</b>	6/15/01	Late. To be up by 12/20/01
D-1.12	Complete update to website to correlate with current C&C system info <b>(TASK 7)</b>	2/28/02	-



### Tasks

#### *Task 1 – Define Information and Communication Requirements*

##### ***Work Accomplished to Date –***

- Metering / Monitoring Definition of Requirements
- Metering / Monitoring software and hardware platforms have been selected.
- Platform Validation
- Communication lines installed and now being upgraded to DSL.
- Initial data parameters defined.
- Additional Metering / Monitoring Integrations
- Proposed Solution for Building Control Systems Integrations
- Only a final report needs to be generated (early January 2002).

##### ***Insights –***

Additional integration requirements pushed back the selection of data inputs, to June. The integration requirements involved the testing of gateways, metering, and controlling systems from multiple vendors. This process continued through mid-August. The platform's optimization took another month and continues on a site-by-site basis in all cases,.

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### Tasks

#### *Task 1 – Define Information and Communication Requirements*

##### ***Hardware and Software–***

- Extensive testing and analysis has resulted in our Phase 1 Technology Solution. This selection was based on a combination of parameters
    - Open Communications Platform
    - Expandability
    - Flexibility
    - Cost
  - RealEnergy selected the ModBus Communications Protocol. Widely used for years in the HVAC / BCS world, it offers a compelling method of communicating with our network. This will ultimately lead to Next Generation Devices that will enhance and reduce future cost.
  - The ModBus Communications Protocol lends itself to the seamless integration of our DG systems with the existing Building Control Systems. These existing systems are comprised of many different manufacturers including, Honeywell, Siemens, Johnson, Andover and Trane, but they all have the ability to speak to the ModBus protocol.
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## **Status – Base Year**

### **Task 1**

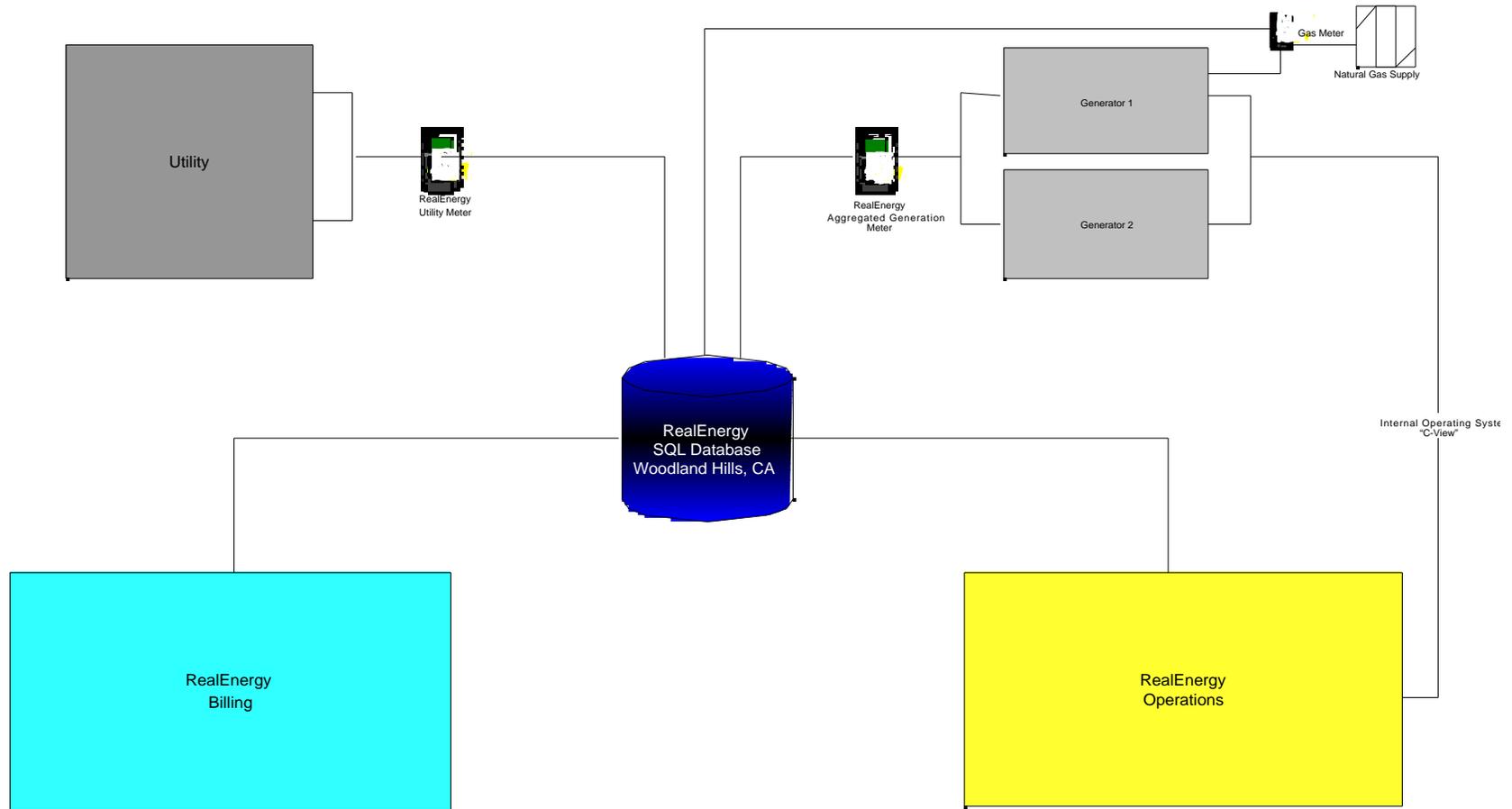
*Task 1 – Define Information and Communication Requirements*

**Hardware and Software Selected –**

- Power Measurement ION 7500 Utility Meter
    - 8 analog ports
    - 8 digital ports
    - RS485 Comm port
    - ModBus Protocol
    - Modem or Ethernet configurations
    - Veris CT's
  - **Software Specific**
    - Microsoft Window 2000 Advanced Server
    - Microsoft SQL 7.0 Database
    - Vista 3.0 information portal
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# Typical Metering/Monitoring Installation



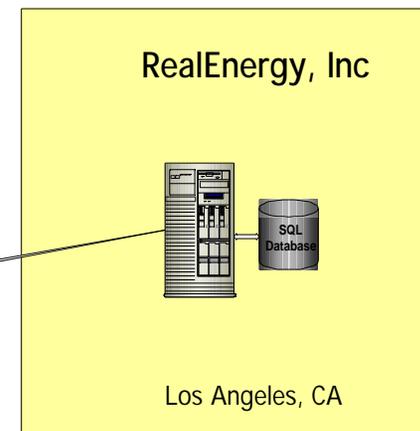
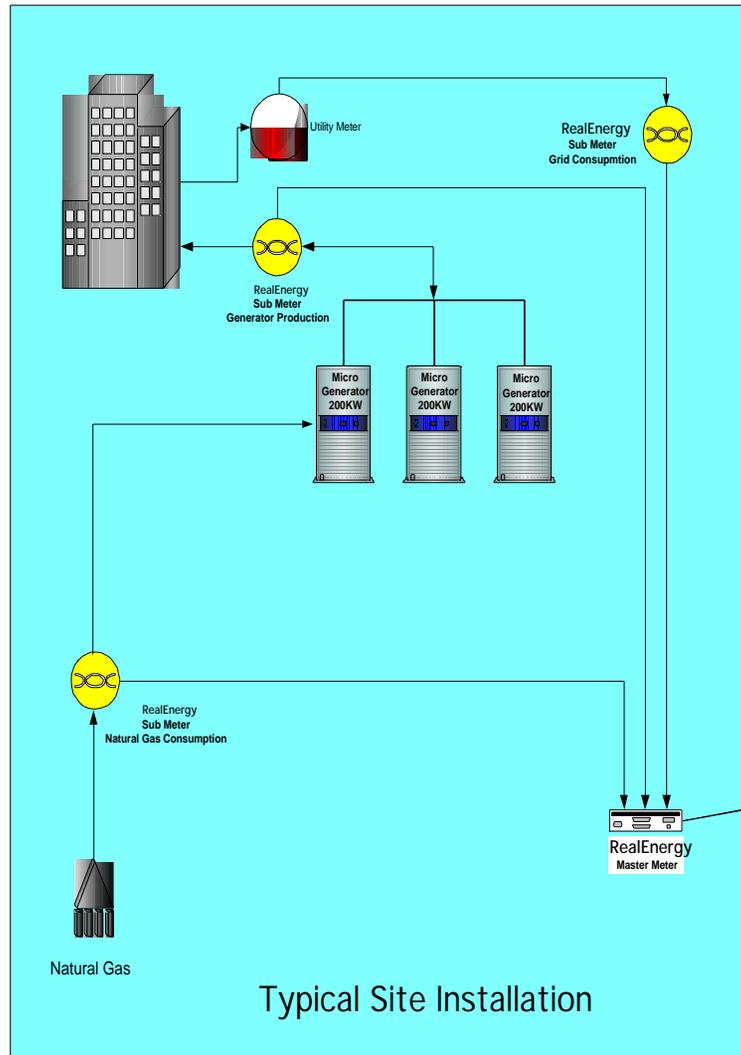


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# Gen-Net

RealEnergy, Inc  
Gen-Net<sup>®</sup>

Multi-Node Generation Network  
Single Site Configuration

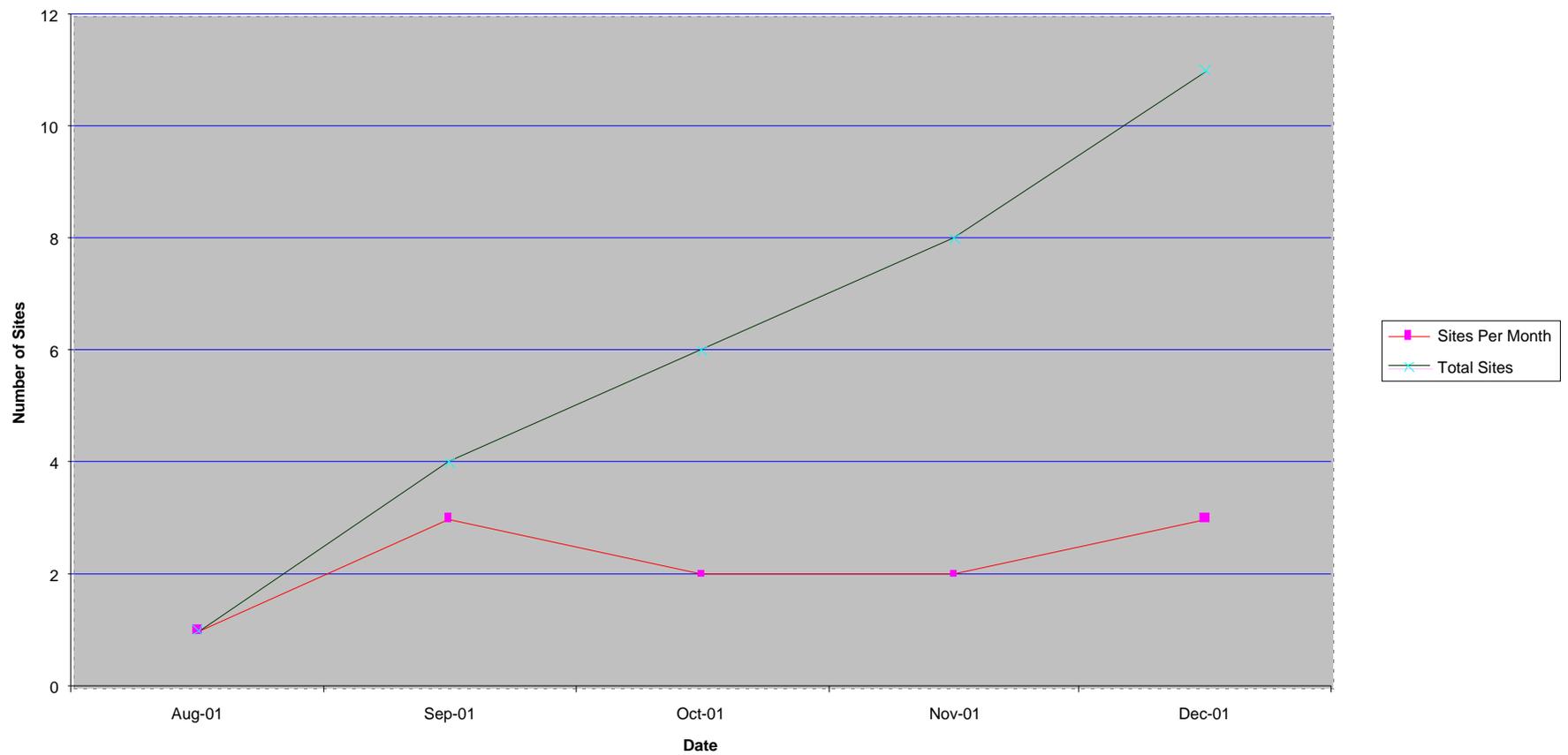




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**Gen-Net**

# Information Technology Site Integrations





- **Generation Network (Gen-Net)**
    - Primary Responsibilities
      - Integration
      - **Communications**
      - **Metering**
      - **Monitoring**
      - **Billing**
      - **Alarming**
    - Secondary Responsibilities
      - Analysis
      - Information Sharing (Clients, Utilities, NREL)
      - New Product Evaluation
        - Cost analysis
        - Feasibility
        - Risk / Reward study
- ICMMBA**
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- Two arrows originate from the 'Primary Responsibilities' list. One arrow starts at the 'Integration' item and points towards the 'ICMMBA' text. The other arrow starts at the 'Alarming' item and also points towards the 'ICMMBA' text.



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## Status – Base Year (cont.)

### Tasks

*Task 2 – Develop Dispatch Algorithms / Task 3 – Develop Codes and Modules*

*Task 4 – Test Codes and Modules / Task 5 – Deploy Codes and Modules*

#### ***Work Accomplished to Date –***

In search of the most versatile, efficient, and reliable communications technology, RealEnergy experimented with many commercially available products. The desired outcome would be comprised of a cost effective and reliable solution.

In addition, Seamless integration with the installed Building Control System (BCS) and a “NON Proprietary” communications protocol were critical components in the selection process.

A variety of devices were investigated, evaluated and a select few were installed in test locations. These test cases resulted in the final platform selection.

Devices included (but not limited to) the following:

- MTC Webfoot
  - Enflex
  - eLutions ePimm
  - Personal Computer Based Configurations
  - Power Measurement ION Utility Meters
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### Tasks

*Task 2 – Develop Dispatch Algorithms / Task 3 – Develop Codes and Modules*

*Task 4 – Test Codes and Modules / Task 5 – Deploy Codes and Modules*

#### ***Data Parameter Defined –***

- All data collection will be done in 15 min interval increments. These intervals are for 15 selected data points, which include KWH, KVAR, Power Quality, I, Sag/Swell
- The data will reflect the Utility contribution to the property as well as the RealEnergy production at the site.

#### ***Process for Feeding Info back to RealEnergy –***

- During phase one, each site will be polled hourly and all accumulated data will be transferred from the meter to our database. During this process, an additional query is run comparing historical data to the collected data to look for abnormalities. If the query produces an undesired result, the system sends out an Email Alert Notification to key RealEnergy team members for further evaluation.
  - All development has been based on our systems integrating with the Primary Utility Provider. As the evolution continues and our installations become more complicated, an additional integration will be required. The ability of RealEnergy to import/export hot or cold water from our systems into the host systems will require some integration with the existing BCS. To that end, an additional controlling device (PLC) will be required. The Primary Logic Controller is a fairly common device and will not require a long decision process.
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## **Status – Base Year**

### **Tasks**

*Task 2 – Develop Dispatch Algorithms / Task 3 – Develop Codes and Modules*

*Task 4 – Test Codes and Modules / Task 5 – Deploy Codes and Modules*

#### ***Process for Feeding Info back to RealEnergy –***

- Meters – These meters measure amounts in the 1/1000<sup>th</sup> of a kw. This number accumulates in the meter and at the 15 min interval, the meter grabs that number and stores it into memory. This process continues (30 day capacity), until a connection is made with the RealEnergy Server. At that point the information is transferred in packets to our database.
  - To date: RealEnergy has received more than 10,000 15 min interval transactions and have only lost 2 squares of data. This is an amazing success rate.
  - This process showcases the first phase of our communication and transmission of information. It has been a great success. Much more information is slated to be integrated to better enhance and expand our capabilities.
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### Tasks

*Task 2 – Develop Dispatch Algorithms / Task 3 – Develop Codes and Modules*

*Task 4 – Test Codes and Modules / Task 5 – Deploy Codes and Modules*

#### **Insights –**

All of the work in this area has been driven by the operational and financial needs of an onsite distributed energy network in the California DG market. This has forced RealEnergy to reevaluate and reassess the types of algorithms to be developed for the optimal dispatch of the company's DG resources. Examples of market forces shaping the development of RealEnergy's "working" dispatch algorithms:

- As RealEnergy's market niche is commercial real estate facilities, the deployment of generation assets has been optimized in order to be fully utilized by the onsite demand. This optimization takes into account the building's most recent historical energy load and the market vagaries of tenant occupancy over a fifteen year period (the length of our contract).
  - The termination of direct access and the challenges in securing interconnection agreements, for even the most simple system configurations (i.e., non-exporting, non-islanding, parallel induction generation), has limited RealEnergy to design simplified projects focused on serving *only* the host facility's onsite energy demand.
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## Status – Base Year (cont.)

### Tasks

#### *Task 6 – Policy Paper on the Various Transaction Costs Associated with Projects*

##### **Work Accomplished to Date –**

First draft of the report will be completed early January.

##### **Insights –**

Some of the most salient examples of “barriers to market entry” have revolved around the interconnection issues facing RealEnergy:

- **Third Party Agreements.** California’s investor-owned utilities (IOUs) had previously insisted that interconnection agreements could only be between the host site and themselves, placing RealEnergy’s investments in jeopardy and exposing its customers to an unwanted amount of risk. RealEnergy has had to expend hundreds of man-hours and several thousand dollars in legal fees to persuade the IOUs that bilateral interconnection agreements between the IOUs and independent energy producers were allowed under the law. Through working groups and private lobbying efforts, RealEnergy has succeeded in bringing about a change. Sometime prior to the end of December a joint briefing by the IOUs will be filed with the California Public Utility Commission (CPUC) allowing for bilateral contracts between onsite energy producers and the IOUs.
  - **Standards and procedures are not harmonized across the IOUs.** California’s interconnection process for DG is governed by a CPUC code titled “Rule 21.” Although a public–private working group has been working to address various issues, Rule 21’s standards and procedures still vary as they apply to the IOUs, creating uncertainty in the process for those wishing to connect their systems to the grid.
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## **Status – Base Year**

### *Task 6 – Policy Paper on the Various Transaction Costs Associated with Projects*

#### **Insights –**

Construction delays also exacted a toll on the progress of RealEnergy's operations. Example

➤ **Municipal approval of gas interconnection proved to be an unexpected complication**

- *Resolution* – Initiate approval process sooner and offer visits to existing sites to process administrators. When doing work again in a city, request that the same administrator handle the case.
  - *Resolution* – Gas line filings will take place sooner.
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## Status – Base Year (cont.)

### Tasks

#### *Task 7 – DER Operational Information for Public Use (Website)*

##### **Work Accomplished to Date –**

- Framework complete.
  - SQL database up and running; catalogues “Day+1” meter feeds to provide data for future NREL/RealEnergy website.
  - Website redesigned to create a consistent “look” with RealEnergy corporate website and will eventually be incorporated into the corporate site.
  - Phase I NREL/RealEnergy beta site should be operational by Thursday, December 20.
    - Web Deployment, Phase I (12/31/01)
      - Structure Skeleton
      - Basic information included on the homepage and other pages: (1) generation technologies deployed; (2) RealEnergy info; (3) limited generation data displayed on one of the projects of the projects
    - Web Deployment, Phase II (2/15/02)
      - “Day+1” generation data displayed with the ability to access historical data
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## **Conclusion**

This year will end on a high note for RealEnergy.

The IT Department has proven the RealEnergy concept as viable through its deployment of technology able to control generation assets remotely, while managing utility expectations for safe and reliable interconnection and integration into their grids. The information technology foundation was also solid enough to have the component of Client Bill Creation spin off several months sooner than planned.

The ability to create a “Standard Deployment Package” that can be engineered throughout the RealEnergy Portfolio will be the next measure of success.

### Next Quarter -

- Finalize the development and integration of RealEnergy’s system for control of a distributed network of generation assets able to economically dispatch energy systems in the California market.
  - Continue to establish utility confidence in the RealEnergy system integration process so as to build a level of comfort with regards to interconnections. First five system commissionings, and tests of the protective relay and the communication functions – done in the presence of the utilities – have gone flawlessly.
  - Continue to document and catalogue insights into the various barriers to market entry and interconnection that the company has faced while trying to bring these first group of projects on line.
-