The Art of Smart Services

VOLUME 2: Smart Cleantech
The Clean Component of the Smart Services Equation

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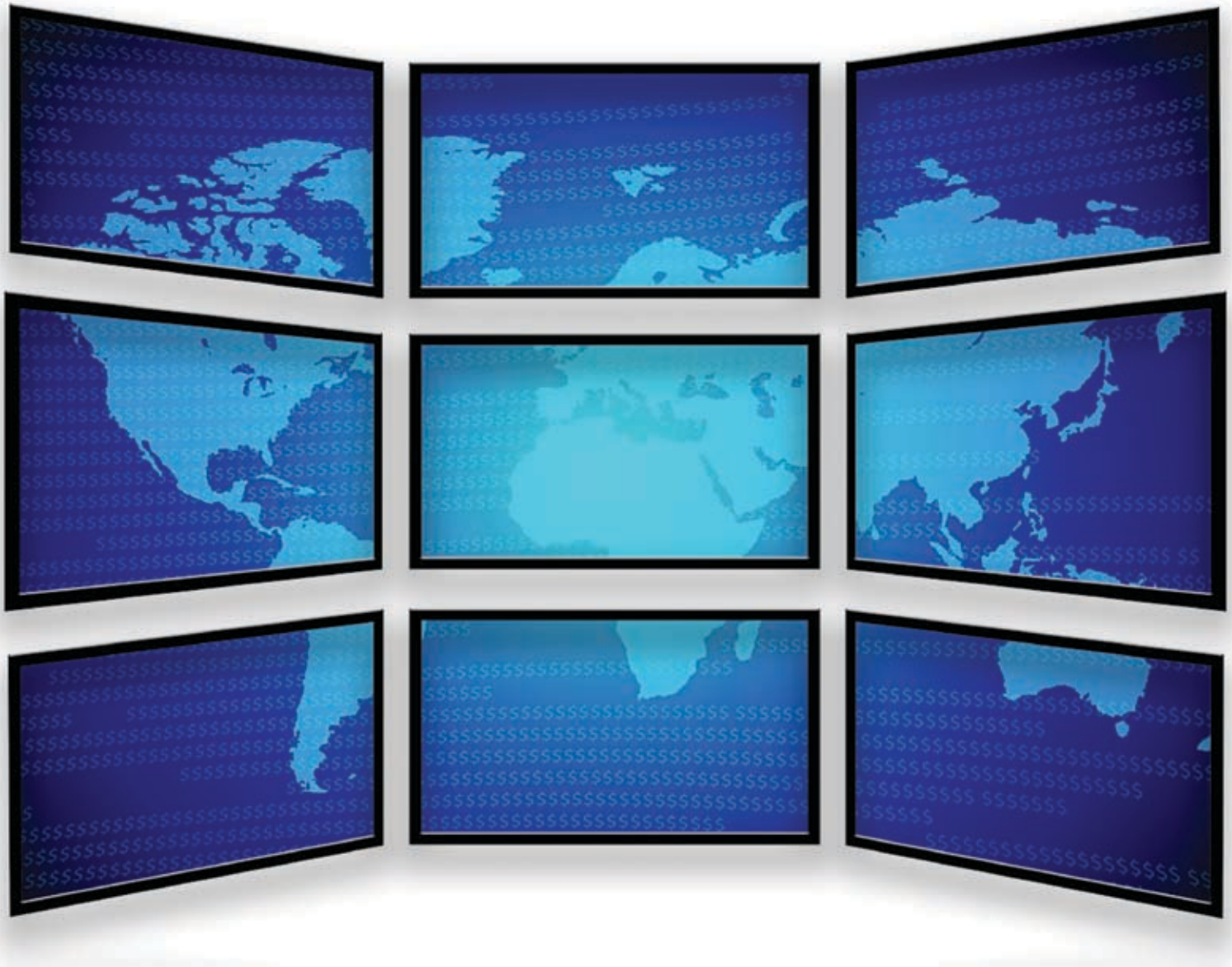

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EXECUTIVE SUMMARY

Whether we are talking about wirelessly monitoring your electric car battery, allowing a cardiologist to remotely monitor a patient's heart condition, detecting when hydrogen fuel needs to be replenished, or solving a water pumping problem in Bali from Minneapolis, experts agree that the "Internet of Things" has arrived. The global opportunity is some 50 billion machines, or "things," that have the potential to be interconnected, and that number is rising as embedded intelligence becomes standard in all distributed devices on the emerging Smart Grid.

Smart Services are the commercial realization of the Internet of Things for manufacturers, where post-sales product support capabilities enable a fundamental change in the value equation of business. Combine this concept with applications that deliver environmental benefits either by enhancing new alternative energy solutions, or improving efficiencies in materials, energy, capital and waste—i.e. Cleantech—and we derive a new category: Smart Cleantech. The implications of this movement are already being felt in legislation, venture capital investment and broad manufacturing industries, and reflect the ultimate convergence of the vestiges of the Industrial Revolution with the matured Information Society.

Smart Services + Cleantech = "Smart Cleantech"

Smart Services are the commercial realization of the Internet of Things for manufacturers. Smart Services are differentiated post-sales product support capabilities delivered by manufacturers or service providers to their channel and/or end customers, enabled by capturing and analyzing real-time product performance information via wireless or wireline communications networks. Smart Services represent a way of doing business where the relationship that a manufacturer cultivates with its customers after the initial product sale is just as financially relevant—if not more so—as the sale itself.

In an interview with start-it magazine, Steve Pazol, vice president and general manager at Qualcomm Enterprise Services, had this to say about Smart Services (Manufacturers are Getting Smart, 2007):

> "The premise behind Smart Services is that companies can provide innovative and differentiated offerings as part of a service offering by connecting to their products in the field and extracting insight remotely. In other words, companies can provide better service more cost effectively when they have visibility into how their products are being used in real time or near real time."

Emerging along with Smart Services in recent years has been a movement towards Clean Technology. As originally defined by The Cleantech Group, LLC, a leading Cleantech industry research firm that introduced Cleantech as an investment category in 2002. The term "Cleantech" refers to an investment category that consists of products, services and processes designed to:

1) Improve the productive and responsible use of natural resources;

2) greatly reduce or eliminate negative ecological impact, and

3) provide superior performance at lower costs than existing solutions.

Cleantech thereby differs in focus compared to the traditional "green tech," or "end-of-pipe" environmental technologies such as pollution control equipment, remediation techniques, or hazardous waste treatment methods. Cleantech also excludes pure consultancy services as well as emission trading companies, as they are not technology based. Cleantech, as an investment category, can be divided in the following 11 sectors, for which typical but non-exclusive examples of technologies are provided:

1. Energy Generation: wind, solar, hydro/marine, geothermal
2. Energy Storage: fuels cells, advanced batteries, hybrid systems
3. Energy Infrastructure: management, transmission, smart grid
4. Energy Efficiency: lighting, buildings, glass
5. Transportation and Logistics: vehicles, logistics, structures, fuels
6. Water and Wastewater: conservation, purification, treatment,
7. Air and Environment: emissions monitoring and offset, trading
8. Advanced Materials: nano, bio, green chemicals
9. Manufacturing and Industrial: advanced packaging, smart production
10. Agriculture: natural pesticides, land management, aquaculture
11. Recycling and Waste : recycling, waste treatment

The definition of "Cleantech" continues to evolve over time to incorporate new sectors and technologies. The latest definition of Cleantech can be found at www.cleantech.com[1].

The basis of the value of Smart Cleantech has to do with concepts applicable to networks. Metcalfe's Law states that the value of a network is equal to the square of the number of users. This applies to Cleantech by virtue of widely dispersed assets, particularly true in energy. The hydrogen economy strives to attain a more dispersed energy grid to the point that power will be produced at the site of use. This calls a "smart grid" concept into play where one can dynamically produce, use and resell energy to the grid. For this to be possible, the widely dispersed energy producing and consuming assets must be electronically networked.

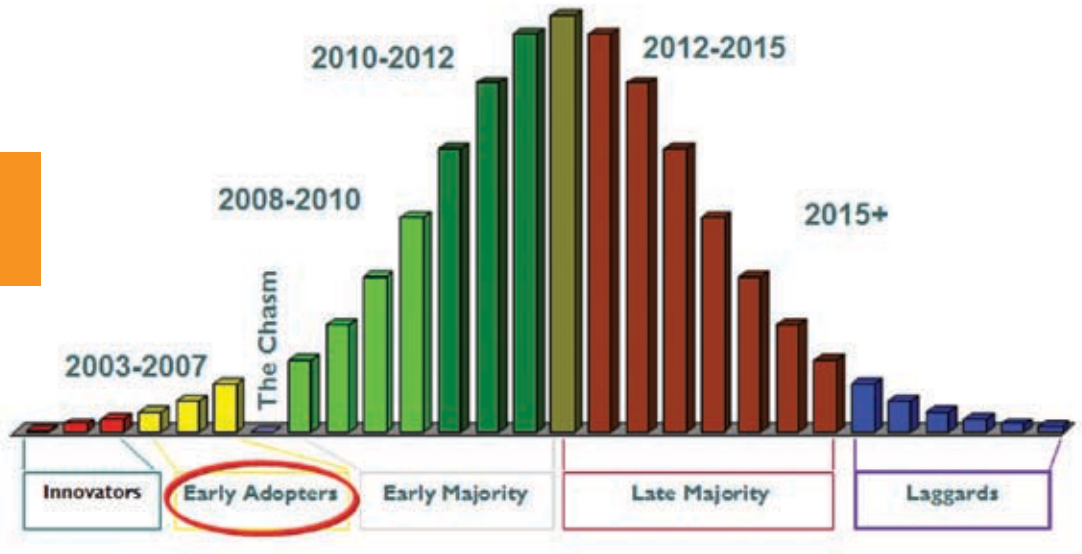
Smart Services can be a catalyst for Cleantech initiatives, according to Walter Derzko, a frequent speaker on emerging smart technologies and blogmaster of Smart Economy blog[2].

> "Whenever a new technology is introduced you'll find that most companies don't see beyond the obvious application to change their business models and take advantage of these inflection points to move their businesses to the next step," says Derzko. "The value lies in clustering technologies in new ways to create new advantages. This is particularly important in mature industries that have become commoditized. Smart Services could be the accelerating complimenting technology to Cleantech initiatives, essentially taking Cleantech to the next level."

According to Harbor Research founder Glen Allmendinger,[3] one of the main drivers of Smart Cleantech is the embeddedness of technology in products.

> "We will see the quality of the data of smart-enabled products continue to rise, along with their value and ubiquity. The big driving force behind this is ultimately the value of the network as a whole which is enhanced as more and more data sources are added—embedded—into it. Smart Cleantech knits all the information value of this network together for a greater good: the global quality of life."

Stage of Smart Cleantech



[1] Brian Fan, Director of Research of The Cleantech Group, LLC.
[2] http://smarteconomy.typepad.com
[3] http://www.harborresearch.com/harbor

At the recent Cleantech Summit in San Francisco many speakers and presenters discussed the notion of the "instrumented planet" that feeds data back and forth on the smart grid. This is a direct reference to the nature of embedded devices being able to communicate, and their importance in the Smart Cleantech argument. During the conference Rob Bernard, chief environmental strategist for Microsoft commented,

> "One of the important trends that we see during the next ten years is distributed power management."

Clearly this concept delineates a Smart Cleantech approach. Here is an example of how Air Products, the world's largest seller of the hydrogen molecule, has engaged Smart Services to handle their distributed facilities.

CASE STUDY

Air Products & Chemicals

Air Products has a tremendous interest in anything having to do with changes in the hydrogen economy, particularly enhancements to it. Smart Services plays a significant role in several of Air Products' initiatives, specifically Air Products' Hydrogen Energy Systems (HES) group, which advances hydrogen as a new energy source and fuel.

HES provides hydrogen dispensers that serve as the end point fueling for a hydrogen powered fuel cell vehicle, including private use and municipal fleet vehicles. Many of the vehicles using hydrogen are in the prototype testing stage. Using the Qualcomm wireless network, Air Products monitors these distributed facilities across a broad range of variables and provides the collected data to the station owner. For example, when a vehicle is filled with gaseous hydrogen Air Products measures the rate of the fill, the amount of the fill, and various pressure rises among other technical data. The measurements are used to improve the performance of the dispensers and can also be used by vehicle manufacturers to understand the performance of their fueling system design. Ultimately this data will be used to improve the operating performance and make engineering improvements on Air Products' products as well as those of the station owners and the vehicle manufacturers.

"Half of the facilities stations are mobile and are regularly moved from place to place and are dependent on a wireless connection for data retrieval," says Bill Crawford, business technology manager, Air Products. "The advantage of Smart Services is clear: utilizing this allows Air Products access to more complete and accurate right time data."

"The Mobile Fueler plays an important role in enabling the early phase of the hydrogen economy," says Brian Bonner, global marketing manager of Air Products HES group. "It has the ability to supply hydrogen to the OEM and is a totally self-contained hydrogen fueling station."

Smart Cleantech Market Drivers

Taken collectively, commoditization, digitization, legislation, networking, disruptive innovation, and venture capital investments are creating a groundswell of market drivers for Smart Cleantech.

1) Commoditization

With the Industrial Revolution now well into the rear view mirror of developed countries, massive numbers of product industries are in a mature state. Companies that have been able to survive provide high quality products, have implemented lean manufacturing techniques, and have dominated the market or been acquired. All the while, buyer power has increased tremendously through the information revolution and foreign competition has stiffened. The net result for manufacturers is a sweeping mandate: change or die. This is essentially the core concept behind the popular "red ocean—blue ocean" theory, as espoused by authors W. Chan Kim and Renee Mauborgne in their book, Blue Ocean Strategy.

> "Raising revenues from after-sale services ought to be at the top of the management agenda for companies in maturing industries."
>
> **McKinsey & Company**

One significant development as a response to these potentially crippling forces is service. Whether it's provided by the product manufacturer directly or through its channel, service has emerged as a key differentiator and growth driver across virtually all mature and commoditized industries.

After several years of taking faltering baby steps in a trial and error approach, many organizations have discovered that succeeding in service as a growth driver is much more difficult than at first imagined, particularly for product-based businesses. The challenge of utilizing a product channel to sell and deliver service is profound. Differentiating a service from a local competitor who already has the service business, has a lower cost of operation, and who approaches service with the same reactive service model is equally profound. Enter Smart Services—differentiated value based on real-time enterprise visibility of product performance and service needs. Here is an example of how Gardner Denver, a global manufacturer of air compressors, blowers and pumps, used Smart Services to differentiate in a highly competitive, matured market. The energy savings of this engagement, the clean component, is another example of the connection between Smart Services and Cleantech.

CASE STUDY

Gardner Denver: Energy Savings through Qualcomm Enabled Smart Services

"Our involvement in the Smart Services or sensor network project is driven by our desire to find a way to deliver more value to the customers we serve. The compressor market is the epitome of mature particularly in the United States. As a manufacture looking for organic growth we have to find ways to stay connected with the product through a fairly long life cycle and buying cycle" says Mike Bakalyar, manager of Enhanced Services at Gardner Denver, Inc. "Our objective is to stay connected so that the business cycle and life cycle are the same."

"Air compressors are considered by much of industry to be the driver of the 4th utility. Compressed air is a convenient and generally safe method to deliver work force and motion, however it is not free. It is essentially a reconstitution of electric energy and the transition is costly in terms of energy consumed. The ratio of 10 kW input energy to deliver 1 kW in pneumatic work is typical for a 100 psig system operating at best practice efficiency. Most systems however are not operated at best practice and it is not unusual to find ratios of 20:1 or even 30:1 being tolerated. So we are looking at Smart Services as a tool that will allow us to assist our customers in operating their systems properly and salvaging net profit dollars. Smart Services provide visibility to issues of operating practice and maintenance that if left unaddressed will add significantly to the cost while decreasing the benefit."

If a company operating four (4) 150 hp compressors with the above conditions saved 15% (modest results) by increasing and maintaining operating efficiency the 10 year project life savings will be 6.9 million kWh, 7,400 metric tons of CO2 and $ 690,000.00 net profit. Smart Services provide the window through which this system can be observed and the tireless never sleeping watchman who reports on any deviation from design performance.

By the Gardner Denver example, at $0.10/kWh the 10-year cost of electricity required to drive a 150HP compressor is over $1 million. An effective Smart Services solution can reduce electricity consumption by 10% or more. With a 10% savings, a manufacturing facility with eight 150HP air compressors will save $800,000 over a ten year period, or about 8 million kWh or about 16 million pounds of C02. This is the equivalent of eliminating about twelve hundred cars from the road in any given year.

Equipped with this Smart Cleantech solution, Gardner Denver is positioned to change the fundamental value equation of its business and effectively climb up the slippery slope of commoditization.

2) Digitization

Digitization is ubiquitous: cell phones, smart phones, computers, navigation systems, location tracking systems have become critical and expected assets in our personal lives and in virtually every aspect of manufacturing. The now famous Moore's Law states that the speed of computer chips doubles every 18 months as the cost for manufacturing them halves during the same period. Embedded intelligence has followed a similar curve, to the point that manufacturing would be reduced to a pre World War Two state without it. Digitization is the lynchpin enabler of Smart Cleantech and represents what will ultimately be viewed as modern manufacturing's break through as the implementation of Smart Services initiatives per Glen Allmendinger:

> "Embeddedness is one of the critical enablers of Smart Cleantech and will continue to fuel the engine as the quality and efficiency of data transmission continues to increase."

3) Networking

Networking is the corollary to Digitization that makes "Smart Cleantech" truly possible. According to Cleantech's Brian Fan:

> "Digitization can exist in silos, e.g. everyone has a cell phone, but the cell phones didn't really start connecting with each other, until they became "smartphones" that were truly networked. Then we saw an explosion in applications, enabled by networking connectivity: email, GPS-based local advertising, Telenav, etc. A great case study is the use of GPS and other smart sensors in agriculture. Farmers now use GPS devices from Garmin, et al to precisely plant, irrigate, and harvest crops down to the square foot."

> "Another good case study is the use of active RFID tags in "EZPass" and similar automated toll collection sensors in cars. This networking of thousands of individual cars via their RFID tags or GPS units enables new applications, especially smart traffic software that allows real-time tracking of traffic conditions, and accurate estimates of the time it will take you to travel various distances."

Recent moves by technology leaders such as Qualcomm are enabling the "Internet of Things" to enter mainstream markets on a global scale through networks. In its recent press announcement "nPhase® methodology powers Qualcomm's Global Smart Services Business," Qualcomm positioned itself for leadership in the worldwide Smart Services market with aggressive investment in its newly-branded Global Smart Services business.

A confluence of forces within many discrete manufacturing industries has created a unique opportunity for Qualcomm to meet the complex and dynamic needs of today's manufacturers through the advancement of its Global Smart Services business. This expansion began with Qualcomm's acquisition of nPhase,® LLC in October 2006.

With the global capabilities of Smart Services now commercially accessible to virtually any product manufacturer, leaders and innovators are exploiting these new capabilities as a strategic tool to drive growth in profits and shareholder value. In some cases, those exploiting the possibilities of Smart Services are the product manufacturer dealers and distributors, virtually forcing the OEMs into the game. In other cases, leading OEMs like ABB Robotics

and Gardner Denver are implementing Smart Services as a strategic tool in their business. Regardless of where the exploitation occurs, it is forcing others to follow and made possible by emerging networks.

4) Legislation

There has been no shortage of debate and interest in Clean Technology and climate control issues with an industrial component, invigorated recently by the Bush administration's stance on the Kyoto accord. On a state by state and now a national basis, with the Climate Security Act of 2007 (S. 2191) issues involving the climate and the economy are undeniably interrelated. These measures would set a limit, or cap, on carbon dioxide emissions from fossil fuel use with each covered utility, oil or manufacturing facility given allowances based on historical data or some type of individual calculation.

California, long a bellwether state for technology, venture capital and environmental initiatives, has several Cleantech bills and laws on the books, these include:

- **Global Warming Solutions Act of 2006 (AB 32**): This legislation, signed into law by the Governor, looks to market mechanisms like emissions trading to reduce greenhouse gas emissions in California to 1990 levels by 2020.
- **Low Carbon Fuel Standard (LCFS)**: California's LCFS requires fuel providers to reduce the carbon intensity of transportation fuels sold in the state, dramatically expanding the market for alternative fuels in California.
- **Million Solar Roofs Initiative**: This initiative, introduced in 2004, provides 3,000 megawatts of additional clean energy and reduces the output of greenhouse gases by 3 million tons. The $2.9 billion incentive plan for home and building owners who install solar electric systems will lead to one million solar roofs in California by the year 2018.
- **Renewable Portfolio Standard (RPS)**: California's RPS calls for more energy to come from clean, renewable sources and is among the most ambitious standards in the nation. In 2003, the Governor called for an acceleration of the RPS to 20 percent by 2010 rather than 2017, seven years earlier than statute, and in 2005, he called for an acceleration of the RPS to 33 percent by 2020.[4]

Many private sector companies have joined in discreet government initiatives, including The United States Commercial Service (US Department of Commerce), 2007—2008 Clean Technology Initiative, which promotes the export of US Clean Technology, products and services. In a very telling move, Power-Gen, the premier trade show for the energy sector is hosting their fifth annual Renewable Energy & Fuels, America's premier all-renewables conference and exhibition designed to move renewables into the mainstream of the energy sector.

[4] http://gov.ca.gov/issue/energy-environment/

5) Disruptive Innovation

The term "disruptive technology" was coined by Clayton Christiansen who then changed it to "disruptive innovation" to broaden its usage. In a Sloan Management Review article he says:

> "Many companies proudly think of themselves as innovative. The great majority of them, however, are adept at producing only sustaining innovations—products or services that meet the demands of existing customers in established markets. Few companies have introduced genuinely disruptive innovations, the kind that results in the creation of entirely new markets and business models. And yet the motivation to pursue such innovations should be urgent. In almost any industry you care to examine, the most dramatic stories of growth and success were launched from a platform of disruptive innovation." (Christiansen, 2002)

Disruptive innovations are easy to understand in times of crisis: they are manufacturing's own form of natural selection. The innovative companies will adopt disruptive solutions to maintain viability. The new business of electronically connecting "things," referred to in the paper's introduction, was born out of the need for extending a company's revenue realization through the lifecycle of a product. The adoption rate for this innovation is a classic example of Geoffrey Moore's "Crossing the Chasm" scenario. Smart Cleantech answers the multiple needs of the disruptive innovation criteria: creating entirely new markets and business models; potentially affecting the global quality of life and, in a textbook example of the definition, the initiative was born out of urgency: for both business and the environment.

6) Venture Investment

"Follow the money" is a trail that is literally being blazed by Cleantech investors as we near the end of the first decade of the New Millennium. Cleantech is attracting venture capital in the way that nascent Internet companies did in the middle to late 1990s—albeit with a far more altruistic and globally sensitive element. Not only has the activity level surrounding Cleantech exploded in terms of shows, trade associations and press coverage, but the venture community has embraced this across the board, and may set record investment levels. Combine this with the growth of Smart Services and the return on investment potential is staggering.

According to the Cleantech Group, LLC (www.cleantech.com), in 2007, $5.18 billion was invested by venture investors in the Cleantech investment category in North America and Europe combined, up from $3.6 billion in 2006, a growth rate of 44%. Historical totals for Cleantech investing in US and Europe are:

2007	USD $5.18 billion
2006	USD $3.6 billion
2005	USD $2.5 billion
2004	USD $1.8 billion
2003	USD $1.7 billion
2002	USD $899 million
2001	USD $714 million

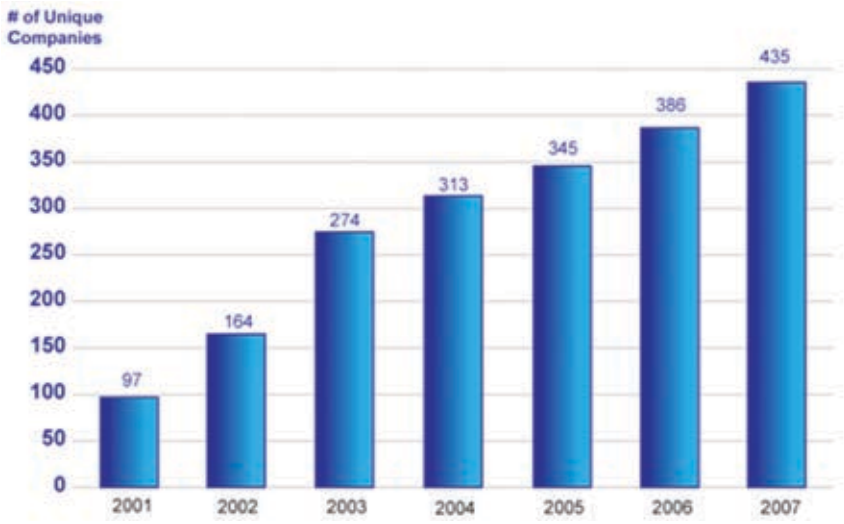
Source: The Cleantech Group, LLC (www.cleantech.com)

Global Cleantech VC Investment, 2001-2007

In 2007, the top five Cleantech sectors by total invested were:

- Energy Generation: USD $2.75 billion; 172 deals
- Energy Storage: USD $471 million; 20 deals
- Transportation: USD $445 million; 20 deals
- Energy Efficiency: USD $356 million; 41 deals
- Recycling & Waste: USD $291 million; 17 deals

The number of unique companies funded globally each year continues to grow steadily, from 97 in 2001, to 435 in 2007:

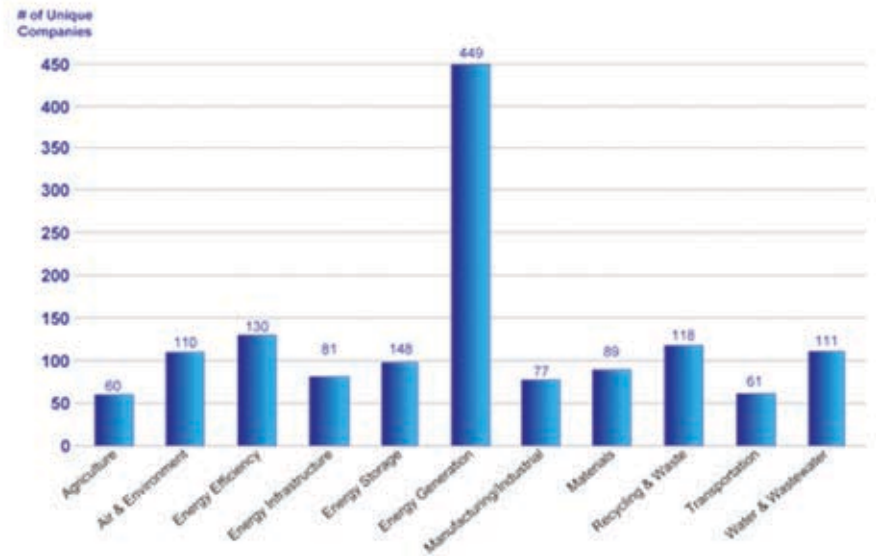


Source: The Cleantech Group, LLC (www.cleantech.com)

Number of Unique Cleantech Companies Funded Globally, 2001-2007

By sector, Energy Generation is the leader in terms of unique companies funded globally, at 449. The next leading sectors are Energy Storage, at 148 unique companies funded, Energy Efficiency, with 130 unique companies funded, Recycling and Waste, at 118 unique companies funded, and Water and Wastewater, at 111 companies funded.

Companies Funded Globally by Cleantech Sector, 2001-2007

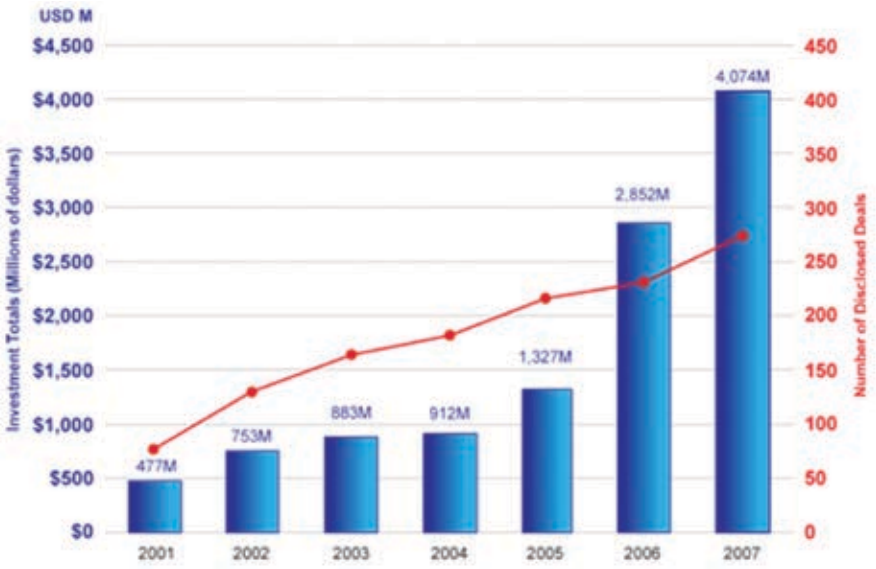


Source: The Cleantech Group, LLC (www.cleantech.com)

North America Cleantech investing in 2007 grew by 38 percent, from $2.87 billion invested in 2006 to $3.95 billion invested in 2007. The number of deals increased by 15 percent, from 233 in 2006 to 268 in 2007. The average deal size increased by 20 percent, from an average of $12.3 million in 2006 to $14.7 million in 2007.

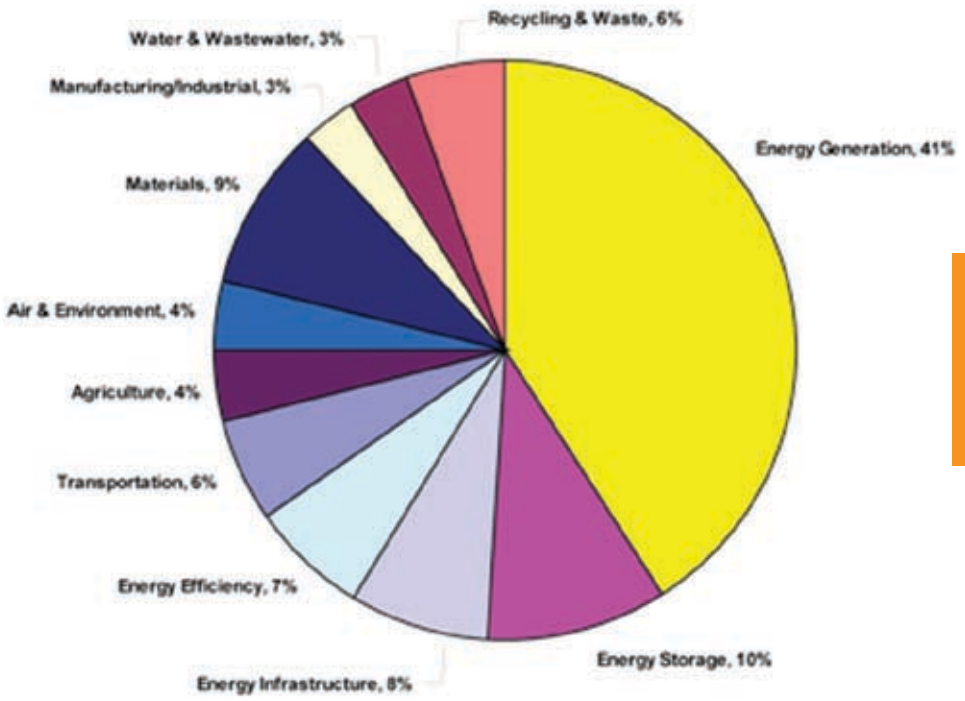
North American companies continue to receive the lion's share of Cleantech venture investing, with North American-based companies receiving over 3x the investment of European-based companies.

Annual North American Cleantech Venture Capital Deals and Investment Totals, 2001 to 2007 (USD $M)



Source: The Cleantech Group, LLC (www.cleantech.com)

By sector, North America VC investments and Europe VC investments are primarily in the Energy sectors (Energy Generation, Energy Storage, Energy Infrastructure, and Energy Efficiency). However, significant investments are being made in Materials, Transportation, and Recycling & Waste:



North America Cleantech VC Investment by Segment, 2003-2007

Source: The Cleantech Group, LLC (www.cleantech.com)

According to a study released in January 2008 by KPMG, "Venture capitalists will largely direct their investments to the greentech and biotech industries in the coming year (2008)"[5]

Additionally they commented on the competitive demand of the investment in innovations:

> "Perceptions of the investment community are also changing. Venture capital firms are seeing increased competition from private equity and hedge funds as these firms look for novel strategies to deploy their hordes of capital earlier in the lifecycle of innovative companies. In fact, 66 percent indicated that they expect private equity firms will also continue to increase their presence in the venture capital market."

Taken together this makes the case for Smart Cleantech extremely strong.

The number of venture capital firms investing in and developing Cleantech specific funds swells on a weekly basis, as any cursory reading of VentureWire or the Cleantech.com can attest.

According to the Venture Power Report, in 2007 alone, over 37 new Cleantech venture funds were closed, totaling $3.2 billion in new venture capital dedicated to Cleantech. This total is more than double the $1.4 billion raised in 2006. In the past 3 years, almost $6 billion in dedicated Cleantech venture funds have been closed.

[5] Venture Capitalists Bullish on Greentech and Biotech, http://www.us.kpmg.com

According to the publisher's description of Pernick and Wilder's *The Cleantech Revolution* (Pernick & Wilder, 2007):

> "When industry giants such as GE, Toyota, and Sharp and investment firms such as Goldman Sachs are making multibillion dollar investments in Clean Technology, the message is clear. Developing Clean Technologies is no longer a social issue championed by environmentalists; it's a moneymaking enterprise moving solidly into the business mainstream."

According to Harbor Research's Glen Allmendinger, discussing Smart Cleantech:

> "As awareness widens it feeds on itself—just like network elements. From a business standpoint the investment world is now kicking into high gear. The more attention is focused on these things the more they are monetized. "

Business Case for Smart Cleantech

From the perspective of the company that produces Cleantech products, their products like any other product manufacturer are inherently widely dispersed. By applying Smart Services on their products, Cleantech product manufacturers stand to significantly improve their financial performance. The Smart Services Value Blades™ serves as a framework for establishing the business case (Vigoroso 2007).

Service Performance

There has been a major shift towards services across virtually all product-based businesses in recent years, Cleantech product companies included. Whether service is provided directly by the OEM or through the channel, Cleantech OEMs stand to improve their financial performance through improved service performance of their products. Rather than relying on time-based routine service calls and reactive emergency service calls, the servicing organization can proactively determine service priorities, remotely diagnose and trouble shoot problems, and optimize the dispatch of services resources.

The Smart Services Value Blades™

Product Performance

Product manufacturers know the most about how to get maximum performance from their products—the problem is they rarely know how their products are being operated once in the field. By gaining access to real-world product performance information, product manufacturers can identify opportunities to improve product performance, both by changing operational practices, maintenance activities, and by designing better products for the future.

Customer Value

Improving the value delivered to customers ought to be a primary business objective of any products-based business. Smart Services opens up an entirely new spectrum of possibilities. This could be as simple as knowing precisely when to change the oil and oil filters on a product, regardless of production variations, and without having to be onsite. In this instance, the customer may gain by reducing downtime, extending equipment life, and/or improving operating efficiency. The product manufacturer may gain by capturing the aftermarket business for consumables that were previously provided by third party pirates. The possibilities of delivering

improved customer value are extensive. The most limiting factors are typically the imagination of the OEM and their ability to executive on a new business model.

Competitive Advantage

Cleantech product manufacturers stand to garner competitive advantages by implementing Smart Services. By combining their product with a unique Smart Service value proposition, the provider of Smart Cleantech is able to differentiate their offering.

One of the clearest examples of this is found in the transportation industry, where monitoring expensive, mobile assets has long been a critical element of commercial fleet management. Qualcomm for instance has been a major player in this category for over twenty years. Today these types of capabilities are now trickling down into the consumer space.

During a presentation at the 2008 Cleantech conference in San Francisco, Chetan Maini, the deputy chairman of Reva Electric Car, discussed his view on their next generation of EV's. Maini observed that the cars are now equipped to monitor battery levels to report on the condition to their owners. In the future he sees a need for cars to send and receive data, such as critical software upgrades, thereby simplifying the ownership process by allowing the company to deliver a post-sales service to a customer. The natural extension of this principal is easy to see: vehicles that are in constant contact with a source that can fine tune performance in real time and anticipate service based on data, not schedules. The savings in this approach can be measured in terms of more efficiently operating vehicles, less downtime and fewer costly repairs.

Another example of competitive advantage can be found in this case study on Siemens Water Technologies (SWT), the world's leading water and wastewater treatment company providing comprehensive water treatment systems and services for industrial, institutional and municipal markets. With over 200,000 installations, SWT has a clear market need to create and maintain revenue streams based on a massive existing client base.

CASE STUDY

Siemens Water Technologies

SIEMENS

The controls system group of SWT provides products and services to water municipalities and is the first of many business units at SWT to implement Smart Cleantech solutions. Their Smart Cleantech solution, Link2Site,™ enables cellular wireless monitoring and control of lift station equipment at water municipalities on a global scale.

Link2Site consists of intelligent field devices that connect to back end application servers using GSM/GPRS cellular wireless technology. A robust Qualcomm wireless communications network and enterprise management application has been tailored to meet the unique needs of SWT, which includes a rich feature set that enables proactive, automated asset management.

Link2Site is allowing SWT to drive differentiated product sales and deliver a new service, while capturing recurring revenues and profits. SWT channel and customers benefit from increased productivity, decreased downtime, and a new level of business intelligence.

Outlook for Smart Cleantech

For its part, Smart Services is poised for meteoric growth. Sales of wireless modules used for connecting devices, sensors and machines are expected to grow from 33 million units today to around 400 million in 2011, according to Harbor Research. And as quoted in the Economist in April 2007, revenues for hardware and services are expected to grow from $48 billion today to some $200 billion by 2011. (The Economist, 2007).

> "Smart Services today is very close to where the Internet was in the early 90s," says Steve Pazol. "Knowledge of the Internet was growing, but very few people really had a clear idea of how Internet-enabling their business would change it. In just twelve years, not only were companies like Google and eBay created, but many existing businesses have fundamentally changed the way they do business and interact with their customer." (The Economist, 2007).

According to Brian Fan, Director of Research of The Cleantech Group, LLC,

> "Smart Cleantech represents the convergence of digitization, networking, and the Cleantech revolution. Although Smart Cleantech is still in its infancy, and significant hurdles have to be overcome in building enormously complex systems tying together hardware, software, databases, applications and new business models, we believe that 'smart' will become an increasingly fundamental part of key manufacturing and service processes in energy production, manufacturing, building operations, water, and agriculture. The core promise of Cleantech is to improve the productive use of resources while reducing negative ecological impacts- creating smart feedback systems in key industrial activities will be a crucial part of delivering that promise."

Mark Vigoroso, chief editor of smartserivcesblog.com, asserts,

> "As 'Clean Technology' emerges as its own industry category, Smart Services will prove an invaluable means to efficiently monitor and control the first generations of widely dispersed physical assets needed to provide and sustain alternative energy sources. In fact, I expect to see these new OEMs adopt Smart Services much more aggressively and unilaterally than have manufacturers in mature categories like industrial, medical, or construction equipment."

While there is no federal mandate for Smart Services, Cleantech has drawn the focus of law-makers worldwide, which has only accelerated the adoption of Clean Technologies in markets ranging from automotive, to pharmaceuticals, to industrial equipment. As market demands increase the need for Smart Services, Smart Cleantech initiatives may one day become as ubiquitous as the embedded microprocessor: a critical business element without which all forward movement stops.

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About the authors:

John Tillotson, is a senior director of strategy and market development for Qualcomm Enterprise Services (QES). QES is the Qualcomm division chartered with delivering strategic wireless solutions that leverage proven, secure technology to deliver a competitive advantage and measurable long-term business value across enterprises.

Tillotson is a veteran technology and environmental professional, joining QES in November, 2006 through their acquisition of nPhase. He has broad industrial experience and an impressive track record for commercializing new technologies. In his current role, Tillotson is responsible for strategy, marketing and business development for the Global OEM business. He is spearheading several leading initiatives including a defining push into Smart Services and Cleantech.

Tillotson was the VP/Director of Marketing for nPhase, a prescient and pioneering Machine to Machine technology company. Prior to joining nPhase, he focused on heading up the commercialization of major multi-million dollar technology developments for Nalco Chemical Company of Naperville, IL, the world's largest water treatment chemicals company. His accomplishments at Nalco include the Chairman's Achievement Award (2000) and the Marketer of The Year Award (1998 & 2000).

Tillotson has an M.S. in Environmental Management and Policy from Tufts University, and a B.S. in chemical and geological sciences.

Steve Lundin is the chief hunter and gatherer of BIGfrontier Communications Group, a Chicago based PR firm specializing in strategic marketing initiatives for technology companies. BIGfrontier has been involved with nPhase prior to their launch and through their acquisition by Qualcomm, crafting their brand within the business and technology space. Lundin has conducted award winning public relations work for numerous technology companies since leaving the world of journalism for PR in 1998 and also founded and currently runs one of the oldest and most established technology and business education organizations in the Midwest: BIGfrontier.

Lundin did his undergraduate work in English and Cultural Anthropology at the University of Wisconsin and his graduate work in Counseling Psychology at the Adler School of Professional Psychology and has been twice named one of the top 100 people in technology by 1-Street Magazine. He also writes for numerous publications including the Chicago Sun-Times (technology columnist) and the Fine Life Media Group (technology editor).

ABOUT QUALCOMM

Since 1988, Qualcomm Enterprise Services (QES) has provided integrated wireless systems and services to businesses around the world. QES delivers the actionable information businesses seek in order to operate at peak performance and improve the quality of life for its customers and their employees, as well as the entire value chain. Qualcomm's world-class technology infrastructure, customer care and professional services enable us to meet the increasingly complex needs of many industries, such as mobile enterprise, transportation and logistics, construction equipment, manufacturing, and healthcare. QES' customer focus is based on the knowledge that leveraging technology is critical to creating business insight that helps clients achieve their vision.

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