POISED FOR PROFIT II:

PROSPECTS FOR THE SMART ENERGY SECTOR IN THE PACIFIC NORTHWEST

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THE ATHENA INSTITUTE

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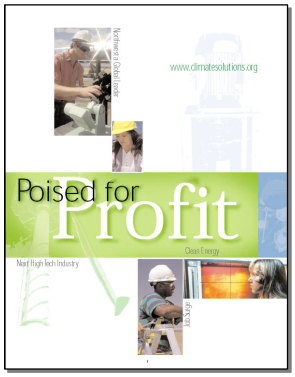
PREFACE

POISED FOR PROFIT: PROMOTING A NORTHWEST CLEAN ENERGY INDUSTRY



In 2001, eight economic development and energy agencies from Oregon, Washington, and British Columbia commissioned a study: *Poised for Profit: How Clean Energy Can Power the Next High-Tech Job Surge in the Northwest*. The resulting report revealed that the clean energy sector could be twice the size of the aircraft industry within 20 years. What's more, it could generate tens of thousands of new jobs. That first report is available at www.climatesolutions.org in the publications section.

A new partnership has come together to fund follow-on research to support a world-class clean energy industry in the Northwest. Poised for Profit II, launched in November 2002, is producing a series of reports containing critical information for investors, entrepreneurs, and policymakers. These tools include:

- Research and analysis to pinpoint the biggest and best opportunities
- Surveys of investor and utility plans
- Directories to research reports, related companies and helpful programs, grants and support services.

This document is part of a research module called the Preliminary Analysis of Near-Term Opportunities. It reports on the market opportunities for Smart Energy technologies. Other documents in the series cover near-term prospects in wind, solar and fuel cells.

ACKNOWLEDGEMENTS: SPECIAL THANKS TO OUR STEERING COMMITTEE

The Athena Institute would like to recognize the following companies and individuals for their direct contributions to the Poised for Profit initiative in general and this report in particular.

For conceiving and catalyzing the project and providing oversight, Climate Solutions with special thanks to Rhys Roth.

For expert comments and research materials, Peter Arias of Reed Global.

For initial research targets, plus ongoing advice and assistance, the co-funders and members of our Steering Committee. In alphabetical order, they are:

- Joe Barra, Portland General Electric
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INTRODUCTION

A clean energy revolution is underway around the world, as documented in the original *Poised for Profit* study released in November 2001. Clean energy businesses will generate trillions in revenues over the next two decades. The Northwest has an opportunity to become a leader, thereby capturing enormous environmental and economic benefits.

A follow-on *Poised for Profit II* research agenda was initiated in late 2002. It set out to discover which specific areas had the most promise for near-term opportunity and growth in the Pacific Northwest. This document presents the market opportunities for the Smart Energy sector.

HOW THIS REPORT IS ORGANIZED

This document presents findings from a multi-month study, divided into seven areas:

- **Executive Summary** -- a brief overview that condenses the major findings
- **Market Overview** -- an introduction to Smart Energy technologies and markets
- **Market Drivers** -- the factors promoting market growth
- **Market Barriers** -- the hurdles and obstacles
- **Market Potential** -- an examination of 14 segments with near-term growth potential around the world
- **Regional Potential** -- the Northwest's assets and challenges
- **Regional Opportunities** -- the market segments that hold the most promise for the Northwest and ways to accelerate progress

UNDERSTANDING THE SCOPE OF THIS REPORT

This report is focused narrowly on near-term market opportunities. As used in this report, a "near-term opportunity" is a market niche that can generate thousands of high-quality local jobs and millions in new revenues within the next three to five years. In addition, that niche must create significant export opportunities, significant growth prospects for current companies and significant reasons for "latent entrepreneurs" to start up related businesses.

The best near-term opportunities come from economic clusters. The Milken Institute defines clusters as "agglomerations of interrelated industries that

foster wealth creation in a region." For instance, Washington's Seattle/King County region is known for its aerospace and software clusters. The greater Portland region is known for semiconductor activities. If the Northwest can uncover and accelerate a clean energy cluster, it will gain significant economic benefits while simultaneously improving the environment.

As you read through this report, please remember that:

- **This report discusses regional cluster prospects, not individual success prospects.** This report does not relate to the prospects for individual companies. We expect to see many "islands of success" in niches that do not qualify as regional cluster opportunities.
- **This report focuses on near-term prospects.** A market niche with little short-term potential could still become a major opportunity later in the decade. The goal was to find sectors that could see significant market growth within five years. Sectors with longer time horizons were not appropriate for inclusion.
- **This report does not rate clean energy potential.** Comments relative to alternative energy speak only to its cluster potential, not to its value as a cleaner way to generate power.
- **This report does not include detailed financial forecasts.** Our numbers represent generally accepted consensus figures of market sizes and growth, as reported by industry analysts and market research firms.

EXECUTIVE SUMMARY

The world's electric power industry is in the early stages of an unstoppable change. For over a century, it has been doing business with the same market configurations and the same basic technologies. Now a transformation is underway. Electricity markets are being deregulated all over the world. At the same time, a new wave of digital technology has arrived, promising a smart, self-healing, ultra-efficient power grid.

Within two decades, the industry will look completely different than it did during the previous century. Along the way will come enormous new opportunities, enormous new companies, and enormous new revenues. Indeed, Smart Energy is already much larger than better-known sectors such as wind, solar and fuel cells. It shows every sign of widening that gap.

The spoils will go to regions, companies and individuals who seize the chance. If the Pacific Northwest becomes one of those leaders, it can gain an industry of distinction to rival current mainstays such as aerospace, biotech, forest products and software.

The Pacific Northwest has the assets to become a global center of excellence in Smart Energy. This report documents the Pacific Northwest's prospects. It outlines the sector, its issues and its potential. It inventories the region, its assets and its challenges. And it reveals the opportunities -- the specific market niches that could bring near-term growth and revenue.

This executive summary presents a brief summary of the findings in these areas:

- **Market Overview**
- **Market Drivers**
- **Market Barriers**
- **Market Potential**
- **Regional Potential**
- **Regional Opportunities**

The complete findings and analysis are found in the full report.

MARKET OVERVIEW

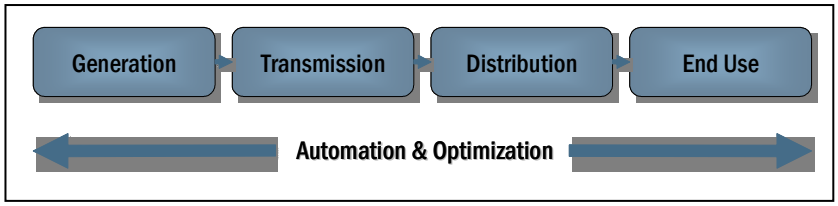
In simplest terms, Smart Energy is the application of digital technology to the electric power industry. It is a collection of technologies that a) relate to

the generation, transmission, distribution or use of electricity and b) include "embedded intelligence" in the form of software, hardware or both. Examples include advanced meters; grid monitors and sensors; digital relays; software for utility companies; and smart devices that use embedded intelligence to improve efficiency or allow remote operation.

The electric power industry traditionally talks about a value chain that goes from Generation to Transmission to Distribution to End Use. Smart Energy spans all four categories, as shown in Figure 1.

Figure 1
Electricity Value Chain

"Smart Energy" (automation and optimization) extends throughout the electricity value chain.



- **Generation.** Smart Energy products can remotely dispatch, monitor and control generation, and connect it safely to the grid. Software can automate parts of the generation process, from resource planning to asset management.
- **Transmission.** Smart Energy products help to design, analyze, transform, control, condition, switch, monitor, protect and optimize electricity transmission.
- **Distribution.** Smart Energy plays an important role in the distribution of electricity with products such as advanced meters, digital relays and intelligent switches.
- **End use.** Smart motors and appliances can increase efficiency and reduce peak loads. Building automation systems can streamline operations while saving energy.

A Subset of an Enormous Market

Smart Energy plays in an enormous market. On one end of the value chain, the U.S. market for retail electricity -- the nation's "electric bill" -- is $247B annually. In another part of the chain, the market for electric power equipment is nearly $70B annually. And these are just two of the sectors along the vast value chain. Overall sales are so large that switching even a small fraction to Smart Energy represents hundreds of millions of dollars.

Six Customer Segments Lead the Market

Six customer segments represent the bulk of the spending in Smart Energy:

- Utilities
- Independent power producers

- Transmission organizations
- Energy service providers
- Large energy users
- Moderate energy users

Utilities represent the most important category. They are the single biggest customer for Smart Energy, as well as the single biggest distribution channel to other customers. As utilities recover from the financial crisis of the early 2000s, they will drive Smart Energy sales to new levels.

MARKET DRIVERS

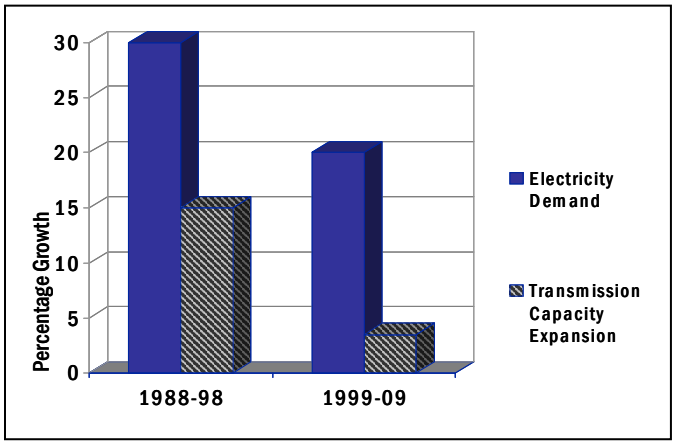
Seven powerful forces are driving the Smart Energy sector worldwide. Taken together, they will create enormous growth between now and the end of the decade. They are:

A crumbling infrastructure. The U.S. electricity infrastructure is inadequate for current needs and falling further and further behind. (See Figure 2.) It is in urgent need of billions in upkeep and upgrades. More and more of those improvements will be made with Smart Energy products in place of old-line electromechanical systems.

Figure 2
The Growing Transmission Gap

For the 10 years from 1988 to 1998, transmission capacity grew at half the rate of electricity demand. Predictions are that the performance will be even worse over the next 10 years, dropping to less than one-fourth.

Source: Pacific Northwest National Laboratory



A growing demand for power. At the same time the infrastructure is deteriorating, the demand for electricity is rising, especially "premium power" -- electricity free of fluctuations and interruptions. Again, Smart Energy provides a solution. It increases supply by making more efficient use of electricity. It increases quality through sophisticated power conditioning.

Concern over the environment. Governments and their citizens are increasingly worried about the environmental consequences of electric power. That concern is bringing changes in regulations and in consumer

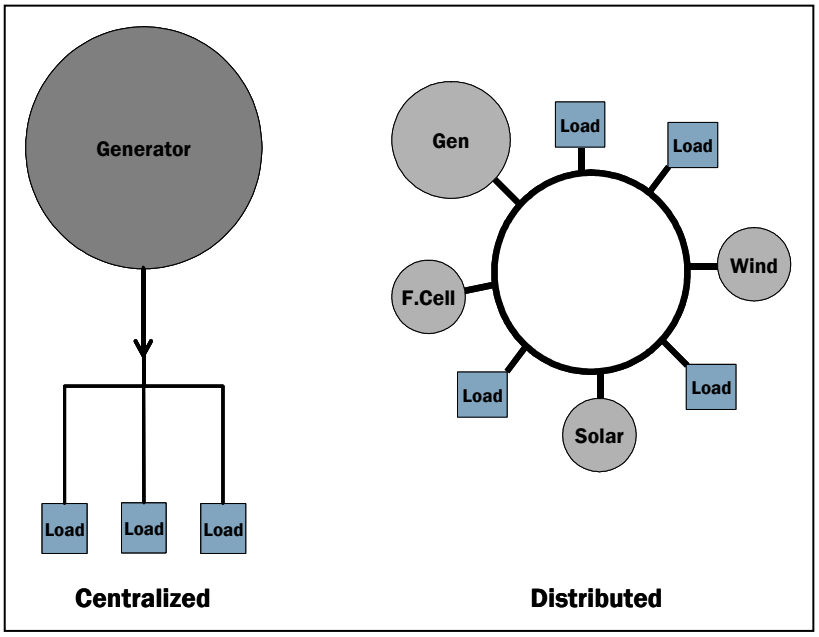
buying. Most Smart Energy products are more efficient, less polluting, or both.

Growing interest in distributed generation. Distributed generation (DG) replaces massive centralized power plants with smaller facilities near the customer. (See Figure 3.) Once we sprinkle power plants throughout the system, we need Smart Energy technologies to tie it all together. Distributed generation will drive the growth of smart products for monitoring, managing and interconnecting DG facilities.

Figure 3
Distributed Generation

Centralized generation (left) features a large central plant that ships power to distant customers.

Distributed generation (right) scatters power plants throughout the system, locating them much closer to customers.



Adapted from NewERA

Rapid technology advances. A series of impressive technical breakthroughs has set the stage for the growth of the Smart Energy sector. Many of the core concepts were pioneered and proved in business computing, telecommunications networks and the Internet. With much of the learning curve out of the way, it becomes relatively simple to apply those same technologies to the electric power industry.

Market restructuring. Despite the occasional pause, the electric power industry is restructuring all over the world. A market formerly dominated by vertically integrated giants is now seeing competition at all levels. As with other historic shifts -- in computers, in telecommunications -- the change is leading to the rise of new market opportunities and fast-growing new companies.

Increased government attention and support. Both federal and local governments have greatly increased their attention to electric power issues.

They are motivated by fears of the deteriorating infrastructure, climate change, rising energy costs, dependence on foreign oil and vulnerability to terrorist attack. Governments increasingly see digital technology as the way to make power grids more reliable and less vulnerable. As a result, they are instituting a variety of incentives for clean energy and for Smart Energy.

MARKET BARRIERS

Despite the powerful forces on the side of growth and opportunity, the Smart Energy sector faces at least four major hurdles (and a handful of lesser roadblocks).

Regulatory chaos inhibits investment. The electric power industry is neither fully regulated nor completely deregulated. This twilight zone is the single greatest challenge to the growth of Smart Energy (and all other sectors connected to the industry). The Federal Energy Regulatory Agency, the Department of Energy, the U.S. Congress and various states are grappling with these issues now. If they make serious progress before the end of the year, 2004 could see a substantial up tick in Smart Energy fortunes. If reform drags on, rapid market expansion could be delayed.

Lack of price signals skews the market. Most electricity customers have no access to real-time pricing. They receive a monthly bill that makes no distinction between expensive peak time electricity and cheap off-peak power. Part of the problem is technical. And part of the problem is regulatory. In many jurisdictions, rates are set arbitrarily and the utility is unable to pass real-time pricing through to the customer. As the *National Transmission Grid Study* points out: "We can keep the lights on at a lower total cost . . . if we allow those who are willing to turn their lights off voluntarily to do so (e.g. in response to economic incentives and price signals)." The first step is to make prices visible to customers.

Lack of market access slows progress. Smart Energy companies are held back by the difficulties of selling to utilities. As the industry gradually transitions to a free market, many utilities find themselves without the interest, understanding, or skills to use new technologies. To be fair, that conservatism was justified in the regulated world of the last century. Today, it stands as a roadblock to progress. Smart Energy companies must undergo extremely long sales cycles at bureaucratic utilities that have many reasons to be cautious and few reasons to be experimental.

Lack of capital makes growth difficult. Most venture capitalist and angel investors do not know about Smart Energy or understand its parallels to the

software and semiconductor industries. As a result, it is hard for startups to find the funds for growth and expansion.

In additional to the major barriers outlined above, the Smart Energy sector must grapple with technology commercialization issues, lack of popular appeal, lack of a common terminology and a shortage of trained engineers.

MARKET POTENTIAL

Our research reveals 14 Smart Energy areas with the potential for dramatic near-term growth around the world. (See Figure 4.) Later in this document we discuss which ones are best suited for the Northwest.

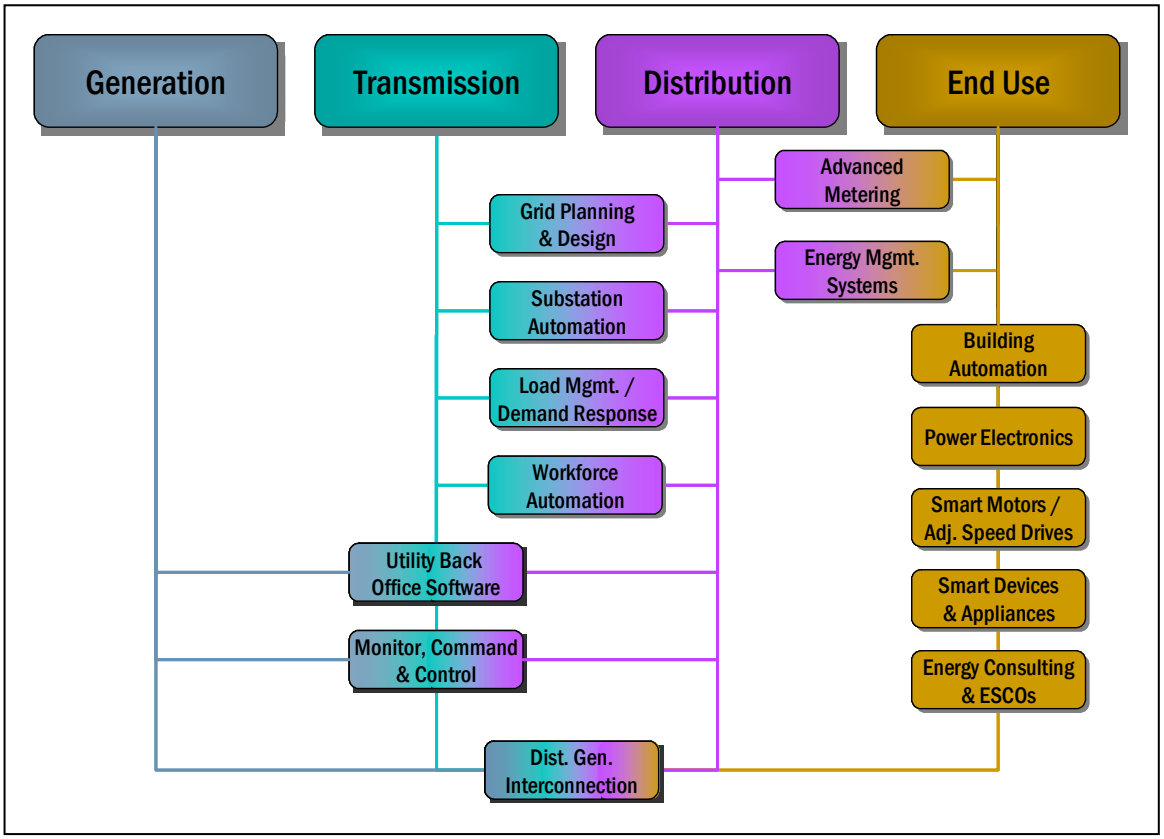


Figure 4: Smart Energy Opportunity Areas

Utility back office software. The electric power industry is one of the last in the world to fully embrace computing. Many utilities still run their operations on ancient minicomputers and home-grown software. With thousands of utilities serving billions of customers, the market opportunity is enormous for such things as customer information systems, asset management systems and ERP.

Northwest companies with products and services in this category include Eden Systems, Energration, Equarius, Utility Solutions and Alstom ESI.

Grid monitoring, command and control. Utilities are increasingly replacing electromechanical systems with digital technology to monitor and remotely manage the grid.

Northwest companies in this category include Consolidated Electronics, MCM Enterprise, Schweitzer Engineering Laboratories, and Serveron.

Grid planning and design tools. The power grid is one of the most complex systems on earth. There is a tremendous need for computer tools to model, simulate, design, optimize and construct grid facilities.

The Northwest is already a national leader in grid planning, with several important research efforts underway at Pacific Northwest National Laboratory (PNNL), University of Washington, Washington State University and Oregon State University. Itron subsidiary Linesoft is a category leader.

Transmission/distribution/substation automation. Products in this category replace old-style electromechanical products with new digital technologies for switching, monitoring, protection and control. As with the related category of grid monitoring, command and control, the potential market is huge since so much of the grid is in urgent need of upgrading.

Northwest companies with a role in this area include Alstom Transformers, Cascade Controls, PC Utilidata and Schweitzer Engineering Laboratories.

Load management/demand response. Products in this category allow a utility to remotely or automatically reduce the amount of power used by customers. They allow utilities a better way to respond to peak loads than to keep another power plant running just in case load spikes. Most analysts predict big revenues in this category once regulatory hurdles are overcome.

Northwest companies with offerings in this area include Celerity Energy, Microplanet and PCS Utilidata.

Workforce automation and management. Products in this category help utilities automate and manage their key assets: their equipment, their workers and their customers.

Northwest companies with interests in this space include Fieldsoft Technologies and Itron.

Distributed generation interconnection. The world is moving to distributed generation -- smaller power plants located closer to the end user. That generation is happening via gas turbines, microturbines, wind, solar, biomass, geothermal, mini-hydro and fuel cells. Regardless of the power source, the resulting electricity must be controlled, conditioned and connected to the grid.

Northwest companies with interests in this space include Alpha Technologies, JATS Alternative Power, New Path Renewables, RBH Electronic Designs, Schott Applied Power and Xantrex.

Advanced metering. The United States alone has approximately 130M electric meters and 140M gas and water meters. Utilities are now converting to advanced digital meters that can transmit data back to the home office. The category is expected to grow 15-20% annually for the next five years.

The Northwest is home to Itron, the world's largest provider of advanced meters, and to several other firms with offerings in this category, including Dent Instruments, Teldata, H.J. Arnett Industries, Utility Systems & Applications and others.

Energy management systems. Energy management systems gather information about energy usage to create a single picture and a single control point. Utilities use them to manage thousands of customers. Large end users employ them to manage high-rises, campuses and factories.

Regional companies in this space include Avista Advantage, Christenson Power Services, and Alstom.

Building automation and control. More and more switches, sensors, thermostats and controls come with embedded intelligence and the ability to communicate. They can be pulled together and managed through building management systems and building diagnostics. Once under control, they can be managed to improve energy efficiency.

The Northwest houses the branch offices of Johnson Controls and Siemens Building Automation. It also has several "home-grown" companies, including Control Contractors, Holaday-Parks Building Automation Systems, and Alerton.

Power electronics. Power electronics convert and condition electricity. Power factor correction devices correct for characteristics of electric motors that cause them to draw more power than they actually need.

The Northwest houses several companies that operate in this space, including Advanced Power Technology, Northern Technologies, Philtek Power, Sure Power Industries and Xantrex.

Smart motors / adjustable speed drives. Electric motors use a significant percentage of the nation's electricity. New designs increase efficiency through on-board intelligence and through the ability to adjust the speed to match the need.

Related Northwest companies include Motors and Controls Corp and MagnaDrive.

Smart devices and appliances. Just as building controls are becoming intelligent, so too are devices, equipment and appliances. This intelligence bestows a number of advantages, including superior energy efficiency.

The Northwest has some ongoing research, but little commercial activity in this space.

Energy consulting & ESCOs. This category is growing in line with the global trend toward outsourcing. Energy consultants work with utilities and large customers. Energy services companies (ESCOs) contract with large users to manage and improve energy use (often receiving a portion of the savings as part of their fee).

Northwest examples include Acres International, Energy International, Clark's Energy Service Corp., Northwest Energy Services, and Quantum Engineering & Development.

REVENUE POTENTIAL

Because of their complexity and their high value-to-weight ratio, many Smart Energy products can be manufactured in the Northwest for export outside the region.

Only some of these Smart Energy categories are routinely tracked by analysts and market research firms. We estimate the 14 segments discussed above represent at least $8B in revenues worldwide. By way of comparison, most experts put the worldwide wind market at $5B, the solar market at $1.5B and the fuel cell market at $0.5B. We predict growth of at least 10%

per year, which would bring the Smart Energy market to more than $14B by 2008 and nearly $23B by 2013.

REGIONAL POTENTIAL

The Northwest has the assets necessary to establish a powerful Smart Energy cluster. The five most important are:

- **Successful pioneers**. The Northwest is already a global leader in Smart Energy thanks to companies such as Itron, Schweitzer, Alstom and others. Our research has uncovered more than 150 Smart Energy-related businesses in the Northwest, doing well over $1B annually.
- **World-class research**. The Northwest is blessed with one of the country's largest concentrations of Smart Energy research. Important centers include Pacific Northwest National Laboratory, WSU, UW and OSU.
- **Transmission and distribution expertise**. The Northwest has deep expertise in transmission modeling, design, planning and installation and decades of experience shipping power between regions.
- **Transferable skills**. Smart Energy has strong synergies with existing regional strengths in software, semiconductors, wireless communications and power electronics.
- **Ideal test-bed environment**. The Northwest has an unparalleled mixture of climates, power sources, transmission facilities, customer types and utility types. Combined with our exceptional research facilities, they make the region a strong option for the many research and demonstration projects now on the drawing board.

The Northwest's entrepreneurial infrastructure, its proximity to Asia-Pacific and its "green" reputation also contribute to our prospects.

REGIONAL CHALLENGES

The Smart Energy industry has numerous challenges, as discussed under Market Barriers above. But those problems are national (or even international) in scope, affecting every region. The Northwest has few relative disadvantages. Perhaps the most serious is the lack of proximity. Northwest Smart Energy firms are scattered hundreds of miles apart throughout the region. What's more, the regional Smart Energy industry is not yet "self-aware." These factors deprive regional firms of networking and partnering opportunities that can accelerate industry growth.

The Northwest also suffers from its lack of national visibility. The world does not look to this region for leadership in Smart Energy (or any kind of

clean energy). One factor is our low power prices, which make it hard to cost-justify energy-saving technologies.

REGIONAL OPPORTUNITIES

After examination of the opportunities, assets and barriers described above, we believe the Northwest has significant potential in at least four niches. These segments were selected for two qualities. First, they will experience near-term growth. Second, they match well with our regional strengths. They are:

- **Advanced metering** (where we already house the 800-lb gorilla)
- **Utility back office software** (where we are home to an industry leader and which meshes with existing software expertise)
- **Grid monitors and controls** (where we also have a category leader)
- **Transmission/distribution/substation automation**

In addition, at least six other niches offer moderate to strong potential:

- Energy management systems
- Building automation and controls
- Distributed generation interconnection and support
- Energy service companies (ESCOs)
- Workforce automation
- Power electronics

ACCELERATING PROGRESS

The Northwest is fortunate to have the beginnings of a meaningful Smart Energy cluster. It should act now to build on this early lead. We believe the following eight initiatives could significantly accelerate growth:

- **A Smart Energy trade association.** An association can supply all-important networking, outreach and joint marketing.
- **Test beds and market access.** A concerted program to design and fund testing and market access could make this region a magnet for Smart Energy startups.
- **Investor outreach and education.** By helping investors understand the category and its success models, we can increase the flow of capital to deserving Smart Energy companies.
- **Innovation centers, incubators and accelerators.** We can speed progress by assisting regional companies in centers that provide services, mentoring and facilities during the startup phase.

- **Promotion and visibility.** To attract investors, entrepreneurs, service companies and relocations, we must let the world know of our region's advantages.
- **Pursuit of major research.** Governments, foundations and private companies are pouring hundreds of millions into Smart Energy research. We need a concerted effort to bring more of those programs to the Northwest.
- **Market transformation.** The Northwest has had success changing consumer behavior in areas such as recycling and compact fluorescents. Those skills should now be applied to Smart Energy products.
- **Workforce training.** By increasing the number of skilled workers and managers, we increase the value of the Northwest as a place to locate a Smart Energy business.

The Northwest already has the beginnings of a Smart Energy cluster. Through actions such as those described above we can add fuel to that flame. By helping this home-grown category grow into a full-fledged industry of distinction, we can bring millions in new revenues while simultaneously reducing pollutants and greenhouse gases.

MARKET OVERVIEW: DIGITAL TECHNOLOGY APPLIED TO ELECTRIC POWER

One of the challenges in understanding Smart Energy is the lack of commonly accepted terms and definitions. Despite sales in the billions of dollars, the sector is poorly understood. Some of its key components are lumped into other vague categories (energy technologies, power systems and energy efficiency, for example). Other components are seemingly overlooked entirely.

Yet our research did uncover a unifying theme-- the application of digital technology to the electric power industry. Smart Energy is a collection of digital technologies that span the entire value chain from generation to transmission to distribution to end use. It is a sub sector of an enormous market, led by six key customer segments.

This section provides details and definitions. The section that follows outlines the factors driving the growth of the Smart Energy sector.

SMART ENERGY IS A COLLECTION OF TECHNOLOGIES

In its simplest sense, Smart Energy is the application of digital technology to the electric power industry.

Patrick Mazza, Research Director of Climate Solutions, defines Smart Energy as: "energy generation, delivery and use optimized by information technology for efficiency, economy and reliability." Others have called it "the convergence of telecommunications, computing, and energy."

Clark Gellings is Vice President for Power Delivery and Markets at the Electric Power Research Institute (EPRI). In an August 2003 article he put it this way: "The very thing that has transformed any number of industries is about to transform [the electric power] industry -- that is, computers and technology that involves communication and sensors. The combination will give us an opportunity to transform our power delivery system."

For the purposes of this report, we use Smart Energy to refer to technologies that a) relate to the generation, transmission, distribution or use of electricity and b) include "embedded intelligence" in the form of software, hardware or both. Examples include:

- **Advanced meters** to collect usage data electronically and automatically, doing away with the need for a physical inspection by a meter reader

- **Monitors and sensors** for remote monitoring and control of functions ranging from generation to transmission to distribution to operation of electric devices
- **Tools for grid planning, design and operation** to simulate, plan and automate the complex transmission and distribution operations
- **Load management/demand response technologies** that help reduce peaks in electric demand and thereby reduce the need for standby power plants
- **Software for utilities** to automate accounting, billing, pricing, reporting, customer service, workforce management, outage restoration and similar functions
- **Smart devices** ranging from motors to HVAC systems to home appliances that use embedded intelligence to improve efficiency and/or allow remote operation

We will cover specific technologies and specific market opportunities later in this report.

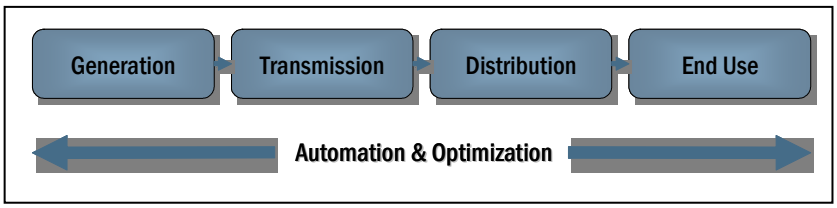
SMART ENERGY AFFECTS ALL FOUR PARTS OF THE ELECTRICITY VALUE CHAIN

In a general sense, Smart Energy refers to automating the electricity value chain. The traditional value chain goes from Generation to Transmission to Distribution to End Use. Automation spans all four categories, as shown in Figure 5. Each step along the value chain provides Smart Energy opportunities, as shown in Figure 6 below.

GENERATION

Figure 5
Electricity Value Chain

"Smart Energy" (automation and optimization) extends throughout the electricity value chain.



The chain begins when a power plant generates electricity. Digital technology can help to remotely dispatch, monitor and control generation, and to connect it safely to the grid. Likewise, utility back office software often helps to automate or optimize parts of the generation process, from resource planning to asset management.

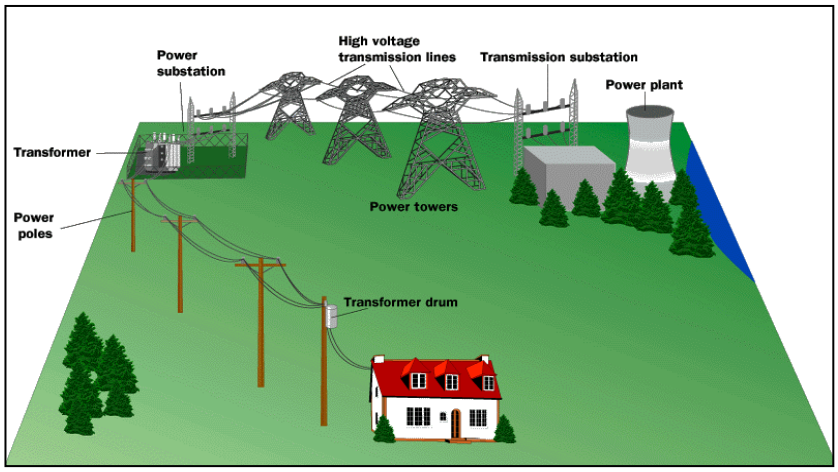
Generation embraces both big, centralized plants as well as new-generation "distributed generation." Distributed generation refers to replacing large, central power plants with smaller plants scattered throughout the grid.

Figure 6
Power System Overview

Power originates in the power plant (upper right), then steps through transmission substations, high-voltage lines, substation transformers and power pole transformers on its way to the end user.

Each step in this journey provides opportunities for new, "smart" devices.

Schweitzer Engineering Labs



With DG, you can place the power much closer to the customer, minimizing the need for expensive high-voltage transmission. Indeed, some DG installations are on the customer's premises.

(Although this report *does* cover connecting DG to the grid, it does *not* address the generation technologies themselves. You will not find coverage of hydropower, fossil fuels, microturbines, fuel cells, wind, solar or other generation technologies.)

TRANSMISSION

After generation, the electricity is stepped up by a transmission substation to a high voltage that can be transmitted efficiently over long distances. Smart Energy products can help to design, analyze, transform, control, condition, switch, monitor, protect and optimize transmission. Examples include grid planning and simulation, grid monitoring and control, substation automation and more.

DISTRIBUTION

Traditionally, distribution starts at the substation and ends at the customer meter. Transformers inside power substations lower the voltages for safe distribution in populated areas. Distribution switchgear controls the amounts delivered. Relays, circuit breakers and surge arresters prevent hazards. Pole transformers step down the voltage further to a level suitable for end-users. Metering systems measure and record the power consumed.

Intelligent digital equipment can play an important role in all these activities. Advanced metering is the largest sub-category, with more and more utilities replacing mechanical meters (and human meter readers) with smart meters that transmit data electronically.

Many concepts and products that apply to transmission also apply to distribution. In fact, the electric power industry often refers to transmission and distribution together under the names "T&D" or "the grid."

END USE

Many opportunities exist to communicate with, control and optimize electrical devices in use by industrial, commercial and residential customers. For instance, customers can use the information from advanced meters to optimize energy usage. Smart motors and appliances can increase efficiency and reduce peak loads. DC microgrids can supply DC current directly to computers and other digital devices, without the power-wasting (and heat-creating) steps of converting it to AC and then back to DC.

This report *does* include smart devices for energy efficiency, but it does *not* cover passive materials or design. You will *not* find discussion of insulation, passive solar design, efficient light bulbs, building materials, and so forth.

SMART ENERGY IS A SUBSET OF AN ENORMOUS MARKET

Smart Energy plays in an enormous market where the stakes are huge. The United States alone has more than 3,000 electric utilities and more than 2,100 other power producers such as independent power companies and customer-owned facilities. The country has about 10,000 power plants. The industry's total asset value exceeds $800B, with approximately 60% invested in power plants, 30% in distribution facilities, and 10% in transmission facilities.

Each portion of the value chain represents billions of dollars in sales each year. For instance, the electric industry serves 131M customers in the U.S. and generates $247B in annual electric revenues according to the Department of Energy (DOE). Another example is the worldwide market for electric power equipment, which is nearly $70B a year according to the Freedonia Group. A small but growing percentage of those sales accrue to Smart Energy products. And, as we saw above, Smart Energy is simultaneously penetrating into other sectors across the entire value chain.

It is important to keep these amounts in mind as we discuss economic opportunities. Overall sales are so large that switching even a small fraction to Smart Energy represents hundreds of millions of dollars.

SIX CUSTOMER SEGMENTS LEAD THIS MARKET

Table 1 summarizes the six major customer groups that represent the bulk of the spending in Smart Energy. Utilities are the most important category. They are the single-biggest customer for Smart Energy, as well as the single biggest distribution channel to other customers. Unhappily, the utility sector is in the midst of a long recession. A study by Newton-Evans on utility spending shows that capital spending in the utility sector has flattened over the last two years. As this sector revives, increased spending will boost Smart Energy revenues to new levels.

TABLE 1 -- SMART ENERGY CUSTOMER SEGMENTS AND REPRESENTATIVE EXAMPLES

Segment	Members of Segment	Applications	Comments
Utilities	Investor Owned Utilities (IOUs) Publicly Owned Utilities (Municipalities, COOPs, Public Utility Districts)	Grid automation Workforce automation Advanced metering Load management/demand response Energy management systems	Utilities are under pressure to retain customers despite deregulation. Both investor-owned and public utilities are looking to reduce costs and increase reliability. Many offer their own energy efficiency/energy management advice to customers.
Independent Power Producers	Independent Power Producers (IPPs) who own part of the grid	Grid automation and controls Workforce automation	IPPS are growing and buying parts of the grid. Many will seek products similar to Transmission Organizations.
Transmission Organizations	Independent System Operator (ISOs) Independent Scheduling Administrator (ISAs) Independent Transmission Company (ITC) Regional Transmission Organization (RTO)	Grid automation and controls Workforce automation	Transmission organizations seek to increase power capacity while reducing costs. They may have less of a bias toward construction than would a traditional vertically integrated utility.
Energy Service Providers	Transmission and Distribution Consultants Energy Service Companies (ESCOs)	Advanced metering Energy management systems Building automation and control Smart devices Workforce automation	ESCOs represent a major distributor/user of key end-use technologies.

Segment	Members of Segment	Applications	Comments
Large Energy Users	Industrial Agricultural Marine Light Industrial Commercial chains Hospitals/HC Networks University Systems Government & military	Building automation and control Energy management systems Power electronics Smart devices Smart motors/adj. speed drives	Industrial processes count for nearly 37% of total energy. NW has local strengths in variable drives, industrial process controls. Many users implement their own energy management programs, even if the utility has a program available. The Northwest has national chains to aggregate, including financial institutions and retail chains.
Moderate Energy Users	Small Commercial Residential	Integrated end-use energy management software Power electronics	Growing emphasis on digital home by EPRI, Microsoft and other organizations could raise profile of home gateways.

MARKET DRIVERS:
SEVEN POWERFUL FORCES ARE CREATING MARKET GROWTH

We have identified seven powerful market drivers at work in the Smart Energy sector. Taken together, they will create enormous growth between now and the end of the decade. They are:

- A crumbling infrastructure
- Growing demand for power
- Concern over the environment
- Growing interest in distributed generation
- Rapid technology advances
- Market restructuring
- Increased government attention and support

THE AGING INFRASTRUCTURE MUST BE UPDATED

The nation's electricity infrastructure is crumbling, as underlined on August 14, 2003 when a blackout cut out power to 50M people in parts of the U.S. and Canada. The power grid must be upgraded. Many of those upgrades will be made with Smart Energy technologies, providing a powerful stimulus to the sector.

The Department of Energy recently conducted a series of meetings and workshops to examine the condition of the national grid and set forth a roadmap for its improvement. A July, 2003 document titled *Grid 2030* concluded that America's electricity system is "aging, inefficient, and congested, and incapable of meeting the future energy needs of the Information Economy."

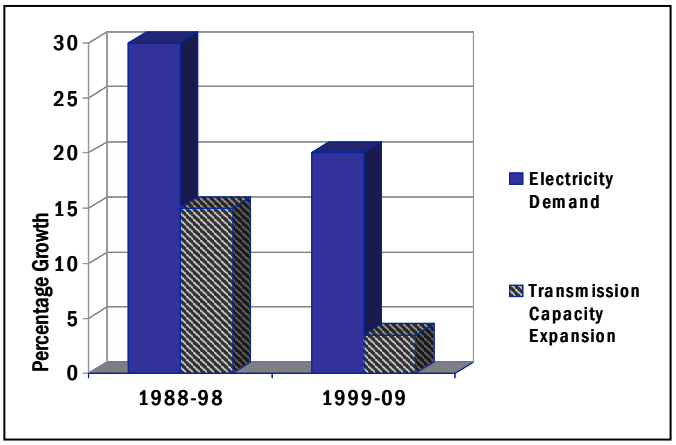
The existing electricity infrastructure was designed in the 1950s and installed in the decades that followed using electromechanical devices that are now outdated. The U.S. has about 157,000 miles of high voltage transmission lines. According to the 2002 National Transmission Grid Study, electricity demand has increased 25% since 1990, yet construction of transmission facilities has decreased 30%. Annual transmission investment has declined steadily for the past 25 years. As Secretary of Energy Spencer Abraham said in his introduction to the study: "Our nation's transmission system over the next decade will fall short of the reliability standards our economy requires."

The Edison Electric Institute has similar findings. No major new transmission investments have occurred in the last 15 years. The majority of existing lines are over 20 years old. The Institute estimates the transmission system needs $56B worth of upgrades over the next decade -- yet less than 1/4 of that is planned. In short, investment in new transmission is lagging far behind growth in demand. (See Figure 7.)

Figure 7
The Growing Transmission Gap

For the 10 years from 1988 to 1998, transmission capacity grew at half the rate of electricity demand. Predictions are that the performance will be even worse over the next 10 years, dropping to less than one-fourth.

Source: Pacific Northwest National Laboratory



The Edison Electric Institute estimates that 94% of all outages are due to the transmission and distribution infrastructure. Congestion and bottlenecks are increasing and the grid is running closer and closer to the edge. One way to improve this situation is to build "traditional" power plants and transmission lines. That method would cost $450B between now and 2020, estimates Pacific Northwest National Laboratory (PNNL).

Another way to address this problem is to use Smart Energy concepts -- adding intelligence to the system to a) add more functionality, b) reduce costs, c) safely run the existing grid at higher capacity and d) increase efficiency so we need less electricity. Such improvements would dramatically reduce the need for new power plants and new transmission lines. PNNL believes smart technologies could shave nearly $80B from the total bill, including $50B by deferring the need for some 200 power plants.

THE GROWING DEMAND FOR HIGH-QUALITY POWER

At the same time the infrastructure is deteriorating, the demand for electricity is rising, especially "premium power" -- electricity free of fluctuations and interruptions. The Smart Energy sector addresses this growing demand. First, it makes the electricity supply more efficient, reducing losses in transmission, distribution and usage. Second, many Smart Energy products also boost the reliability and the quality of electricity.

In 1970, electricity accounted for 8% of total U.S. energy use. In 2000, it accounted for 16%. (Energy Information Agency, 2001.) The demand for electricity will nearly double in the next 20 years. The demand for premium power is growing even faster. High-powered computers, precision manufacturing operations, financial data centers, telecommunications centers and server farms are just a few of the many applications that require premium power. (See Table 2.)

TABLE 2 -- THE COST OF POWER OUTAGES

Industry	Hourly Cost
Cellular Communications	$41,000
Telephone Ticket Sales	$72,000
Airline Reservations	$90,000
Semiconductor Manufacturing	$2,000,000
Credit Card Operations	$2,580,000
Brokerage Operations	$6,480,000

Source: American Power Conversion

"As society continues to find new, smart applications for electricity, it becomes ever more dependent upon a power flow that is characterized by security, quality, reliability, and availability," explains EPRI's Clark Gellings. "In 2001, the U.S. economy experienced an estimated $120B loss in productivity as a result of poor power quality and reliability." According to Gellings, the loss could reach as high as $500B by 2020.

CONCERN OVER THE ENVIRONMENT

Governments and their citizens are increasingly concerned about the environmental consequences of producing electric power. Emissions controls are becoming more stringent, making it harder to site power plants that derive power from fossil fuels. Concern over global warming is leading to new regulations at the state, national and international level. Given that many experts cite power plants as the single largest polluter, it is no wonder that attention is focused on reducing their environmental impact.

Environmental concerns are leading to gradual changes in consumer behavior. "Green" products are finding increasing favor in the marketplace. A growing number of electricity customers are even willing to

pay a small premium for green power. The Pacific Northwest has long been a leader in the green consumer movement.

The trend seems clear. It is becoming more and more expensive -- in financial capital, in political capital and in good will -- to pollute. As a result, companies and consumers will be turning to Smart Energy concepts to produce, transport and use electric power while minimizing the environmental impact.

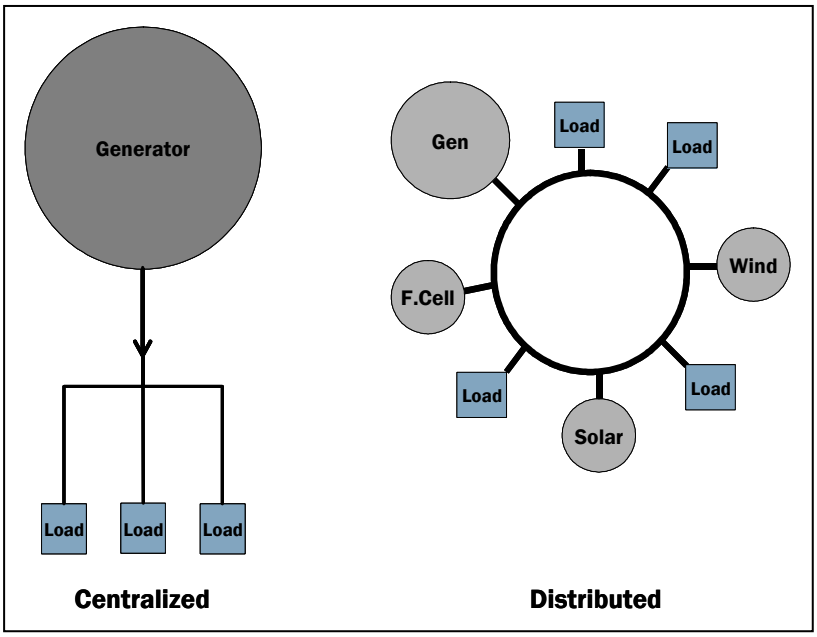
GROWING INTEREST IN DISTRIBUTED GENERATION

Smart Energy is also getting a boost from the move toward "distributed generation" (DG). Distributed generation replaces massive centralized power plants with smaller facilities near the customer. (See Figure 8.) DG reduces the need for new transmission lines, since the power is produced close to the end users. DG also minimizes construction time and

Figure 8
Distributed Generation

Centralized generation (left) features a large central plant that ships power to distant customers.

Distributed generation (right) scatters power plants throughout the system, locating them much closer to customers.



Adapted from NewERA

construction costs, since plants can be built in months, not years. Some analysts estimate one fourth of all generation will be from distributed sources by the next decade.

Once you sprinkle power plants throughout the system, you need Smart Energy technologies to tie it all together. Distributed generation will drive the growth of smart products for monitoring, managing and interconnecting DG facilities. (See Sidebar 1.)

Sidebar 1 -- Portland's Celerity Pioneers Distributed Generation Network

Portland-based Celerity Energy is a different kind of energy management company. Through its Reliable Power subsidiary, it performs many typical ESCO functions. Reliable is a full-service provider of "power reliability" products and services -- standby generators, uninterruptible power supplies and surge suppressors.

The parent company is pioneering a way to link those standby generators into a network that can be called on to generate electricity for peak power needs. Celerity's Networked Distributed Resource service aggregates seldom used standby generators, creating partnerships between utilities and the owners of on-site generation. The same techniques Celerity has developed to remotely monitor, control and dispatch today's diesel and gas generators could someday be used to network cleaner sources such as wind, solar and fuel cells.

TECHNOLOGY ADVANCES MAKE NEW THINGS POSSIBLE

A series of impressive technical breakthroughs has set the stage for the growth of the Smart Energy sector. The DOE's "Grid 2030" report confirms there are "promising technologies on the horizon that could help modernize and expand the Nation's electric delivery system." The report cited numerous Smart Energy examples, including "distributed intelligence and smart controls, power electronics devices for AC-DC conversion and other purposes, and distributed energy resources including on-site generation and demand management."

Many of these technologies were perfected during the computer, telecomm and Internet revolutions of the previous three decades. We now have cheap computing power and low-cost bandwidth for telecommunications. We now know how to use semiconductors to substitute for cumbersome electro-mechanical devices. We now know to use computer hardware and software to connect devices across vast distances, to manage large networks from a single console, and to make automatic decisions based on pre-defined rules. And we know how to communicate wirelessly, reducing the need for expensive wiring and making it easier to retrofit existing installations.

A move is now underway to apply these technologies to the electric industry. This transformation may be delayed by some of the barriers discussed below, but it will certainly not be stopped.

MARKET RESTRUCTURING CREATES OPPORTUNITIES

The gradual but inevitable restructuring of the electricity industry is creating many new Smart Energy opportunities. Industries such as computers, telecomm, Internet and consumer electronics have already undergone restructuring through market forces, government intervention

or both. In every case, that restructuring brought thousands of new companies and hundreds of millions in new revenue. Now that same force is at work in the electric power industry.

This process is well underway. As late as 1997, regulated utilities owned most generation assets, with only 10% in the hands of competitive suppliers. By 2003, that percentage had climbed to 35%.

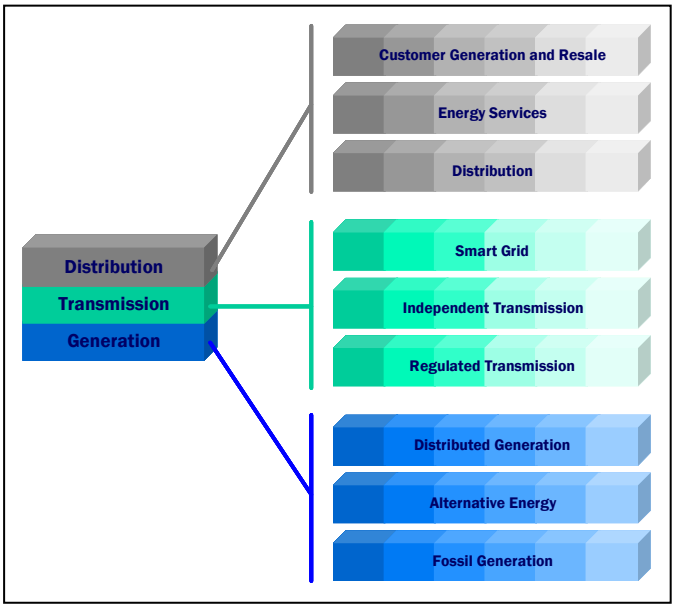
To be sure, restructuring has been marked by fits and starts. Deregulation, for instance, was stalled by the California power crisis at the beginning of the decade. It has now started to see gradual progress again. Although we may continue to see occasional delays, these free market forces will produce a gradual shift from vertical integration to horizontal disaggregation. In a vertically integrated industry, individual companies own all or most of the value chain from top to bottom. As disaggregation occurs, each segment splits into multiple sub-segments. Each sub-segment gains multiple competitors. (See Figure 9.)

Figure 9
Disaggregation

This drawing is a simplified view of what happens as the power industry moves from vertical integration to horizontal disaggregation.

As represented at left, the industry had been vertically integrated for more than a century. Utilities typically owned every aspect of the value chain.

As shown at right, we are now entering an era where each segment has multiple sub-segments, each with multiple competitors.



As more competitors enter the field, they create a "virtuous circle." Having more competitors means more choice and lower prices. More choice and lower prices means more sales. Achieving more sales attracts more competitors. And so the circle continues.

The disaggregation of the computer industry led to the rise of giant companies such as Microsoft and Dell. The deregulation and disaggregation of the telecomm industry led to an explosion of new products and services -- cell phones, 800 numbers, 911 services, advanced PBXes and more. These

same forces will bring about similar changes -- and similar economic opportunities -- in the electric power industry.

INCREASED ATTENTION FROM GOVERNMENT ACCELERATES PROGRESS

Both federal and local governments have greatly increased their attention to electric power issues. Motives include several of the issues discussed above, along with several others:

- The deteriorating infrastructure
- Climate change
- Maintaining affordable, reliable power for constituents
- Dependence on foreign oil
- Vulnerability to terrorist attack

Federal and regional agencies increasingly see digital technology as a way to make the grid more reliable and less vulnerable. A smart grid can route around damaged areas, whether that damage is from a natural disaster or a terrorist attack. A smart grid also makes it much easier to quickly install distributed generation when and where needed.

GOVERNMENT PROGRAMS TO ACCELERATE MARKET GROWTH

Since 1996, the government has gradually been transforming the grid into an interstate highway for wholesale electricity. As the 2002 *National Transmission Grid Study* described, "the national transmission grid DOE envisions is based on the principles of free markets with clear rules, equal access, consumer safeguards, economic incentives and investment opportunities rather than federal ownership and operation."

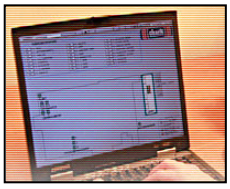
In mid-2003, the DOE established a new Office of Electric Transmission and Distribution. Meanwhile, the Federal Energy Regulatory Commission (FERC) is evaluating new proposals to further deregulate the grid. Through these and other agencies, the government will spend millions of dollars on research, development, pilot programs and market incentives, many of them directly related to Smart Energy.

Meanwhile, dozens of state, provincial and city governments have instituted incentives to spur the adoption of better energy solutions. Examples include tax credits, accelerated depreciation, rebates and net metering. Although many of these incentives are targeted at renewable energy or energy efficiency, they often stimulate Smart Energy sales as well. For instance, connecting wind or solar to the grid involves power electronics and

interconnection technologies. Likewise, many energy efficiency schemes have intelligent controls at the heart.

The spending and the incentives described above will accelerate the growth of the Smart Energy market and provide many opportunities for entrepreneurial success.

Sidebar 2 -- Seattle's Powerit Solutions Reduces Energy Costs for Large Facilities



Seattle-based Powerit Solutions markets a Web-based tool that helps commercial and industrial sites reduce energy costs. Its Energy Director software monitors and controls equipment according to rules set by the customer. The company achieves typical savings of 10-15% on electricity bills by adjusting loads at times of peak demand.

The software typically manages equipment such as HVAC, materials processing, freezing, pumping, drying, conveyors and other equipment with high power needs. It monitors their energy usage and automatically reduces peak demand by prioritizing energy loads -- that is, by cutting back less-important loads during peak periods. Developed in Sweden, the system has been installed in over 250 facilities worldwide. Target customers are those with annual energy bills of $100,000 or more who have large power loads that can be interrupted or reduced.

MARKET BARRIERS: FOUR OBSTACLES COULD SLOW PROGRESS

Despite the powerful forces on the side of growth and opportunity, the Smart Energy sector faces at least four major hurdles (and a handful of lesser roadblocks). Although these obstacles will not prevent the arrival of the new era, they can slow things down enough to put companies out of business and frighten investors. The key factor is how rapidly the federal government removes the regulatory and financial hurdles. Once those problems are out of the way, we believe the force of the free market will steamroller the remaining roadblocks.

REGULATORY CHAOS INHIBITS INVESTMENT

The electric power industry finds itself in a twilight zone. It is neither fully regulated nor completely deregulated. This confusing state of affairs is the single greatest challenge facing the industry. Without clear rules, investors and entrepreneurs face enormous risks -- risks that, in most cases, cause them to hold back from investing in new concepts.

"Unprecedented levels of risk and uncertainty about future conditions in the electric industry are causing many investors to pursue other opportunities," confirms the DOE's *Grid 2030* report. "Capital investment in new electric transmission and distribution facilities is at an all-time low."

Electricity restructuring began in the U.S. with the Energy Policy Act of 1992. Since that time, several other countries have partially or totally restructured, including Australia, Brazil, Chile, New Zealand and the U.K. Meanwhile, the U.S. has struggled. Part of the problem is the fragmented regulatory structure in this country. Jurisdiction is divided between federal, regional, state and local agencies. Creating a cohesive national plan requires "a degree of intergovernmental cooperation that has been difficult to achieve" as *Grid 2030* puts it.

This is not the forum for a discussion of these problems, but it is important to flag them as the number one constraint on market growth. The Federal Energy Regulatory Agency, the Department of Energy, the U.S. Congress and various states are all grappling with these issues now. If they make serious progress before the end of the year, 2004 could see a substantial uptick in Smart Energy fortunes. If reform drags on, rapid market expansion could be delayed.

REGULATIONS THAT DISCOURAGE EFFICIENCY AND OPTIMIZATION

In addition to the restructuring issues mentioned above, current regulations make it difficult to roll out new technologies for energy efficiency and demand response.

Current regulations reward investor-owned utilities for building new power plants. In fact, that is typically the only way those utilities can earn returns for shareholders. Most observers now agree that utilities should not have profits tied solely to the amount of power sold. They should also have financial incentives to optimize service with the full range of technologies. Regulations should allow to utilities to choose conservation, efficiency or demand management when those options are preferable.

Unfortunately, the Balkanized nature of the North American electric industry means those changes must be made state-by-state or even district-by-district. The Northwest does have a few incentives in place or in the works. Certain utility efficiency improvements qualify for Oregon's 35% Business Energy Tax Credit. And some utilities qualify for partial reimbursement through BPA's conservation and renewables discount. As regulations are improved and modernized, they will unleash large new markets for Smart Energy technologies.

LACK OF PRICE SIGNALS SKEWS THE MARKET

With the exception of large industrial and commercial users, most electricity customers have no access to real-time pricing. They receive a monthly bill that makes no distinction between expensive peak time electricity and cheap off-peak power. They have no way to view and understand the market, much less participate. They have no economic incentive to shift usage and adopt energy efficiency.

Part of the problem is regulatory. In many jurisdictions, rates are set artificially and arbitrarily and the utility is not allowed to pass real-time pricing through to the customer. And part of the problem is technical. Utilities must install advanced meters that show real-time prices. Systems must be developed to respond automatically to those price signals according to pre-defined limits.

As the *National Transmission Grid Study* points out: "We can keep most of the lights on at a lower total cost . . . if we allow those who are willing to turn their lights off voluntarily (e.g. in response to economic incentives and price signals) to do so." The first step toward that vision is to make prices visible to customers.

LACK OF MARKET ACCESS SLOWS PROGRESS

Smart Energy companies are held back by the difficulties of selling to utilities.

Utilities have historically been reluctant to try new technologies. When Utilipoint surveyed 300 utilities in early 2003, only 11% described themselves as early adopters -- those that innovate by using new technologies. Another 47% were conservative adopters -- those that use a technology once they have seen others do so successfully. The remaining 42% were followers -- those that run old technology because it is proven.

As the industry gradually transitions to a free market, many utilities find themselves without the interest, understanding, or skills to use new technologies. To be fair, utilities are not bad guys trying to block progress. Regulators, customers and financial markets historically rewarded reliability, not risk-taking. Utility conservatism was entirely justified in the regulated world of the last century. Utilities are simply living by old rules that served them well for decades. But even if their attitudes are understandable, they pose a roadblock to full success. Most Smart Energy products will be a) purchased by utilities or b) offered by utilities to their customers.

To get a new technology to market, Smart Energy companies must undergo extremely long sales cycles at bureaucratic utilities that have many reasons to be cautious and few reasons to be experimental. Utilities historically preferred to build their own rather than buy off the shelf, so there are few standards. Vendors must often reconfigure their products for each utility. And because many utilities suffer from "not-invented-here syndrome," vendors must often undergo lengthy test periods.

Many Smart Energy companies -- including several in the Northwest -- are already growing quickly. Market growth will be even more dramatic when better regulations, incentives and financial rewards make mainstream utilities more receptive to new technology.

LACK OF CAPITAL MAKES GROWTH DIFFICULT

Like almost every other industry, Smart Energy suffers from today's difficult market for seed and venture capital and from today's challenging economic climate.

But the energy sector also has its own special challenges. Even forward-thinking utilities often find themselves without the money for new technology, thanks to a series of financial catastrophes in the energy sector. One problem was the collapse of Enron, which saddled many utilities with unexpected debt and which tainted the entire sector. The Dow Jones Utility Average dropped 28.7% in 2001 and another 26.8% in 2002 -- the steepest decline since the Depression.

Another issue is the size of the debt load. In anticipation of a brave new deregulated world, power companies borrowed a collective $600B in the late 90s and early 00s. Starting in 2003 and continuing through 2006, some $90B must be repaid or renegotiated. As former energy executive Karl Miller recently told *Fortune Magazine*: "The debt bubble in this industry is massive."

These problems made worse by investor attitudes towards the energy sector. Most venture capitalist and angel investors do not know about the technology breakthroughs and most (correctly) fear that regulatory uncertainties could hinder growth. The *Poised for Profit II* research initiative has documented some of these issues in its *Survey of Investor Attitudes and Perceptions*.

SIX ADDITIONAL FACTORS CONSTRAIN THE SMART ENERGY SECTOR

In addition to the four major barriers cited above, we note the following six factors that also hinder market growth.

Technology commercialization issues. Although the fundamental concepts are in place, many technologies still require lots of work to get from concept to commercialization. In some cases, the technology is still at the prototype stage and requires market testing and large-scale manufacturing to reach critical mass. In other cases, the technology is mature, but the industry still has not settled on standards, making purchase, operation and interconnection difficult.

Solutions include 1) national standards for interoperability and interconnection and 2) test bed and market access programs. The more of these we see, and the sooner we see them, the sooner the technologies will move into the mainstream.

Low electricity prices. The United States has some of the lowest electricity prices in the world. Other countries have stronger financial incentives to embrace power-saving Smart Energy solutions.

Lack of popular appeal. It may seem silly to talk about "sex appeal" in connection with technology markets. Nevertheless, certain technologies create a public fascination. A few years ago, the Internet fit that description. Today, fuel cells and the hydrogen economy have captured the imagination. Things such as energy efficiency and T&D improvements simply do not have the same allure.

Lack of a common terminology. Again, it may sound trivial to talk about vocabulary as a market constraint. Yet even industry veterans typically don't have names for the product categories they manufacture. A single phrase means four different things to four different energy professionals -- and means absolutely nothing to most customers. It's hard to sell something investors and customers can't understand.

Shortage of trained engineers. According to the Chair of the Electrical Engineering Department at Washington State University, Dr. Chen-Ching Liu, the national shortage of power engineers will reach a crisis point in the next decade as the baby boom generation retires. Without highly-trained workers and innovators, it is unclear how the country can bring about a dramatic shift to a more efficient, more reliable, less polluting energy infrastructure. Although Canada, China and several European countries actively support workforce training in power-related topics, the U.S. has no such policy as of this writing.

Sidebar 3 -- Tacoma Power Explores Energy Management Services for End Users

Tacoma Power is one of the innovative utilities that could help make the Northwest a leader in Smart Energy. Like many utilities, it generates, transmits and distributes electricity. But it also provides telecommunications services, including cable TV and high-speed Internet access through its Click! Network, which runs over a 750 MHz two-way hybrid fiber/coax network.

Now the utility is exploring ways to use the network to provide advanced energy products and services. One residential gateway concept would turn meters into Internet devices for two-way dialog between consumers and the utility.

Tacoma Power is "interested in giving our customers the most control possible," explains gateway project manager John Athow, "There are two questions -- whether it's technically possible and whether it's of interest to customers. We are investigating both."

MARKET POTENTIAL:
SMART ENERGY WILL BE A MAJOR FORCE

This section outlines the worldwide potential for the Smart Energy market. A later section details the opportunity areas with particular promise for the Northwest.

SMART ENERGY HAS MANY OPPORTUNITY AREAS

Up to this point, we've defined Smart Energy and looked at a broad overview of the industry. With this as a foundation, we can look at the opportunity areas within the value chain.

Figure 10 below shows 14 important Smart Energy opportunities and where they fit in the big picture. As you can see, many of these opportunities span two, three or even four portions of the value chain.

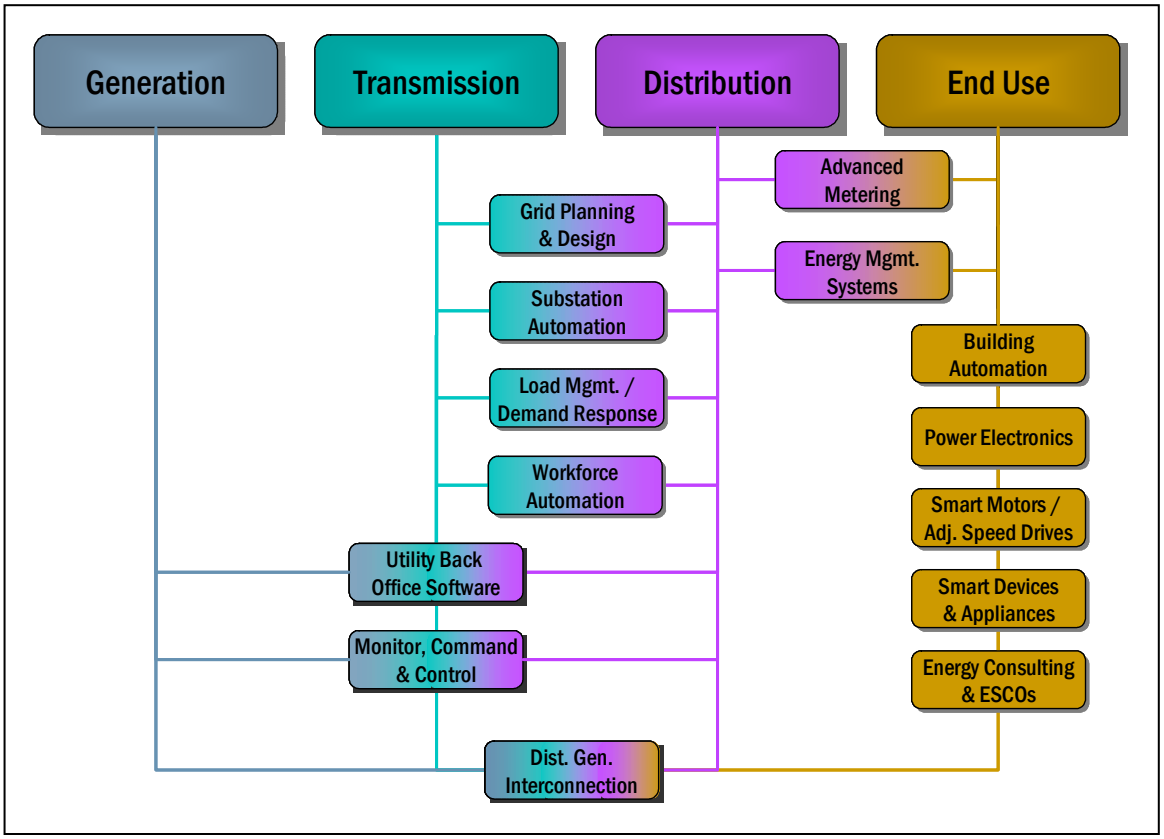


Figure 10: Smart Energy Opportunity Areas

A note about taxonomy: Smart Energy applications have been around for at least two decades (albeit in crude versions in the early days). Despite this

long history, the segment has never become "self-aware." Instead, different industries claim different pieces. As a result, there is no generally accepted taxonomy. Various portions of the Smart Energy market go by different names -- "energy technologies" and "power systems technologies" and "energy efficiency" and others.

The important point is not the labeling. The important point is the identification of bona-fide market opportunities. We believe the taxonomy shown in Figure 10 is a useful way to picture the Smart Energy sector and its relationships. Most of all, we believe the 14 niches discussed here collectively represent a multi-billion dollar market opportunity.

FOURTEEN SEGMENTS STAND OUT WORLDWIDE

The 14 Smart Energy market segments will be sources of near- and mid-term growth worldwide. This section briefly describes these segments and their global implications. Later in this document, we explain which product categories have the most importance for the Pacific Northwest.

OPPORTUNITY #1: UTILITY BACK OFFICE SOFTWARE

Until recently, utilities preferred to custom program their own applications, even complex back office systems. Today, more and more utilities are turning to industrial-strength packaged software, which can then be customized to the utility's special needs. This approach typically cuts costs while increasingly functionality. As utilities emerge from their current financial crisis, this category should experience strong growth, as it did previously in many other industries.

This category has some overlap with workforce automation (see below). Some typical examples include:

- **Customer information and billing systems** track customers, services provided, amounts owed, payments, service history, etc.
- **Asset management systems** help utilities inventory, plan, track and optimize the use of their resources while maintaining regulatory compliance.
- **Enterprise resource planning systems (ERP)** integrate traditional back office functions such as general ledger, accounts receivable, accounts payable, payroll, etc.
- **Graphical information systems (GIS)** display assets (generation, transmission, distribution, facilities) and customers on computer maps. Typically used in conjunction with other software categories including

asset management, customer information, workforce management and outage management.

To grasp the size and scale of this market opportunity, you have only to realize that the global electric power industry a) is comprised of thousands of utilities serving billions of customers and b) has not yet fully embraced the computer hardware and software that is at the heart of virtually every other major industry today.

Northwest companies with products and services in this category include Eden Systems, Energration, Equarius, Utility Solutions and Alstom ESI. (See Sidebar 4.)

Sidebar 4 -- Alstom ESI Wins Energy Contracts in Romania

February 2003, Bellevue, WA. Alstom ESI, formerly known as Alstom Esca, will deliver systems to manage both the power transmission grid and the central market for Romania's newly deregulated electricity market. The contract embraces hardware and software, including servers, workstations and e-terra software modules.

Alstom is a global specialist in energy infrastructure, providing utilities with systems and solutions for small substations up to entire transmission grids. It employs approximately 300 people in Bellevue, WA.

The Bellevue office is part of Alstom's Energy Automation and Information division. Its e-terra solutions are designed to meet the changing needs imposed by the deregulation of the worldwide electric power industry. The company's software manages six of the eight regional hubs for electricity trading around the country.

OPPORTUNITY #2: GRID MONITORING, COMMAND AND CONTROL

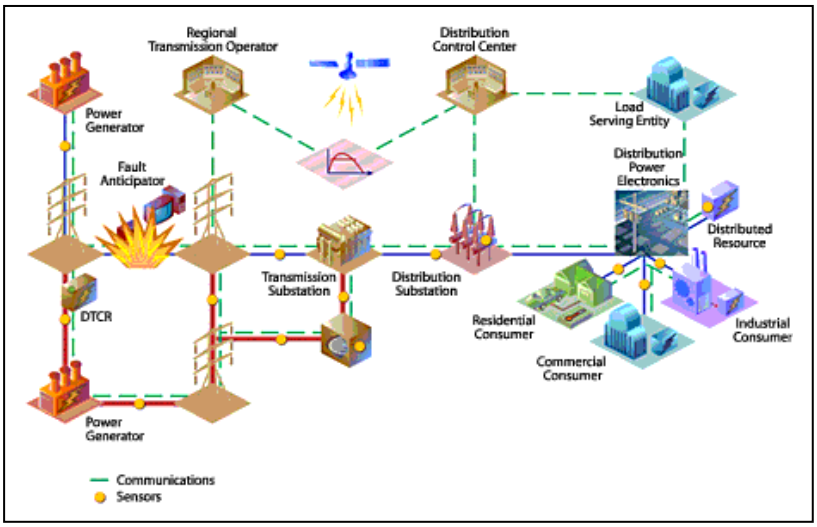
We use this designation to capture a wide range of technologies that span generation, transmission and distribution. In general, they involve the use of digital technology to remotely monitor and manage various assets.

Figure 11 shows a vision of the smart grid of the future created by EPRI. Notice that sensors and communications are a key aspect. Here are just a few of the different types:

- **Power systems monitors** observe and assess grid behavior. Digital devices collect signals (e.g. power flows, bus voltages, and alarms) and send them to a control console for analysis.
- **Power quality analyzers** evaluate the power quality at the substation by measuring such things as sags and swells, voltage transients, and min/max volts.
- **Power systems controls** interpret data from the monitors to determine customer needs, operate the transmission networks, and regulate the

Figure 11
EPRI Smart Power Vision

The Electric Power Research Institute believes communications and intelligent sensors will enable a self-healing power delivery system.



Source: EPRI

flow of power. Common systems for the real-time management of grid assets include SCADA, EMS, DA, and DMS.

- **Condition monitoring systems** watch transmission/distribution equipment and track degradation over time, including transformers, battery banks, etc. They also support a utility's maintenance programs.

Northwest companies in this category include Consolidated Electronics, MCM Enterprise, Schweitzer Engineering Laboratories, and Serveron. (See Sidebar 5.)

Sidebar 5 -- John Day Dam Adopts Smart Monitoring Equipment from Oregon Company

February 4, 2003, Hillsboro, OR. Serveron Corporation announced today that it has installed a dozen of its units at the John Day Dam to remotely monitor the hydropower facility's critically important large transformers.

Launched in February 2001, Serveron provides remote monitoring of transmission and distribution facilities using the Internet. Operating around the clock, 365 days per year, Serveron provides installation, monitoring, alert notification, and maintenance information. It also offers computer analysis of utility assets. As one of the country's first dedicated providers of next-generation, "smart" equipment and services, Serveron stands as an example of the new business opportunities now arising.

OPPORTUNITY #3: GRID PLANNING AND DESIGN TOOLS

The power grid is one of the most complex systems on earth. As it evolves, the complexity increases, thereby intensifying the need for computer tools.

- **Power system simulators** perform complex simulations to derive network limits, spot bottlenecks and forecast problems.
- **Distributed generation simulators** evaluate grid conditions and identify the impact of distributed generation at a particular site.

- **Engineering design and optimization tools** allow utility engineers to make a wide variety of drawings, calculations and analyses for siting, estimating, designing and constructing towers, lines, connections, substations and other facilities.

At the high end -- the modeling of regional and national grids -- the Northwest is already a national leader, with several important research efforts underway. PNNL, University of Washington, Washington State University and Oregon State University are all working on concepts relevant to grid optimization. At the mid-range, the Northwest has a category leader in Linesoft, a division of Itron.

OPPORTUNITY #4: TRANSMISSION/DISTRIBUTION/SUBSTATION AUTOMATION

This category includes components that replace old-style electromechanical products with new digital technologies. Those technologies accomplish switching, monitoring, protection and control. Most experts predict huge growth in this segment as utilities replace their aging infrastructure with new digital products. Solutions in this category include individual components such as intelligent switchgear, controllers, circuit switchers, circuit breakers, surge arresters, reclosers, power flow controls, automatic protection relays, and voltage regulators. It also incorporates software, consulting and turn-key systems.

In many cases, digital products are considerably less expensive than older, electromechanical devices even before calculating additional benefits such as remote monitoring and remote control. For instance, nearly 90% of all new relay unit purchases in the U.S. are digital (and over 40% of the installed relays are digital). Export opportunities are significant. International utilities outspend North American utilities 15 to 1 on new substation programs, according to research firm Newton-Evans.

Sidebar 6 -- University Spin-Out Rides Smart Grid Trend to Rapid Growth

Founded in 1982 as a "spin-out" from Washington State University, Schweitzer Engineering Labs introduced the world's first micro-processor-based relays in 1984. (Relays switch large currents on or off automatically or from a distance.) A single SEL product can often replace an entire panel of electro-mechanical relays at one-third the price.

After years of steady progress, the Pullman, WA-based company has recently experienced rapid growth as Smart Grid concepts start to catch on. In 2002, the company exceeded $100M in revenues and added more than 100 employees to reach nearly 700 in total.

Today, SEL has more than two dozen offices across the country and more than a dozen overseas. It is now expanding into related products and services for utilities and industrial customers.

You will find some overlap between this category and the grid monitoring, command and control category described above. Northwest companies with a role in this area include Alstom Transformers, Cascade Controls, PC Utilidata and Schweitzer Engineering Laboratories. (See Sidebar 6.)

OPPORTUNITY #5: LOAD MANAGEMENT/DEMAND RESPONSE

Broadly speaking, products and services in this category reduce the amount of electricity used in response to certain situations. Typically, they allow a utility to reduce peak loads by decreasing the amount of electricity customers use until the peak has passed. Active demand products reduce voltages, curtail use or otherwise allow a utility to cut back the power. Passive demand products create scheduled time of use programs. Both methods can reduce the need for expensive stand-by generation.

Many analysts believe demand response will eventually see enormous revenues, driven by utilities' needs to do peak load shaving. For instance, a McKinsey & Co. study in 2001 showed potential nationwide savings of $10-15B per year from demand response programs. All that's needed, some experts think, is a way to let the demand side bid into the market. Rather than bidding to supply additional power, aggregators could bid to reduce power by the same amount.

At the moment, however, this market mechanism is often blocked by regulatory barriers. (See the "Market Barriers" section for a further discussion of this obstacle.) Many utilities are not allowed to recover the costs of installing technologies for demand response (although they can recover the costs of a new power plant). What's more, utilities do not yet have the infrastructure to support load management or the in-house

Sidebar 7 -- MicroPlanet and PCS UtiliData Target Voltage Control for Utilities

At least two Northwest firms are marketing energy-saving voltage control devices to utilities, according to the March 27, 2003 issue of the Con.Web newsletter. Conservation voltage regulation (CVR) allows utilities to lower line voltage, thereby saving electricity that is otherwise wasted.

National standards require utilities to operate between 114 and 126 volts. Most utilities err on the high side -- around 123 or 124 volts -- to allow for sags and line losses. This excess voltage results in higher energy bills and shortened lifespan for lights, motors and appliances.

CVR devices allow utilities to lower the delivered voltage while maintaining or even improving reliability. In January, the Northwest Energy Efficiency Alliance approved a $2.8M project to implement and test Conservation Voltage Regulation in the Pacific Northwest.

Edmonds, WA-based MicroPlanet makes a small CVR box that plugs into the customer's meter. The $1,000 programmable device stabilizes voltage at a lower level. Although MicroPlanet sells to conservation-minded end users and business owners, it hopes to open a channel to utilities. The company has set up a sales network in 30 states and 21 countries to market to utilities, homebuilders and local governments.

Spokane-based PCS UtiliData uses a different approach. Its Adaptive Voltage Control system operates at the substation level, regulating voltage to hundreds or thousands of homes at a time. In many cases, an AVC system can replace a noisy, polluting diesel generator. Instead of firing up a generator to increase power supply, a utility can use AVC to instantaneously reduce power demand.

expertise to apply it properly. For these and other reasons, it may be several more years before this category begins to hit its full potential.

Northwest companies with offerings in this area include Celerity Energy, Microplanet and PCS Utilidata. (See Sidebar 7.)

OPPORTUNITY #6: WORKFORCE AUTOMATION AND MANAGEMENT

Products in this category help utilities automate and manage their key assets: their equipment, their workers and their customers. Although it often interfaces with utility back-end software (see above), we believe it qualifies as a category of its own. Examples include:

- **Workforce management** is a growing trend in many industries, including electric utilities. The greatest area of interest is in mobile workforce automation and scheduling, to make expensive repair and installation technicians more cost-effective. These systems often tie central scheduling applications to wireless terminals, so technicians can get up-to-the-minute changes without calling or returning to the office.
- **Outage management solutions** use remote monitors, GIS information and computer software to more efficiently pinpoint outages and their likely causes.
- **GIS applications.** Graphical Information Systems create computer maps of widely dispersed equipment. Utilities can associate a database with the map, so clicking on a piece of equipment on the screen brings up technical and maintenance details. These applications also allow for more efficient repair and maintenance scheduling, equipment upgrades and troubleshooting. Advanced systems even interface with GPS units mounted on repair trucks to show where they are in real time.
- **Maintenance expert systems** provide "just-in-time" training to technicians. An electronic database contains expert repair, installation and troubleshooting information. Technicians can call up the data as needed. Advanced wireless versions let technicians access this information in the field as they are working.

Automating and managing the workforce is likely to become a significant component of utilities' drive to manage costs and reliability. According to IDC, the worldwide market for wireless and mobile consulting, integration and management could reach $37B in four years. Wireless integrator Motorola estimates the utility segment of that market at $1B and growing at 15% a year. GIS, Global Positioning Systems (GPS), remote sensing and surveying grew in popularity over the last several years. According to ESRI, the market for these technologies and services increased by 23% in 2002, with the biggest spenders being electric, gas and other utilities.

Northwest companies with interests in this space include Fieldsoft Technologies and Itron.

OPPORTUNITY #7: DISTRIBUTED GENERATION INTERCONNECTION

This category spans the entire value chain -- generation, transmission, distribution and end use. Some DG projects connect to high-voltage transmission lines. Other times, the power is produced closer to customers and the connection is made to the distribution grid. In still other cases, the power is generated on the customer site.

This category also spans all forms of distributed generation -- mini-hydro, microturbines, fuel cells, wind, solar and so on. In all of those cases, the power plant must be connected to the grid. Issues can include:

- Conditioning the power so it is suitable for use
- Integrating safety features to prevent harm to customers and to line workers
- Making the physical connection
- Allowing for net metering (selling power back to the utility)
- Integrating batteries or other methods to overcome the intermittent nature of some renewable sources

Although still small, this category is primed for rapid growth by the middle of this decade. The IEEE has just released proposed standards to DG interconnection. As those standards gain acceptance they will make it easier and safer to buy and install DG. They will also create large-scale market opportunities. Companies will be able to create standard products that can be used virtually anywhere.

According to Allied Business Intelligence, global distributed generation (DG) capacity will increase from 20,000 MW to just shy of 300,000 MW by 2011. A report from Darnell shows the worldwide distributed and cogeneration (DCG) market growing from 53 GW in 2003 to 78 GW in 2008, creating a $30B opportunity by 2008, some fraction of which would be interconnection technologies.

Northwest companies with interests in this space include Alpha Technologies, JATS Alternative Power, New Path Renewables, RBH Electronic Designs, Schott Applied Power and Xantrex.

OPPORTUNITY #8: ADVANCED METERING

The United States has approximately 130M electric meters (not to mention 140M gas and water meters). Until recently, most were read manually once a month. Today, utilities are converting to advanced meters, which transmit data via phone, Internet or wireless connection. Advanced meters can show how much electricity is being used on an hour-by-hour basis.

The metering market seems poised for continued growth. Investment banking firm Delafield Hambrecht calls advanced metering "a significant untapped market." The firm estimates only 17% of the total market is equipped with advanced meters, far short of the 60-90% projected penetration rate. The Chartwell market research firm also forecasts strong growth for advanced metering. Its April 2003 report predicts the market will grow 15-20% over the next five years.

The Northwest is home to Itron, the world's largest provider of advanced meters (see Sidebar 8) and to several other firms with offerings in this category, including Dent Instruments, Teldata, H.J. Arnett Industries, Utility Systems & Applications and others.

Sidebar 8 -- Itron Reports Record Financial Results for 2002

July 16, 2003. Spokane, WA-based Itron today reported financial results for the quarter ended June 30, 2003. Second quarter revenues were $80.3M, up $7.8M, or 11% over second quarter 2002 revenues.

Itron made its mark in automated meter reading -- including wireless, "drive-by" products as pictured -- where it is far and away the market leader after its $250M acquisition of Schlumberger Electricity Metering (SEM) in summer 2003. SEM had revenues of $229M and EBITDA of $33M in 2002. It brings to Itron more than 1,000 new employees and more than 3,000 utility customers. Itron also acquired three companies in 2002 and announced plans to acquire a fourth.

The publicly traded company is headquartered in Spokane, with manufacturing facilities in Michigan and North Carolina. It has moved into many other areas beyond meters, including energy information management, demand side response, workforce automation, and customer information systems.

OPPORTUNITY #9: ENERGY MANAGEMENT SYSTEMS

Integrated energy management software gathers information about energy usage to create a single picture and single control point. Utility-side products pull together data from thousands of advanced meters to provide load analysis, forecasting and planning. End-user products bring together information from meters, from sensors and from building controls to manage campuses, office parks, factories, apartments and high-rises. Large office towers can sometimes save hundreds of thousands per year through better energy management.

Regional companies in this space include Avista Advantage, Christenson Power Services, and Alstom.

OPPORTUNITY #10: BUILDING AUTOMATION AND CONTROL

Building automation and control, building management systems, and building diagnostics work to control energy use. The most straightforward application is to remotely control such things as lighting, heating and air conditioning. The next step is to use that same data and those same controls to improve efficiency (at which point there is overlap with end-user energy management systems, as described above).

The two driving trends in this subcategory are 1) a switch away from proprietary systems toward an open standard called BACnet and 2) a move toward centralized control of multiple buildings via the Internet.

The Northwest has branch offices of several internationals in this area, including Johnson Controls and Siemens Building Automation. It also has several "home-grown" companies, including Control Contractors, Holaday-Parks Building Automation Systems, and Alerton. (See Sidebar 9.)

Sidebar 9 -- UK Firm Buys Redmond, WA-Based Maker of Smart Building Controls

March 3, 2003. Novar plc of the United Kingdom has completed its acquisition of Redmond, WA-based Alerton Technologies, a maker of building automation and control systems.

Alerton is recognized as a pioneer in the building automation and controls industry. Its digital controls and computerized monitoring are in place in thousands of buildings, including Seattle's Bank of America building (see photo).

Building automation and control systems can provide major energy savings, along with many other benefits. Alerton was known for its leadership role in BACnet products. BACnet is an industry standard for interoperability that allows computer-based systems to manage controls and equipment from a wide range of manufacturers.

Alerton will remain in Redmond and become a subsidiary of Novar's Intelligent Building Systems division. Novar plc is a $2.3B corporation with interests and subsidiaries in several industries, including building management systems and energy management systems.

OPPORTUNITY #11: POWER ELECTRONICS

Some products in this category convert or condition electricity for applications that require premium power, such as computers, sensitive medical equipment, telecommunications centers, financial services centers, and so on. Other products correct for characteristics of electric motors that cause them to draw more power than they actually need.

The Northwest houses several companies that operate in this space, including Advanced Power Technology, Northern Technologies, Philtek Power, Sure Power Industries and Xantrex.

OPPORTUNITY #12: SMART MOTORS / ADJUSTABLE SPEED DRIVES

Electric motors use a significant percentage of the nation's electricity (25% by some estimates). New motor designs can reduce that amount considerably, through on-board intelligence and through the ability to adjust the speed to match the need.

Smart motors and adjustable speed drives are a part of a worldwide market for electronic motor drives, which is slated to grow from $12.5B in 2000 to $19.1B in 2005, according to Drives Research Corporation.

Northwest companies include Motors and Controls Corp and MagnaDrive, a Washington company that holds patents for a unique adjustable speed drive that could, in theory, revolutionize industrial motors. (See Sidebar 10.)

Sidebar 10 -- Seattle's MagnaDrive Signs International Distribution Agreement

Seattle, WA, February 19, 2003. MagnaDrive today announced it has signed an agreement for UK-based British Autogard to represent Magna-Drive products in Europe, Southern Africa, Australia and Asia. MagnaDrive produces innovative electric motors that use magnetic induction in place of physical connections, thereby reducing friction, vibration and energy use.

The company's technology was named a Technology of the Year for 2001 by *IndustryWeek Magazine.* It's adjustable speed drives (ASDs) offer energy savings of one-fourth to two-thirds over ordinary electric motors. Industrial motors consume approximately 25% of the nation's electricity.

This agreement adds to the company's existing distribution arrangements in Canada, Taiwan, Korea and Japan. Because electricity costs are higher overseas, analysts believe the international market for ASDs will be twice as large as the domestic market.

OPPORTUNITY #13: SMART DEVICES AND APPLIANCES

Smart devices can encompass anything from industrial equipment to home appliances, as long as it includes communications and intelligence. There is some overlap between the building automation category described above. Building automation relates to lighting, heating, air conditioning and related functions. Smart devices relates to individual products with embedded intelligence.

The Northwest has little commercial activity in this space. To some extent, Microsoft's smart home efforts relate to this category. And some of PNNL's research involves products that can sense the condition of the grid and reduce the power load as needed. (See Sidebar 11.)

OPPORTUNITY #14: ENERGY CONSULTING & ESCOS

Outsourcing is a growing trend in all technology areas, and energy is no exception.

Sidebar 11 -- PNNL Prototypes Smart, "Grid-Aware" Appliances

Energy research underway at Pacific Northwest National Laboratory is one of the assets that make the Northwest a natural candidate to lead the Smart Energy sector. For instance, PNNL researchers in Richland, WA, have a prototype device that senses grid conditions and then controls water heaters, air-conditioners, and other appliances to help avoid power outages.

If it senses a grid problem, the device automatically takes actions to reduce the electrical load. Examples include brief delays in starting a hot water heating cycle, slight postponements of defrost cycles, small reductions in voltage, minor dimming of lights, and so on. This type of "non-intrusive load management" could be one key to a smart, self-repairing grid.

By itself, a single device has little impact on grid conditions. But if thousands of such devices were attached to the grid, they would provide a brief but all-important cushion. If the grid can operate closer to the limit, utilities have less need for expensive spinning reserves -- power plants kept online "just in case."

Energy consultants provide a wide range of services to utilities and large end users, such as resource planning, consulting engineering and strategic planning. Northwest examples include Acres International, Energy International and a long list of engineering firms.

Energy service companies (ESCOs) provide a wide range of services, including management consulting, engineering consulting, system integration, site assessments, financing, project installations, maintenance contracts, energy management and building control. Their primary targets are commercial and industrial customers. They typically prefer agreements that last five years or more. Many ESCOs work on performance guarantees while assuming some technical, operational and financial risk. Some of them also receive a percentage of the energy savings they produce, although most have a flat fee as some portion of their compensation.

According to a 2002 study by the National Association of Energy Services Companies, ESCO revenues increased at a 24% annualized rate over the past decade, although growth has declined since 1996 to 9%. Current ESCO market activity ranges between $1.9B and $2.1B each year.

The energy services opportunity has slowed from its original high expectations, but it is poised to experience resurgence. Growth will be driven by the overall trend toward outsourcing. This trend is affecting most industries. It is expected to have a large impact in the utility arena, which had traditionally been reluctant to outsource. In today's economic climate, utilities can no longer afford to do everything themselves when they can outsource to less expensive, more efficient specialists.

Northwest ESCOs include Clark's Energy Service Corp., Northwest Energy Services, and Quantum Engineering & Development.

SMART ENERGY WILL GENERATE SIGNIFICANT EXPORTS AND REVENUES

Because of their complexity and their high value-to-weight ratio, many Smart Energy products can be manufactured in this region for export. In fact, export must be a component of every company's strategy since so much of the opportunity is located beyond the United States.

The electric power industry is mature in most industrial countries, but deregulation, privatization and liberalization are driving demand for Smart Energy solutions. Deregulation has also increased the interest in more advanced products in energy trading and metering. This trend is affecting several regions of the United States, Canada and Mexico, creating North America export opportunities. Market restructuring is also driving growth in parts of Latin America, Australasia and Western Europe, particularly in the United Kingdom and the Scandinavian countries.

In developing countries, export opportunities derive less from deregulation and more from growing energy needs. Export opportunities include construction and upgrades of power T&D networks in these countries, plus demand for new power generation (including distributed generation). More than a dozen large international financial institutions (such as The World Bank) fund energy-related infrastructure projects in developing countries.

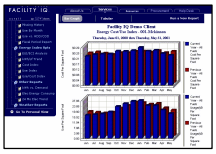
SIZING THE MARKET

Earlier we discussed the challenges in defining terminology for the Smart Energy sector. Finding accurate market projections is equally difficult. A few sectors -- most notably advanced metering -- have received widespread attention from analysts and market research firms. A few others were tracked by Wall Street during the boom days of the late 90s, only to be dropped when the markets fell. Still others -- such as distributed generation interconnection -- have been lumped into larger categories. And some segments have never been carefully charted, despite their growing sales.

For these reasons, we can offer only an approximation of the market size. Based on existing projections for some segments and estimates for others, we believe the 14 areas discussed in this represent at least $8B in revenues worldwide. By way of comparison, most experts put the worldwide wind market at $5B, the solar market at $1.5B and the fuel cell market at $0.5B.

Growth of 10% per year would bring the Smart Energy market to more than $14B by 2008 and nearly $23B by 2013.

Sidebar 12 -- Facility IQ Manages Large Sites Over the Internet



A subsidiary of Spokane's Avista Utilities has found success as a service company that manages electric, water, waste and phone bills for large companies. Originally spun out of Avista Utilities in 1995, Avista Advantage now boasts more than 200 clients around the country. Its flagship FacilityIQ product line helps these large companies manage expenses across more than 100,000 locations.

At heart, Facility IQ is a bill paying/bill management system for services such as electricity and telephone. For instance, a customer using the Utilities module has all its energy, water and sewage bills sent to Facility IQ. The bills are audited, entered into a master database and presented online for payment approval. Once the bill-paying data is in the system, it can help to reduce usage and costs. Facility IQ provides instant online access to key data, reports and comparisons, allowing customers to find trouble spots and reduce consumption.

REGIONAL POTENTIAL: KEY ADVANTAGES AND MANAGEABLE HURDLES

In the previous section, we examined the global market for Smart Energy. In this section, we identify the assets that strengthen our region's prospects and the hurdles that block its path. As you will see, the Northwest has all of the assets necessary to establish a powerful Smart Energy cluster. The five most important are:

- Successful pioneers
- World-class research
- Transmission and distribution expertise
- Transferable skills
- Ideal test-bed environment

THE NORTHWEST HAS SUCCESSFUL PIONEER COMPANIES

Economic development research reveals that the number one factor for growth is the existence of several successful companies in close proximity. These companies play several roles. Their early success attracts venture capital. Their success also attracts employees, who typically look for regions with "thick" employment -- that is, where they have several options to continue their careers without leaving the area. These pioneers also act as an "executive university," creating a supply of people with the all-important combination of technical expertise and management skills.

What's more, it turns out to be much easier to grow existing companies than to encourage startups or to attract companies from outside the region. Happily, the Northwest has such a cluster as embodied by firms such as Itron, Alstom Esca, Schweitzer Engineering Labs, Teldata, Alerton, and others. These companies have found growth and success even in the midst of the economic downturn -- proof that they are on to something.

Thanks to our region's preoccupation with aerospace and software, the success of this cluster has gone largely unnoticed by the press and by investors. Yet the Northwest is already one of the country's leaders in this emerging sector. With its recent purchase of a rival maker of advanced meters, Itron will pass the $500M mark in annual revenues. Schweitzer and Alstom are both well past $100M. In total, our research has uncovered more than 150 Smart Energy-related businesses in the Northwest, doing well over $1B annually in combined revenues.

THE NORTHWEST BOASTS WORLD-CLASS RESEARCH FACILITIES

If having successful "pioneers" is the number one factor for economic growth, then research facilities is number two. The Northwest is blessed with one of the country's largest concentrations of Smart Energy research. According to the Institute of Electrical and Electronics Engineers, fewer than 15 universities nationwide offer PhD-level programs in power engineering. Fortunately, both Washington State University and the University of Washington are in that number, and Gonzaga boasts a strong undergraduate program. These programs provide a regional advantage, as the industry braces for a shortage of power engineers. The U.S. currently awards about 500 undergraduate degrees in the field, compared to about 2,000 in the 1980s.

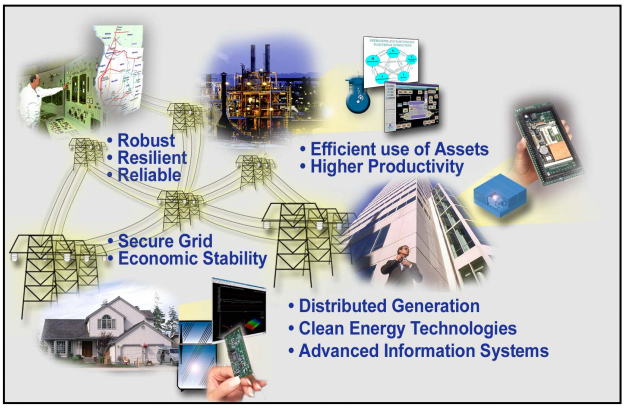
Below is a brief overview of leading Northwest Smart Energy research assets:

Pacific Northwest National Laboratory is one of the country's top Smart Energy research centers. (See Figure 12.) PNNL has its headquarters in Richland, WA plus offices in Seattle, WA, Tacoma, WA and Portland, OR. In response to the DOE's increasing emphasis on transmission and distribution, PNNL expects to significantly expand its research in that area.

Figure 12
Energy System Transformation

Pacific Northwest National Laboratory has an ongoing program to "bring the energy system into the information age." It also researches power grids, energy efficiency, building energy codes, automated building management and advanced building technologies.

Source: PNNL



The University of Washington has ten engineering programs with nearly 1,500 undergraduates and 1,200 graduate students. It has degree programs in power engineering that typically enroll about 50 students per year (roughly 20 graduate students). The university also encourages research on transmission optimization, automation, and power quality. Its power engineering program has partnerships with the Grainger Foundation, the Electric Energy Industrial Consortium and the Advanced Power Technologies Center. The Washington Technology Center is also located at the University, and supports firms developing and testing prototypes in many fields, including engineering fields.

Washington State University's energy and power systems program is one of the largest and strongest in the country, typically enrolling about 40 students per year, half at the undergraduate and half at the graduate level. (See Sidebar 13.) WSU is also a member of the Power Systems Engineering Research Center, which is funded through the National Science Foundation. In addition to its power engineering programs, WSU operates the Energy Program for the State of Washington. That program includes a library and clearinghouse services for energy professionals, plus numerous technology and consulting services, mostly geared to energy efficiency.

Sidebar 13-- WSU Power Engineering Program Spurs Business Opportunities

Power engineering at Washington State University remains one of the strongest and largest programs in the country. In addition to providing nationally-recognized academic programs, WSU's Energy and Power Systems program also acts as a leading research facility. The number of research projects is now at record levels and the program continues to be called on for research of national consequence.

One of the program's hallmarks is a public-private consortium called the Power Professorship. Private sector members include utilities, power vendors and consulting companies. Both faculty and students work closely with these industrial partners on technical projects of direct relevance.

The partnership is obviously working. Pullman graduates are heavily recruited within the industry. And Washington's Inland Empire has seen the rise of a growing cluster of energy-related businesses. Several of these companies were founded by, or rely heavily on, professors and graduates from WSU.

The Oregon Institute of Technology hosts the Oregon Renewable Energy Center, which includes research into grid interconnection and other Smart Energy topics. In particular, OREC emphasizes the integration of technologies into energy systems of practical use to businesses and the public. OIT also has an incubator that can be used to accelerate the growth and commercialization of particular Smart Energy technologies.

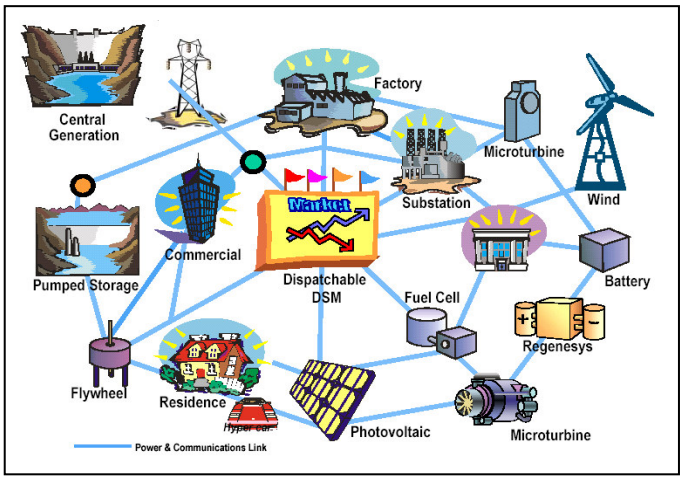
The Oregon State University's School of Electrical Engineering and Computer Science (EECS) features a research program in Energy Systems. It is also home to the Motor Systems Resource Facility, one of the country's top research and testing laboratories for motors, drives, power electronics and power quality. It also has an energy extension program in its College of Engineering that helps solve energy-related problems for homes and businesses. In cooperation with BPA, the Energy Resources Research Laboratory (ERRL) collects and manages data from transmission line research (it also tracks data from BPA's wind energy resource studies). And OSU also hosts a regional Industrial Assessment Center for improving the energy efficiency of medium-sized businesses.

The Bonneville Power Administration has sponsored many important research projects and hosts the EnergyWeb project, a vision of a future Smart Grid that integrates "the utility electrical system, the telecommunications system and the energy market." (See Figure 13.) In addition, BPA owns and operates significant transmission assets, and therefore represents a strong opportunity for companies to demonstrate the effectiveness of new technologies. BPA also works in cooperation with PNNL and regional universities to develop intellectual property and insights into transmission challenges. BPA is headquartered in Portland, OR.

Figure 13
BPA's EnergyWeb

The Bonneville Power Administration is one of the country's leaders in understanding and advancing the concept of an intelligent, decentralized power system, as illustrated in this concept drawing.

Source: BPA



THE NORTHWEST HAS DEEP TRANSMISSION AND DISTRIBUTION EXPERTISE

The Northwest heritage includes hydropower, long distances between metropolitan areas and shipping power back and forth to California. As a result, we have a vast network of transmission lines and long experience with transmission challenges.

We have exceptional expertise in transmission modeling, design, planning and installation. This know-how resides in agencies such as the Bonneville Power Administration and the Army Corps of Engineers. And in the utilities that are exporters and importers of power. And in our universities and research labs. And in private companies such as Schweitzer Engineering Labs, American Line Builders and the Linesoft division of Itron.

THE NORTHWEST HAS TRANSFERABLE PRIVATE SECTOR SKILLS

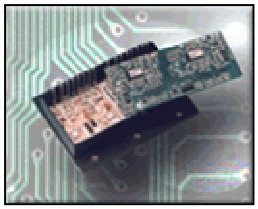
Of all the categories investigated during the *Poised for Profit* project, Smart Energy has the most immediate and obvious overlap with regional strengths such as:

Software engineering. The Northwest is home to nationally known software organizations such as Microsoft, Attachmate, WRQ, Adobe, Boeing Computer Services, and Timberline Software, not to mention hundreds of innovative small firms. Several regional universities host strong software engineering programs.

Internet expertise. With firms such as Amazon, RealNetworks, Infospace and many others, the Northwest is a leading center of Internet expertise. (Some of it un- or under-employed due to the dot-com crash.) Since many people describe Smart Energy as a marriage of energy and Internet, this expertise is of value and significance.

Semiconductor design and manufacturing. Oregon's base of semiconductor expertise has direct relevance to the growing number of digital devices for the power industry. (See Sidebar 14.)

Sidebar 14 -- Bend, OR-Based Advanced Power Technology Acquires Two Companies in 2002



Advanced Power Technology of Bend, OR acquired two companies in 2002 as it works towards its goal of becoming the world leader in power semiconductors for high-power and high-frequency applications. Power semiconductors are used in the conditioning and control of electrical power.

APT's specialty products are found in high-powered medical, industrial and aerospace devices. The company also makes a line of products for the burgeoning RF market, including radar and avionics.

Although people might not think of Bend as a high-tech hotspot, APT successfully competes with such high-tech heavyweights as Motorola, Philips and Fairchild. Its 2002 revenues of $43.4M represented a 17.8% increase over 2001, despite the current economic downturn.

Wireless communications. Washington State boasts one of the largest wireless clusters in the nation. Utilities and power companies are increasingly interested in wireless methods of monitoring equipment and gathering data. (See Sidebar 15.)

Sidebar 15 -- Spokane Maker of Rugged, Wireless Laptops Finds Success in Utility Market

Spokane-based Itronix illustrates how the Smart Grid trend can provide opportunities in adjacent industries. As more utilities automate their mobile workforces, Itronix has found a ready market for its ultra-rugged laptops and handhelds.

The company's products feature rugged construction for demanding work environments, integrated wireless communications for mobile workers, and in-vehicle docking stations for recharging. In addition to utility companies, Itronix sells to the military, construction, telecoms and other industries that need highly reliable computers for indoor/outdoor use. (Itronix has no relation to Itron, the utility automation company also based in Spokane.)

Power electronics. In the mid-90s, Washington State firms commanded three-fourths of the global market for power inverters, a necessary component for distributed generation. In the late 90s, British Columbia firms purchased the top companies. They have since moved management to Canada, outsourced much of the manufacturing overseas and reduced their presence in Washington. Nonetheless, the state retains modest engineering and manufacturing operations along with several small spin-off firms.

The skills developed over the past 25 years in the industries mentioned above -- management skills, product development skills, sales skills -- can now be deployed in Smart Energy. In addition, regional organizations such as Intec (Spokane), South Sound Technology Alliance (Tacoma) and Oregon Institute of Technology (Klamath Falls) have programs underway to identify and supply the workforce training needs of the electric power industry.

THE NORTHWEST IS AN IDEAL SMART ENERGY TEST-BED

The assets described above make the Northwest an ideal test bed for the new Smart Grid. The case is made even stronger by these additional factors that make the Northwest a great place to demonstrate new technologies:

- **Diverse climates and geographies.** The Northwest has four distinct seasons and a wide range of geographies, from desert to mountain to seacoast to urban.
- **Diverse mix of power sources.** We produce baseload power from centralized hydro, nuclear, coal and wind facilities. We also have pilot distributed generation facilities powered by fuel cells, solar and wind.
- **Diverse mix of transmission facilities.** We have thousands of miles of transmission lines and multiple voltages. Approximately 50% of the lines are owned by public utilities. And the region has lots of rural areas, which are excellent for distributed generation experimentation.
- **Diverse mix of commercial, industrial and high-tech giants.** Organizations such as Boeing, Weyerhauser, Starbucks, Microsoft and our regional ports are ideal candidates to pilot new technologies.
- **Diverse mix of utilities.** Our region includes federal, state, municipal, coop and investor-owned utilities.
- **History of utility cooperation.** Northwest utilities routinely work together on business, technology and policy matters. The BPA is a nexus for cooperative research and discussion. We have numerous organizations with a history of collaboration, including the Northwest Energy Efficiency Alliance, the Northwest Power Planning Council, the Electric League of the Pacific Northwest and several others.

- **Test bed efforts now underway.** The Northwest Energy Technology Collaborative is actively working to create test beds and demonstration projects. The Northwest Energy Efficiency Alliance, the Bonneville Power Administration and several of the larger utilities also sponsor demos and testing that often overlaps into the Smart Energy arena. And the Northwest Hydrogen Coalition is seeking a $150M federal grant for fuel cell testing, including tests of fuel cells for distributed generation.

OTHER NORTHWEST ADVANTAGES

The Pacific Northwest has several other factors that could benefit the growth of a Smart Energy cluster:

Entrepreneurial infrastructure. Washington State ranks high in most measures of entrepreneur energy and infrastructure. Oregon typically ranks in the top third. The region is well-served by angel investors, venture capital firms, law firms, accounting firms, banks, trade associations and serial entrepreneurs. Although this infrastructure is concentrated near Seattle and Portland, nearly all communities of any size have access and local economic development organizations to assist.

One of the secrets to economic development is to unlock "latent entrepreneurs" -- those individuals inside companies who have ideas for startups. The region's entrepreneurial infrastructure is an asset in allowing those people to grow their ideas into new companies.

Gateway to the Asia-Pacific region. Many Smart Energy niches have significant overseas markets. The Northwest is known as an access point to the Pacific Rim, and can use this status to attract companies who want to export their Smart Energy products and services.

A "green" lifestyle. Our region has a national reputation for a beautiful environment and an eco-friendly population. This green lifestyle is an advantage when recruiting Smart Energy workers and companies.

NORTHWEST CHALLENGES: LACK OF AWARENESS, PROXIMITY, AND VISIBILITY

Most of our region's obstacles are the same ones that face the rest of nation, as discussed earlier under Market Barriers:

- Regulatory chaos
- Lack of price signals
- Conservative utilities

- Lack of capital

We do note four areas where the Northwest is at a disadvantage:

GEOGRAPHICAL DISTANCE AND REGIONAL RIVALRY

Close proximity makes clusters easier to establish and maintain. Some economic development experts argue that clusters cannot arise unless companies are highly concentrated. The Northwest has long distances between its metropolitan centers. Smart Energy companies in Washington, Oregon and Canada rarely communicate or cooperate. Even the nascent energy technology cluster in Washington's Inland Empire is scattered hundreds of miles apart between Spokane, Pullman and the Tri-Cities.

THE REGIONAL INDUSTRY IS NOT YET "SELF-AWARE"

Twenty years ago the personal computer industry became "self-aware" and began to organize trade associations, conferences, joint marketing and lobbying efforts. The Northwest took a lead in this effort, and became one of the world's top software centers. By contrast, most Northwest Smart Energy companies do not yet realize that this region is already a leading center and that they could accelerate progress through cooperative efforts.

LACK OF NATIONAL VISIBILITY

Even though the Northwest has significant companies and significant research, it is not known as an important player in the "new energy" sector. This lack of reputation is a disadvantage when it comes to attracting businesses and workers.

LOW POWER PRICES

Most people would name low power costs as an advantage. When it comes to jump-starting the Smart Energy sector, however, low prices create less incentive to implement new ideas. In addition, virtually all Northwest power comes from baseload plants. Unlike regions such as California, there is very little gap between peak and off-peak prices. It is therefore difficult for Northwest utilities to implement time-of-day pricing and other demand management programs.

REGIONAL OPPORTUNITIES: FOUR MAJOR OPPORTUNITIES AWAIT

To this point, we've examined the global scene and our regional issues. With those discussions as background, we are ready to consider where and whether the Northwest has near-term opportunities in the Smart Energy space. Our preliminary research has uncovered at least four strong prospects and at least six with moderate potential.

THE NORTHWEST HAS SIGNIFICANT POTENTIAL IN FOUR IMPORTANT NICHES

At this early stage of the game, the Pacific Northwest could still gain a leading stake in the Smart Energy sector. Our research uncovered five areas that combine a) near-term growth prospects with b) regional strengths. Table 3 lists these opportunities along with their associated issues.

TABLE 3 -- STRONG OPPORTUNITIES FOR NORTHWEST SMART ENERGY GROWTH

Opportunity	Assets	Challenges	Organizations
Advanced Metering	▪ Region already has market leaders in this area ▪ Builds on our wireless capabilities	▪ Will require education to inform software companies of the opportunities to augment this area	▪ Itron: Spokane, WA ▪ Teldata Solutions: Portland, OR
Utility Back Office Software	▪ Region has a world-leader and several promising upstarts	▪ Geographical distance from some of the best markets	▪ Alstom: Bellevue, WA ▪ Enegration: Vancouver, WA ▪ Utility Solutions: Bend, OR
Grid Monitors and Controls	▪ Regional IP from PNNL, Universities ▪ Regional strengths in sensors and control development	▪ Technology transfer difficult ▪ Sensor and control strengths are in industrial processes, not utilities	▪ Alstom: Bellevue, WA ▪ Micromonitors: Bend OR ▪ PNNL: Richland, WA
Transmission/ Distribution/ Substation Automation	▪ Regional strengths in digital relays ▪ Strong transmission presence with BPA. Area is net exporter of power ▪ Intec, OIT, and other academic programs could develop complementary training	▪ Hardware margins decreasing ▪ Service opportunities in this category difficult to export ▪ Category dominated by large players, start-ups may have challenges	▪ Alstom: Bellevue, WA ▪ Schweitzer: Pullman WA ▪ IST: Vancouver, WA

ADVANCED METERING

Metering is our region's single largest opportunity in terms of revenue and jobs, since the worldwide leader is Spokane-based Itron. With its recent acquisition of SEM, Itron now has more than 60% of the market and does more than a half billion in sales each year.

The Northwest's strengths in wireless applications should prove useful as metering companies continue to look for wireless solutions. Although most analysts are not yet factoring meter-related software into their growth equations, we believe utilities will increasingly seek to make business use of the rich data they are now collecting. Our region's expertise in software development should help support growth in that area. As the meter moves to become a gateway with which to offer other products and services, proximity to Microsoft and its digital home agenda could be strategic.

GRID MONITORING, COMMAND AND CONTROL

The Northwest should be able to play a central role in this area. Regionally, several groups are working to develop intellectual property around grid optimization, including University of Washington, PNNL and WSU. As SCADA systems continue to move from Unix towards Windows platforms, the region's proximity to Microsoft means regional Windows-based software companies could find this an appropriate area to explore. We have anecdotal evidence that companies in this category are influenced by the number of power engineers available in the region when selecting sites for offices and branches. WSU, UW, Gonzaga, OIT and OSU currently offer or are in a position to offer programs tailored to training power and electrical engineers.

This opportunity also builds on regional strengths in sensors and controls where there are dozens of niche opportunities. Micromonitors in Bend, Oregon is one example of a sensor company focused on this space. There are also service opportunities, since anywhere from one fourth to one half of the budget for these systems is spent on training and system integration.

TRANSMISSION/DISTRIBUTION/SUBSTATION AUTOMATION

This segment represents an outstanding opportunity for the Northwest. As with the previous category, it builds on work being done on grid optimization. With the variety of transmission conditions in the Northwest, the region is an ideal place to test new technologies. We also have the beginnings of a cluster with companies such as Alstom, PCS Utilidata and Schweitzer Engineering Labs.

This segment embraces considerable export opportunities. Our location would aid those who are trying to penetrate the Asian market, but does not preclude sales to Europe and Latin America. International utilities are more likely to purchase these products from a large supplier or system integrator, so it may be necessary for regional firms to partner with overseas integrators.

UTILITY BACK OFFICE SOFTWARE

The Northwest already has a large market player in Alstom, which is one of the top six in the world. It also houses branch offices for other important players such as Indus, and for systems integrators now becoming active in this space, such as EDS.

In addition to Alstom, the Northwest also boasts several startups, plus several consulting firms devoted to helping utilities with this challenge. Since the utility industry is following a path blazed by numerous other industries before it, we can expect the Northwest's strengths in enterprise software to come into play. In many cases, it requires only modest changes to customize existing back office programs to the needs of utilities.

Sidebar 16 -- Portland's FirstPoint Energy Corp. Builds Integrated Platform for Utilities

Portland-based FirstPoint Energy combines products from subsidiary and related companies to create energy information services for utilities and large businesses.

FirstPoint owns UtilityOne, a Bay Area provider of e-commerce software for utilities. It also has a relationship to Portland's Teldata Solutions, which provides advanced metering solutions for electric, gas and water utilities. The company's goal is to create a complete, end-to-end integrated energy platform. Current offerings include advanced metering, software for aquiring and managing meter feeds, and energy information software for Internet-based access to that data.

THE NORTHWEST HAS AT LEAST SIX MODERATE TO STRONG OPPORTUNITIES

Our research has uncovered at least six market segments with moderate to strong near-term potential for near-term jobs and revenue growth in the Northwest. Table 4 lists and explains our findings.

TABLE 4 -- MODERATE OPPORTUNITIES FOR NORTHWEST SMART ENERGY GROWTH

Opportunity	Assets	Challenges
Energy Management Systems	▪ Regional emphasis on software and enterprise computing should provide innovations and support ▪ Strong start with Silicon Energy providing versions of these systems	▪ Smaller local demand to support start-up ▪ Requires building commercial go-to-market partnerships and channel relations with existing suppliers
Building Automation and Controls	▪ Redmond-based Alerton is a technology leader ▪ Giants Johnson Controls and Siemens Building Technologies have significant regional presence	▪ Distance from major centers of building activity ▪ Category growth may be slowed by problems in the real estate and construction markets
Distributed Generation Interconnection and Support	▪ Power electronics for interconnection technologies ▪ Could work with local solar and fuel cell developers ▪ Proximity to Canada	▪ Low power prices reduce regional demand for distributed generation ▪ IEEE standard only recently released, protocols still in flux, commercialization horizon may be outside of near-term
Energy Service Companies (ESCOs)	▪ Regional strengths in energy conservation techniques with programs at WSU, elsewhere ▪ High quality labor available	▪ Difficult to export a service ▪ Competes with local utilities that deliver it for free ▪ State tax structure creates disincentives to locate headquarters here
Workforce Automation	▪ Wireless entrepreneurs and skilled software companies ▪ Major carrier presence ▪ GIS application development beginning	▪ Local area is more software heavy than device heavy ▪ Manufacturing components may go elsewhere
Power Electronics	▪ Oregon State University Electrical and Computer Engineering has helped develop power quality devices ▪ Builds on our strengths in power electronics ▪ Can sell to industrials and other commercial customers until utilities come around	▪ Will take off first where power prices are high ▪ Utility resistance is a big hurdle

THE NORTHWEST COULD ACCELERATE PROGRESS

The Northwest is fortunate to have a significant Smart Energy foundation in place. It should take every opportunity to expand its early lead, lest it lose out to other regions. Michigan, Texas, Connecticut and California have multi-million dollar efforts in place to attract clean energy businesses of every kind, including Smart Energy firms. The Northeast has made progress

in restructuring, leading to many market opportunities for new technologies. And the Southeast has exceptional T&D expertise at Oak Ridge and the Tennessee Valley Authority, along with significant power to export.

Nor is the competition limited to the United States. Several Canadian provinces have begun to liberalize their utility markets and Smart Energy companies are springing up in Ontario, Alberta and British Columbia. Europe is home to several of the industry's giants.

There is another important reason to look for ways to accelerate the growth of Smart Energy. A reading of the most recent economic development research reveals that "force-feeding" sectors rarely results in significant economic growths. In the 80s and early 90s, many regions attempted to start new sectors from scratch. All but a few of those efforts failed, including efforts costing tens of millions in the Northeast, in Maryland and in Texas.

On the other hand, efforts built around existing strengths and existing concentrations often find success. It is extremely difficult to command an industry to appear in a region. Yet it is quite achievable to find an early-stage cluster and fan that spark into a flame.

Below are eight examples of initiatives that could meaningfully advance the prospects for a Smart Energy cluster in the Northwest.

A Smart Energy Trade Association

A trade association is virtually a prerequisite for an industry cluster. It is even more important for the Northwest because a) our companies are not yet aware of themselves as a regional force and b) the lack of geographical proximity makes it essential to introduce companies to each other.

As of this writing, a new regional trade association called the Smart Energy Business Alliance is in the formation stages.

Test Beds and Market Access

Lack of market access is one of the major barriers to the growth of Smart Energy companies. It is extremely difficult to get utilities to accept new technologies. The Northwest could improve the prospects of its Smart Energy sector -- and enhance its attractiveness to companies looking to relocate -- by implementing market access programs such as test beds and certification.

Test beds are typically shared cost facilities that share test results with all the participants (and sometimes with the world at large). As of this writing,

a regional consortium called the Northwest Energy Technology Collaborative is preparing a test bed initiative that could be an important first step in the right direction. In addition, organizations such as PNNL, BPA, NWEEA and the state energy offices are actively scouting for opportunities for demonstration projects that can also provide needed real-world results.

Investor Outreach and Education

Access to capital is another formidable challenge for regional Smart Energy companies. Our region has neither large energy funds, nor clean energy VCs, nor public funds committed to clean energy investment. Indeed, most regional investors remain ignorant of Smart Energy as a sector and an opportunity.

Access to venture capital has improved dramatically in Washington and Oregon over the past decade. Even so, very little of that money goes to energy-related businesses of any kind, much less to Smart Energy companies. Regional angels and venture capitalists tend to focus on software and computer-related investments.

Ironically, Smart Energy has great overlap and synergy with those very areas. A short-term (18 months) program of investor education could change this and could establish Smart Energy as a legitimate place for venture investing. Typical examples include venture forums, energy conferences and investor-oriented newsletters.

Innovation Centers, Incubators and Accelerators

The Northwest badly needs a "technology innovation center" to assist emerging clean energy ventures with the rapid commercialization of their products and services. Such centers -- and related organizations such as business incubators and business accelerators -- have found widespread success in many technology industries.

The U.S. now boasts at least 15 clean energy incubators, accelerators and technology centers. Canada, Europe and Japan also have notable facilities. Despite its reputation for environmental friendliness and entrepreneurial activity, the Northwest has no such institution. To be sure, technology centers can cost in the millions. Even so, other regions and countries have found the money, through government, through public benefit funds or through public/private partnerships.

The Northwest should embark urgently on the preparation of a business and fundraising plan for a clean energy innovation center. We would expect

this center to spend the bulk of its time on Smart Energy businesses (since Smart Energy represents the region's largest opportunity), but its services should be available for other clean energy categories as well.

A Promotion and Visibility Effort

Smart Energy is largely unknown as a standalone sector (even though it is many times larger than better known segments such as fuel cells and solar). Likewise, the Northwest is unknown as a center for clean energy or Smart Energy.

A short-term promotion and publicity campaign could quickly raise our profile around the world. This effort would also help to solve some of the region's other challenges as well. For instance, venture capitalists are strongly attracted to emerging clusters that can show early success stories. Likewise, companies shopping for new branch locations prefer regions that can supply customers and skilled workers. Skilled workers, meanwhile, gravitate to "thick" employment markets -- regions with many companies and many jobs in the same sector.

Such promotional efforts do not need to be costly. It is far more effective -- and far less expensive -- to get positive articles in respected publications than to purchase advertisements or send delegations on expensive visits.

The *Poised for Profit II* research initiative will include a promotional and positioning strategy as part of its final modules. That strategy will outline a viable regional message and an action plan for getting that message out to the world.

Pursuit of Major Research Opportunities

The Northwest can raise its Smart Energy prospects by aggressively pursuing research opportunities. With the advent of the DOE's new Office of Electricity Transmission and Distribution, we can expect to see additional DOE research and demonstration projects devoted to Smart Energy. At the same time, several other initiatives are also pursuing major research agendas. Examples include the Consortium for Electric Infrastructure to Support a Digital Society (CEIDS) and the Consortium for Electric Reliability Technology Solutions (CERTS).

As noted earlier, the Northwest has a strong research base in Smart Energy. Nonetheless, much of the most recent research funding has gone to Tennessee, California and New Mexico. The Pacific Northwest should compete aggressively for future awards. A coalition of regional universities

and laboratories might be one vehicle for improving the region's prospects for gaining a larger share of these projects.

Creation of Market Transformation Activities

The Northwest has an excellent record of market transformation, particularly in areas with environmental implications. The Northwest was one of the first regions to successfully implement recycling, for instance. Likewise, the Northwest Energy Efficiency Alliance is recognized around the world for its success in accelerating market acceptance for products such as compact fluorescents and Energy Star appliances.

Similar programs in behalf of Smart Energy could make the Northwest that much more attractive as a place to start and grow Smart Energy-related businesses.

Workforce Training

The Northwest could improve its Smart Energy prospects with a workforce training campaign. Such a campaign might include educational kits for high-schools and junior colleges; additional graduate research programs at area universities; and workforce retraining for utility employees who must deal with new Smart Energy technologies.

Washington Senator Maria Cantwell has released a white paper calling for just such an effort and is pursuing funding opportunities in Congress. Spokane-based Intec has laid out a proposed training program. And the Northwest Public Power Association has established an 80-acre National Utility Training Services facility in Richland, WA, to provide state-of-the-art, performance-based, hands-on industry training.

APPENDIX A: PROJECT OVERVIEW

ABOUT THE POISED FOR PROFIT RESEARCH INITIATIVE

In 2001, eight economic development and energy agencies from Oregon, Washington, and British Columbia commissioned a study: Poised for Profit: How Clean Energy Can Power the Next High-Tech Job Surge in the Northwest. The resulting report was released by Washington Governor Gary Locke and prominent economic development and technology leaders in November 2001.

A new partnership of co-funding organizations has come together to launch Poised for Profit II -- follow-on research that will support the next steps toward a world-class clean industry in the Pacific Northwest. This large research initiative, launched in November 2002, will produce a series of reports containing critical information necessary to help investors, entrepreneurs, policymakers and others build a thriving clean energy industry cluster. It will also produce tools for promoting the Pacific Northwest as a leading region to locate and develop clean energy businesses.

ABOUT THIS REPORT

This document is one of four deliverables that make up the first Market Map module:

- Investigation of Investor Attitudes and Perceptions
- Inventory and Analysis of Existing Research
- Survey of Utility Needs and Positions
- Preliminary Analysis of Near-Term Opportunities

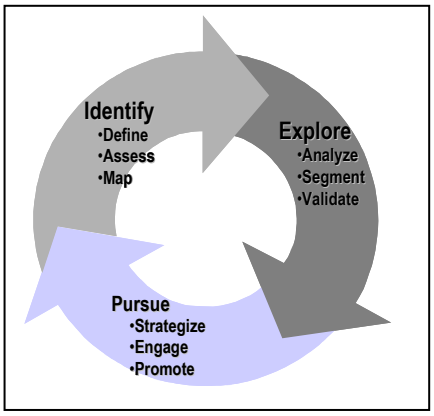
Specifically, this document is part of the Preliminary Analysis of Near-Term Opportunities. It reports on the Smart Energy segment. Other documents cover prospects in wind, solar and fuel cells.

THE ROLE OF THIS REPORT

This report is *not* intended to represent a final decision. It is not for use to promote our region externally. It is an internal tool to help the Steering Committee decide where to focus the next stages of the research. The role of this preliminary analysis is to identify appropriate niches to investigate in more detail. Follow-on research can then examine those niches and select the most promising ones to pursue. (See Figure 14.)

Figure 14

Preliminary reports identify market niches worthy of further effort. The Steering Committee decides which ones to explore in more depth, and which ones to pursue with strategies to engage the stakeholders and promote to the outside world.



THE METHODOLOGY

Athena analysts are specialists in the growth of emerging markets. Athena's ***Regional Competitiveness Program*** aids leaders in growing an industry in their region. The program combines emerging markets expertise with a systematic research methodology:

- Extensive review of secondary data and industry reports
- Multiple interviews, discussions and research roundtables with regional and national players: energy companies, utilities, investors and policy/program leaders
- In-house technical sessions to map information, generate market scenarios, and establish key findings
- Review of draft reports by a committee of advisors and industry experts

Market numbers are included in this report to provide the broadest sense of overall market potential. To size markets at this level, Athena serves as a meta-analyst, using a consensus approach:

- Identify top analysts covering each of the markets and securing their latest estimates
- Reviewing the assumptions, models, and timing of projections through discussions with key analysts
- Exploring areas of disagreement and reconciling the estimates against our own understanding of the marketplace to generate consensus figures

When commissioned specifically to provide market sizing, Athena combines those broader perspectives with detailed modeling. We identify companies that are currently or will be top market makers; review market reports, SEC filing and other documentation; hold analyst briefings with key managers in those companies; conduct formal surveys with a representative group of additional companies, investors, and others attached to the market of focus;

and build financial models. That more exhaustive methodology was not part of this current report.

THE BIBLIOGRAPHY

Athena analysts reviewed more than 150 major research reports and conducted more than five dozen interviews in the process of assembling this report. Inclusion of a full bibliography would render this document too lengthy for easy distribution. Researchers and others interested in more details may request the bibliography as a separate document by sending email to smartenergy@theathenainstitute.com.

ABOUT CLIMATE SOLUTIONS

Climate Solutions is a public interest group that works to make the Pacific Northwest a global warming solutions leader. Since 1998, the group has targeted development of a Northwest clean energy technology industry cluster as a globally significant contribution the Northwest can make to reduce greenhouse emissions into the atmosphere. Climate Solutions generates leading-edge information and knowledge on clean energy technology and economic opportunities it presents. The organization issues reports, organizes conferences and builds cross-cutting alliances to further the goal of rapid energy transition.

ABOUT THE ATHENA INSTITUTE AND THE CENTER FOR SMART ENERGY

The Athena Institute is a research organization that helps executives and organizations find success in emerging markets. Its methodologies and insights have been implemented by many organizations, ranging from Fortune 1000 corporations to public policy agencies.

Athena's *Market Power* program helps organizations take advantage of new opportunities. Its *Partner Assets* program helps them use partnerships as a source of competitive advantage. Its *Strategic Leadership* program strengthens corporations and helps individual leaders position their companies to win. Its *Regional Competitiveness Program* helps governments and regions find the best sources of economic development.

The Center for Smart Energy (www.centerforsmartenergy.com) is operated and maintained by Athena. It is dedicated to making North America the leader in Smart Energy innovation. Center activities provide information and tools to support investors, businesses, technology owners, and regional policy makers as they work toward commercial success in Smart Energy.

ABOUT THE ANALYSTS

PS Reilly is a noted expert, researcher, and advisor on commercial success in emerging markets. Her insights and predictions are regularly featured in articles, columns, and keynotes. Most recently she was Vice President of Emerging Markets for Ziff Davis Media, where she provided strategic advice to leading technology companies, including IBM, Peoplesoft, and many others. She has designed and led numerous large-scale research projects, from analysis of a single market, to investigating the economic impact of regional policy and infrastructure changes.

Jesse Berst is an internationally known technology and business analyst. He has authored or co-authored more than a dozen books on technology topics, written hundreds of articles for leading publications and keynoted dozens of business events in the U.S. and abroad. He combines two decades of professional experience in emerging markets with a personal interest in environmental and energy issues.

Jeff Canin brings 20 years of experience in the financial services sector. As a stock analyst with Hambrecht & Quist, Montgomery Securities and Salomon Brothers in San Francisco, he provided in-depth high tech research coverage to institutional investors in North America and Europe. Since 1995, he has worked as a venture capitalist and consultant to emerging growth companies in the information technology and distributed energy fields.

David Amdal has a 25-year career heading international market research firms. He was formerly head of market research for BIS Strategic Decisions for the Asia-Pacific region, a $30M operation with ten offices in seven countries. (BIS has since become Giga Information Group.) He has conducted 300+ market entry evaluations, identifying the sectors, customers and communication with the strongest potential for success. Clients have included Apple, IBM, Canon, S.C. Johnson, Foremost, R. J. Reynolds, Heineken, Guinness, Bayer, BIC, Coca-Cola and Gillette, as well as regional development authorities.