

Cleantech: new energy and resource efficiency

Clean technology encompasses a diverse range of innovative products and services that optimize the use of natural resources or reduce the negative environmental impact of their use while creating value by lowering costs, improving efficiency or providing superior performance.

“First they ignore you, then they laugh at you, then they fight you, then you win.” – Mahatma Gandhi

Ernst & Young’s Global Cleantech Center is pleased to present *Seizing transformational opportunities*, our fourth annual global cleantech insights and trends report. The report focuses on the opportunities for competitiveness and growth, whether at the company or national level, engendered by the transformation to a resource-efficient and low-carbon economy. This trend is characterized by many observers as the next industrial revolution. Supporting this view is the record US\$243 billion invested in cleantech globally in 2010, up 30% from 2009 and a fivefold increase since 2004.

As the transformation accelerates, global corporations across industries are increasingly coming to the realization that they must understand the impact of cleantech and develop strategic action plans, whether to improve their internal operations, implement a more efficient mix of energy and resources or pursue new cleantech-enabled revenue opportunities.

We have also seen a myriad of pure-play cleantech market leaders emerge over the past five to seven years to meet demand for transformational energy technologies.

At the same time, governments around the world have announced strategic plans to develop, adopt and deploy clean technologies as part of their long-term objectives. These include job creation, the establishment of new innovation-based industries, enhancing energy security and meeting climate change and environmental goals. The natural disaster in Japan and the political instability in the Middle East in recent months have only provided a further impetus to seek cleantech solutions to address such concerns.

As Gandhi’s statement above illustrates, the path of this cleantech-driven transformation is neither smooth nor easy, for it aims to remake the world’s energy infrastructure and affects a wide range of incumbent players and interests. While more bumps can be expected on the road ahead, increasing global energy and resource consumption – and the related concerns about resource scarcity, prices and security, not to mention climate – ensure that the transformation will continue.

We hope that you find this report a source of valuable cleantech insight and that it sparks industry dialogue. We look forward to working with you to seize the transformational opportunities awaiting us.





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Seizing transformational opportunities: corporations embrace cleantech for revenue growth



Gil Forer, Global Cleantech Leader
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Key insights

- ▶ With resource efficiency well established as a competitive baseline, corporations are now seizing transformational opportunities to create new cleantech-enabled products, leverage core competencies to enter the cleantech market or to enter entirely new markets, all with the objective of new revenue generation.
- ▶ The biggest share of cleantech spending – 40% on average – is dedicated to developing new cleantech-enabled products and services.
- ▶ Over the next five years, corporations will move away from the acquisition of value technologies in favor of acquiring leading technologies as they seek breakthrough revenue opportunities.
- ▶ Similarly, the desire to expand revenue business through brand enhancement, innovation, reaching new customers and entering new markets is driving partnerships with emerging cleantech companies.

Global corporations across numerous industries are moving quickly to pursue cleantech revenue opportunities. During the financial downturn, businesses looked to cleantech for cost savings and efficiency improvements. But with efficiency now a competitive given, the corporate focus on cleantech is beginning to shift toward top-line growth through new products and markets.

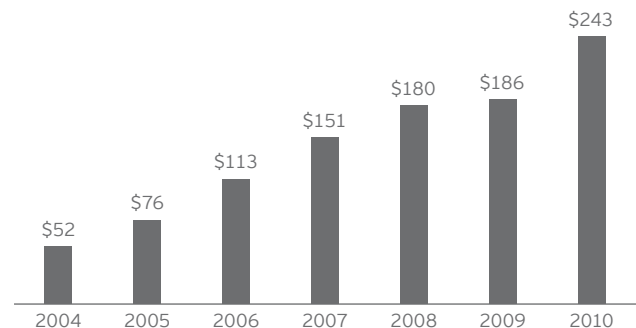
The revenue opportunities are transformational in two senses: they arise from a shift to a resource-efficient and low-carbon economy, and they are changing corporate business strategies. Ernst & Young's latest *Annual survey of global corporate cleantech adoption* provides insight into how corporations are integrating cleantech into strategy, spending, innovation, partnerships and acquisitions to seize such transformational opportunities.

A number of factors are propelling the global transformation to a more resource-efficient and low-carbon global economy. They include the growth in world population, the increasing purchasing power of the middle class in emerging markets and the increasing scarcity of natural resources worldwide. The necessity for energy security, rising energy and commodity prices, the business response to climate change and the new awareness of the need for a corporate sustainability strategy are also important drivers

of change. And all are fundamentally altering the way in which natural resources – including energy and water – are produced, distributed, stored, managed and consumed.

Governments have announced strategic plans to develop, deploy and adopt clean technologies as part of their long-term national strategic objectives, which include jobs and new innovation-based industry creation, as well as energy security, climate change and environmental targets.

Figure 1. Global clean energy investment (US\$b)



Source: Bloomberg New Energy Finance

Overall, a record US\$243 billion was invested in clean energy globally in 2010, up 30% from 2009 and a fivefold increase since 2004, according to Bloomberg New Energy Finance (see Figure 1). Many observers believe that the impact of this trend could have the magnitude of a new industrial and technology revolution.

The path of transformation

Corporations are pursuing transformative opportunities in several important ways. One way is to incorporate clean technologies into existing products to improve their environmental performance. Examples include Procter & Gamble's introduction of a detergent designed to work in cold water and thereby reduce the amount of energy required to wash clothes. Another example is Dow Chemical's partnership with Solazyme to produce oils that come from algae rather than petroleum for insulating electrical transformers.

Another route to corporate transformation is to enter cleantech segments that are adjacent to existing businesses – the semiconductor company that begins manufacturing solar cells, for example, or a generation company that moves into wind.



Cisco's smart-grid initiatives that draw on its networking and communications competencies can be seen in this light.

While the transformations above involve melding cleantech with existing core competencies, in certain cases, the degree of innovation can be even more profound, resulting in entirely novel cleantech-driven product or service offerings. Here, corporations are leveraging their brand power to move into new cleantech markets and participate in a fast-evolving cleantech ecosystem. This becomes a path to forging new customer relationships, supplanting existing industry leaders or even creating completely new industries. The innovations and emerging business models related to the new ecosystem of electric vehicles, for example – involving not only carmakers, utilities, battery manufacturers and smart-grid companies, but also a broader constituency of consumer products, retailers and communication corporations – are generating such fundamental corporate transformations.

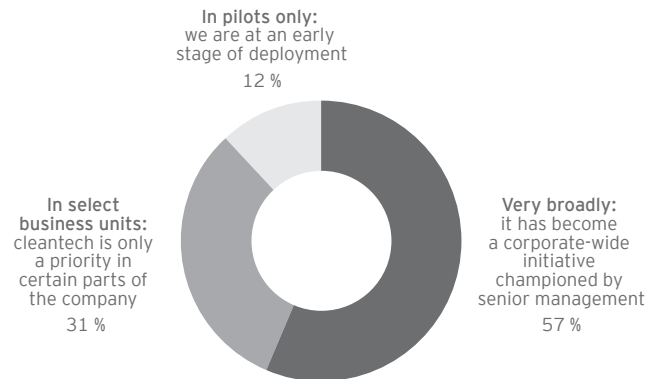
Widespread corporate cleantech adoption

Our survey results show that cleantech adoption is widespread among the world's largest enterprises. Fifty-seven percent of respondents said that cleantech was widely adopted throughout their organizations and championed by their senior management. Another 31% said that cleantech was a priority at the business-unit level. In all, cleantech was a major focus for 88% of respondents (see Figure 2).

The survey indicates that corporations are doing much more than merely talking about cleantech – they're committing significant

amounts of capital to it. A full third (34%) of corporations will spend more than 3% of total annual revenues on cleantech products and services in 2011.

Figure 2. To what extent is your company exploring, researching or utilizing cleantech?



In terms of actual spending, 44% of executives say their corporations plan to spend more than US\$50 million in 2011 on cleantech initiatives. A subset of this group, 12% of the total population, reported that their cleantech spend would exceed US\$250 million. In addition, 74% of corporations plan to increase or significantly increase cleantech budgets between 2012 and 2014 (see Figures 3 and 4).

Figure 3. Cleantech spending in 2011 (US\$ millions)

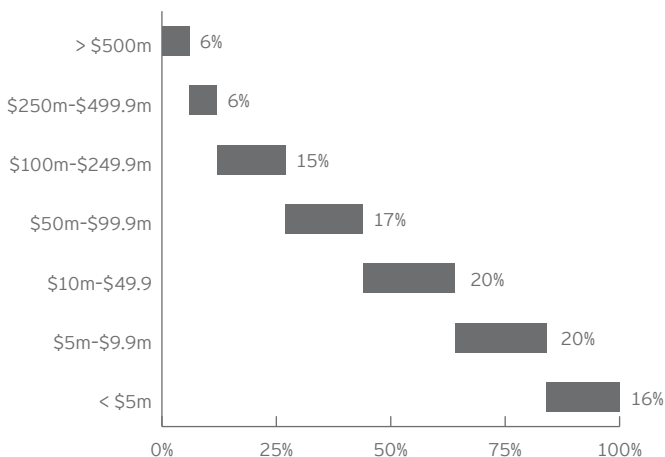
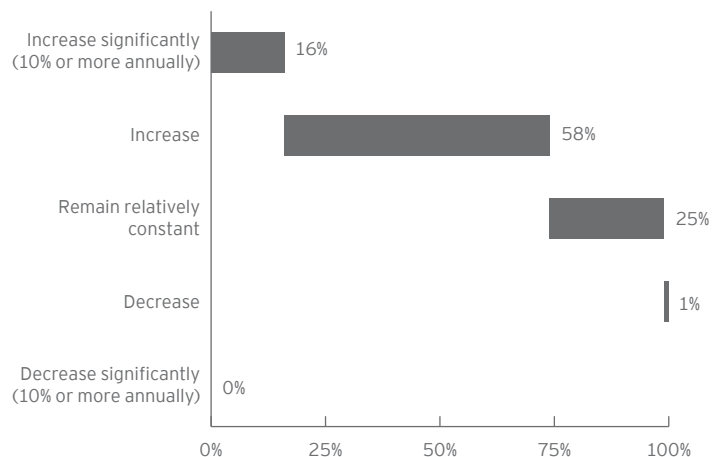


Figure 4. Anticipated change in spending 2012-2014



Growing focus on revenue generation

The most notable shift in this year's survey was the growing focus on cleantech as a way to increase revenue when respondents were asked to identify the most important factor influencing cleantech strategies. While improving operational efficiency to reduce costs remained the most influential factor cited by respondents (38%), increasing revenues moved up to the second position (19%) from third last year. The emphasis on efficiency and revenue generation becomes more pronounced when the analysis is limited to responses from executives in operational roles; of these, 45% say operational efficiency is most important and 24% say that revenue generation is most important.

Figure 5. Top three factors influencing cleantech technology

Most important factor	All respondents	Respondents in operational roles
1. Improve operational efficiency to reduce costs	38%	45%
2. Increase revenues through expansion of core product line to include clean technologies	19%	24%
3. Meet internal objectives for sustainability	14%	11%

Corporations recognize that, without the efficient use of energy and natural resources integrated into strategy and operations, they will lag behind competitors because of growing resource scarcity, rising energy prices and energy security concerns. More important, corporations are viewing cleantech investments as a way to be more competitive not only through operational efficiency but also through generating new revenues and creating new markets as industries change, incumbents are displaced and governments provide cleantech incentives to develop national industries.

The allocation of spending on cleantech reflects the corporate transformational agenda. While an average 27% of respondent cleantech budgets go to internal improvements, just over 40% of spending goes directly to revenue-generating activities – internal research and development (R&D) to create “green” products or develop clean technologies. In accordance with these objectives, 76% of executives said that over the next three years, they expect the cleantech focus of their R&D departments either to increase (49%) or to increase significantly (27%).

Transformation through acquisition of cleantech innovation

Our survey reveals that the world's largest corporations are pursuing transformation not only through the internal R&D investments noted above but also through an active program of cleantech company acquisitions. In this instance, 73% of the companies in the survey say they have acquired a cleantech company or might consider doing so in the near future.

It is not surprising then that 68% of respondents also report that corporate development executives will become increasingly focused on cleantech over the next three years.

Figure 6. How will the cleantech focus of corporate development executives change over the next three years?

Cleantech involvement	Corporate development executive
Significant increase	21%
Increase	47%
Stay about the same	28%
Decrease	3%
Significantly decrease	1%

A shift to leading-edge technology acquisitions

To date, respondents have favored “value” cleantech acquisitions – i.e., ones that provide incremental improvements to existing technologies with immediate returns. However, over the next five years, executives indicated that they will increasingly acquire “leading-edge” technologies that will provide transformational opportunities, investments with the potential for breakthrough performance and/or industry disruption. Executives in operational roles show an even stronger preference than the overall respondent population for acquisitions of leading-edge technologies over the next five years.



Figure 7. What is the focus of your cleantech acquisition strategy?

All executives	Now	Next five years	Change
Value (incremental improvement)	49%	46%	-3%
Leading-edge technologies (breakthrough)	35%	40%	+5%
Both value and leading-edge	16%	14%	-2%
Operational roles only			
Value (incremental improvement)	50%	42%	-8%
Leading-edge technologies (breakthrough)	37%	48%	+11%
Both value and leading-edge	13%	10%	-3%

The current preference for value acquisitions makes sense in the context of the recent economic downturn when short-term demonstrable ROI was paramount. As the economy shows signs of recovery, however, executives – especially the senior executives in operational roles – are looking for acquisitions that will provide innovation-driven breakout opportunities. In 2010, there were US\$19.9 billion in corporate cleantech acquisitions, according to Bloomberg New Energy Finance, a number that looks set to rise as corporations pursue a transformation agenda.

Partnerships and the transformation agenda

The transformation agenda can also be seen clearly in corporate partnering strategies related to emerging cleantech companies, vital to boosting in-house innovation and seizing market opportunities as the world moves toward a resource-efficient and low-carbon economy. The desire to expand revenues through brand enhancement, innovation, reaching new customers and entering new markets is currently driving partnerships with emerging cleantech companies. For an emerging cleantech company, understanding a corporation’s transformation agenda and demonstrating an ability to advance it will be critical to securing such partnerships.

Figure 8. What are your primary drivers in partnering with emerging cleantech companies?

Primary partnership drivers	Respondents
Source innovation	39%
Enhance our brand	39%
Enhance internal innovation capabilities	33%
Reach new customers	33%
Grow the business by entering a new market	32%
Fill gaps in existing cleantech product line	26%
Grow the business by entering a new geography	24%

Seizing transformational opportunities

The first stage of the corporate response to the transformation to a more resource-efficient and low-carbon global economy – improvements in resource efficiency – is well underway and already an essential part of corporate competitive positioning. Now, the executives of market-leading companies are moving to the second stage – seizing transformational opportunities to create new cleantech-enabled products, leverage core competencies to enter the cleantech market or enter entirely new markets, all with the objective of new revenue generation.

While certain companies were early to see and pursue transformational opportunities, we are now entering a period of dynamic strategy formulation, partnership formation and positioning as the broader corporate population seeks to determine its play in cleantech. As we see from our survey results, this has important implications for corporate spending, R&D, acquisitions, innovation and partnerships. As a result, emerging cleantech companies will likely face increased competition from large corporate players but will also benefit from partnership and acquisition opportunities as the corporate demand for cleantech innovation grows.

This is leading us to an era of profound transformation – in products, companies and industries – as the balance sheets of global corporations are brought to bear on cleantech-enabled revenue opportunities.

Global public cleantech company benchmark



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Ernst & Young is introducing our first annual benchmark of the global population and performance of pure-play public cleantech companies. These are companies whose value is primarily derived from clean energy that are emerging as new market leaders in the global transition to a resource-efficient and low-carbon economy, driving clean technology and business model innovation. For this study, “pure-play” is defined as companies whose clean energy focus is designated A-1 Main Driver (50%-100% of value) by Bloomberg New Energy Finance (BNEF).

It is important to note that the public pure-play population represents a thin slice of the overall cleantech population, which ranges from start-ups backed by venture capital (VC) to large private companies and multi-industry Fortune 1000 companies. There are more than 600 other public companies designated by BNEF as having either a considerable (25%-49% of value) or moderate (10%-24% of value) clean energy focus. Included among these are companies such as ABB, Schneider Electric and Johnson Controls in the “considerable” category and GE, Siemens and Cisco in the “moderate” category. Our research shows nearly 1,300 VC-backed companies worldwide targeting cleantech to some degree.¹

We are highlighting the public pure-play population because, as those most focused on cleantech, these companies are in many ways the bellwether of the industry and an indicator of the industry’s ability to create new market leaders. The objective of our benchmark is to provide annual quantitative measures of the pure-play cleantech population as it grows and matures – including the number of companies, headcount, revenues, net income, market capitalization and debt – and offer insights into unique geographic and industry subsegments.

Cleantech growth

We tracked 399 public pure-play cleantech companies with total annual revenues of US\$152.8 billion in the 12 months ending 30 September 2010, net income of US\$5.1 billion and a combined market capitalization of US\$243.2 billion. These figures represent strong growth compared with the same period in 2009 (see Figure 1). At the same time, total debt increased 23% to US\$100.8 billion, suggesting that revenue growth is providing the confidence to increase financial leverage. The availability of capital for cleantech expansion is a positive sign.

Although this population of companies is fairly young – at just a median of 13 years since incorporation – it employs nearly

500,000 people worldwide, underscoring the importance of cleantech as an engine of job creation. And given the growth we are seeing in the revenues and IPO activity of these companies, we can expect the headcount figure to increase.

Regional differentiation

With 149 pure-play public cleantech companies, the Asia-Pacific region hosts the largest share of the population. As might be expected, the region also has the highest total headcount and market capitalization (see Figure 2). Regional revenues grew 44% to US\$46.5 billion with a significant increase in net income; debt also increased 29% to US\$34.0 billion. Asia-Pacific companies are the youngest on a median basis – 12 years since incorporation – which reflects the new entrants from mainland China, Australia and Taiwan in recent years. The median headcount per company is 412, far higher than in EMEA or North America, largely as the result of the low-cost workforce of Chinese manufacturers.

EMEA, with 128 pure-play companies, is the second-largest region by number of companies, headcount and market

Figure 1. Global public pure-play cleantech companies

Number of companies	399
Median age (years)	13
Total headcount	496,311
Median headcount	203
2010 market cap (US\$b)	\$243.2
Annual change	27%*
2010 annual revenues (US\$b)	\$152.8
Annual change	21%
2010 net income (US\$b)	\$5.1
Annual change	126%
2010 debt (US\$b)	\$100.8
Annual change	23%

Note: includes public companies designated as clean energy A-1 Main Driver (50%-100% of value) by BNEF, excluding listed investment funds and acquisition vehicles; 2009 and 2010 annual financial data comprises the 12 months ending 30 September as available in CapitalIQ; market capitalization as of 15 February 2011

* Includes addition of new entrant market cap; without new entrants, market cap growth amounts to 7%

¹ Dow Jones VentureSource; Ernst & Young’s *Venture Insights*, March 2011

capitalization, but the leader in terms of revenues, which reached US\$72.8 billion in 2010. Median EMEA company revenues were US\$120.3 million. Supportive European government policies, such as feed-in tariffs for renewable energy production, contribute to the region's revenue strength. Many countries are finding it challenging to maintain the previous levels of such support, however, because of the current austerity measures they are taking. Consequently, EU-based companies are now looking for additional revenue sources in other markets.

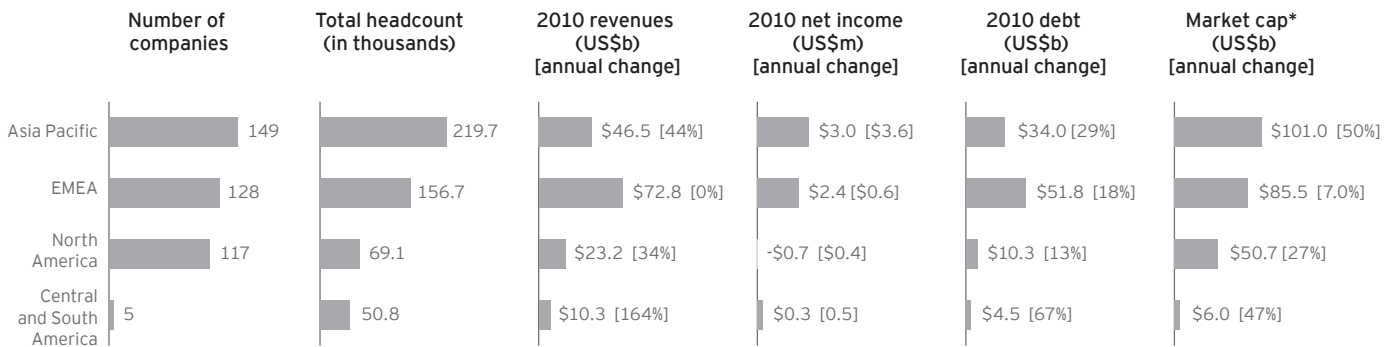
North America's pure-play cleantech company population numbers 117. The region's companies are the smallest across the board, with a median headcount of 130 and median revenues of US\$53.8 million. Debt levels are also the lowest. The median age of companies in North America is 15 years since incorporation, the highest of all the regions. Their relatively small size may be related to the fact that most pure-play companies

in North America come from the venture capital or private equity ecosystem rather than from the larger family-owned or state-owned enterprises seen in Europe and China.

The pure-play population in Central and South America is small – just five companies – and dominated by large Brazilian ethanol producers such as Cosan. Net income improved substantially in 2010, rising US\$540 million from negative levels to reach US\$368.1 million, even as overall revenues declined. The total and median headcount for this population is high, the result of the agricultural nature of ethanol production.

Despite the regional differences, the median market cap per headcount is similar in the major regions, with the exception of Central and South America – US\$0.66 million in Asia Pacific, US\$0.66 million in EMEA and US\$0.74 million in North America – suggesting that the companies are broadly comparable in terms of productivity and value creation.

Figure 2. Global pure-play cleantech public company landscape by region



* 15 February 2011

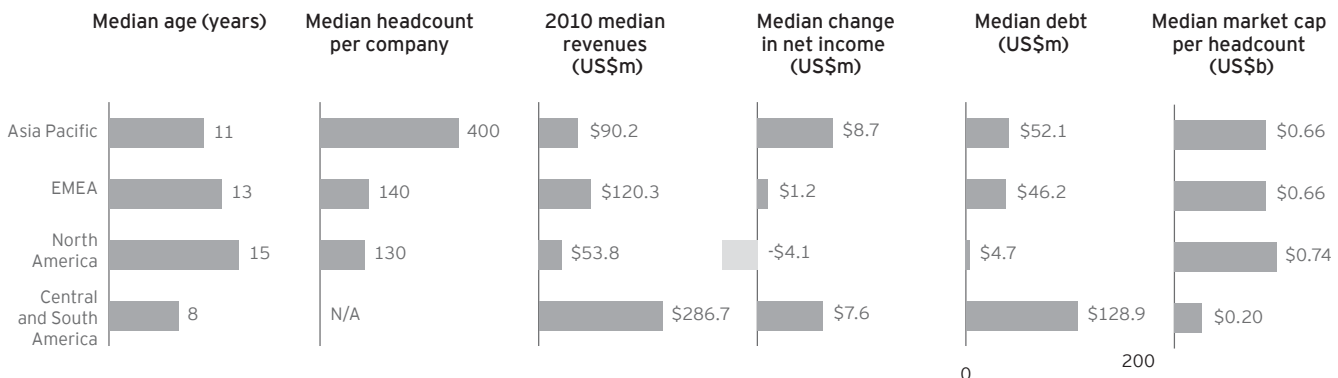
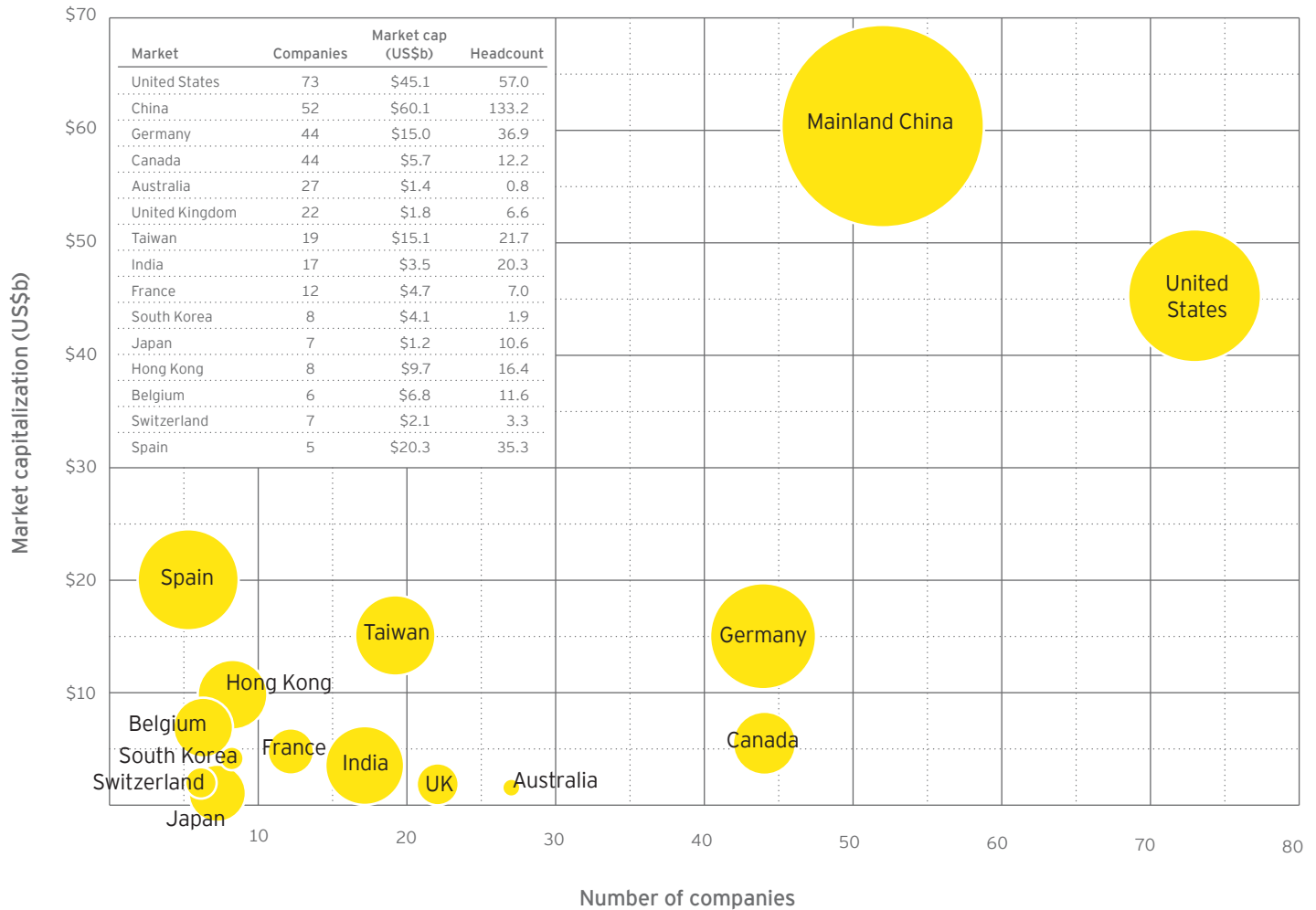


Figure 3. Pure-play cleantech company market landscape – top 15 markets by cleantech company population



Note: includes public companies designated as clean energy A-1 Main Driver (50%-100% of value) by BNEF; market capitalization data as of 15 February 2011

Bubble volume represents cleantech company headcount

Market landscape

Further distinctions can be made at the market level (see Figure 3). China and the US make up a first market tier in terms of company population and market capitalization. While the US has the largest number of companies (73), China has the greatest market capitalization (US\$60.1 billion). China’s company headcount is also several times larger than that of any other market.

Germany and Canada form another tier in terms of company population, with 44 pure-play cleantech companies each.

A third tier is composed of markets with fewer than 30 companies. Spain is an outlier in this group for its high aggregate market

capitalization, due to Iberdrola Renovables, the pure-play cleantech company with the highest market capitalization.

Despite its large company population, the United States has not yet produced many market-leading companies in terms of market capitalization. Only one American company is on the list of top 10 companies by market capitalization (see Figure 4). In contrast, three Chinese companies are on the list.

Cleantech companies by segment: solar predominates

The rapid scaling of the global solar industry becomes evident when analyzing the cleantech company population by segment. The 102 solar companies constitute the largest share – just over

Figure 4. Top ten pure-play cleantech companies by market capitalization

Company	Market	Cleantech segment	Year incorporated	Market cap (US\$B)	Stock exchange	IPO year
Iberdrola Renovables SA	Spain	Renewable energy generation	2001	\$15.4	BME: SIBE	2007
First Solar Inc.	United States	Solar	1999	\$14.3	NASDAQ/OMX: New York	2006
Enel Green Power SpA	Italy	Renewable energy generation	2008	\$11.1	Milan SE	2010
Xinjiang Goldwind Science & Technology Co. Ltd.	China	Wind	1998	\$7.6	Hong Kong SE	2010
GCL-Poly Energy Holdings Ltd.	Hong Kong	Renewable energy generation	2006	\$6.8	Hong Kong SE	2007
China Longyuan Power Group Corp. Ltd.	China	Wind	1993	\$6.6	Hong Kong SE	2009
Vestas Wind Systems A/S	Denmark	Wind	1898	\$6.4	NASDAQ/OMX: Copenhagen	1998
Umicore	Belgium	Environment	1904	\$6.1	NYSE/Euronex: Euronext	Pre-1990
EDP Renovaveis SA	Portugal	Renewable energy generation	2007	\$5.3	NYSE/Euronex: Euronext	2008
Sanen Optoelectronics Co. Ltd.	China	Energy efficiency products	1993	\$4.7	Shanghai SE	1996

Figure 5. Global public pure-play cleantech companies by segment

Segment	Number of companies	Median years since incorporation	Headcount	Market capitalization (US\$b)			Revenues (US\$b)		Net income (US\$m)		Debt (US\$b)	
				2010 market cap	Annual change	Median market cap/headcount	2010 revenues	Annual change	2010 net income	Median annual change	2010 debt	Annual change
Solar	102	12	161,280	\$68.8	48%	\$0.45	\$52.8	46%	\$1,422	\$7.7	\$31.8	19%
Wind	52	13	81,694	\$47.6	-18%	\$0.75	\$31.8	-6%	\$1,121	\$0.1	\$25.4	46%
Energy storage	47	15	59,412	\$13.5	63%	\$0.67	\$7.5	16%	-\$229	-\$0.4	\$2.0	10%
Energy efficiency products	42	22	66,078	\$29.3	93%	\$0.32	\$12.9	11%	\$842	\$3.8	\$3.5	-6%
Biofuels	33	7	51,787	\$10.5	58%	\$0.41	\$15.5	82%	\$128	\$2.3	\$6.0	28%
Renewable energy generation	23	14	23,174	\$42.4	35%	\$1.13	\$8.6	16%	\$1,295	\$0.2	\$23.5	27%
Biomass and waste energy	22	9	6,423	\$3.7	-6%	\$0.57	\$2.3	11%	\$42	-\$0.8	\$2.5	-12%
Geothermal	20	7	4,309	\$5.2	-5%	\$1.71	\$1.2	20%	\$98	-\$0.8	\$2.3	28%
Clean transport	15	16	3,875	\$4.4	152%	\$1.11	\$1.0	26%	-\$175	\$1.7	\$0.2	87%
Power and efficiency management services	14	18	9,956	\$3.6	41%	\$0.45	\$3.0	13%	\$67	\$2.5	\$0.5	-41%
Hydro	11	12	4,728	\$2.5	-12%	\$1.23	\$0.5	25%	\$47	-\$0.5	\$1.4	0%
Environment	9	23	13,495	\$8.6	64%	\$0.73	\$12.9	0%	\$295	\$3.0	\$1.0	-45%
Water treatment and conservation	9	21	10,100	\$3.1	-2%	\$0.47	\$2.8	8%	\$122	\$2.6	\$0.6	49%

Note: based on analysis of public companies designated as clean energy A-1 Main Driver (50%-100% of value) by BNEF; market cap data as of 15 February 2011



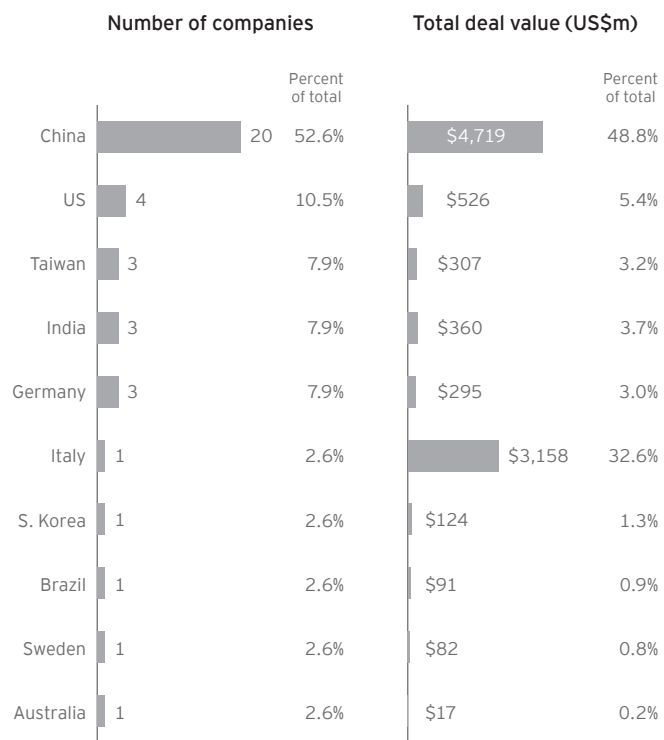
25% – of the population, employ more than 160,000 people and generated more than US\$52.8 billion in revenues, yet the median time since incorporation of these companies is just 12 years. Solar showed strong improvement in financial growth in 2010.

Wind, the second-largest segment at 52 companies, is also relatively youthful, with a median time since incorporation of 13 years, revenues of US\$31.8 billion and a headcount of nearly 82,000. These figures suggest that solar and wind have matured further down the value chain – with greater value creation in manufacturing and installation than other clean technologies.

The youngest of all the segments in terms of time since company incorporation is biofuels, with a median of seven years. Nonetheless, the 33 companies in this segment employ nearly 52,000 people and generate revenues in excess of US\$15 billion.

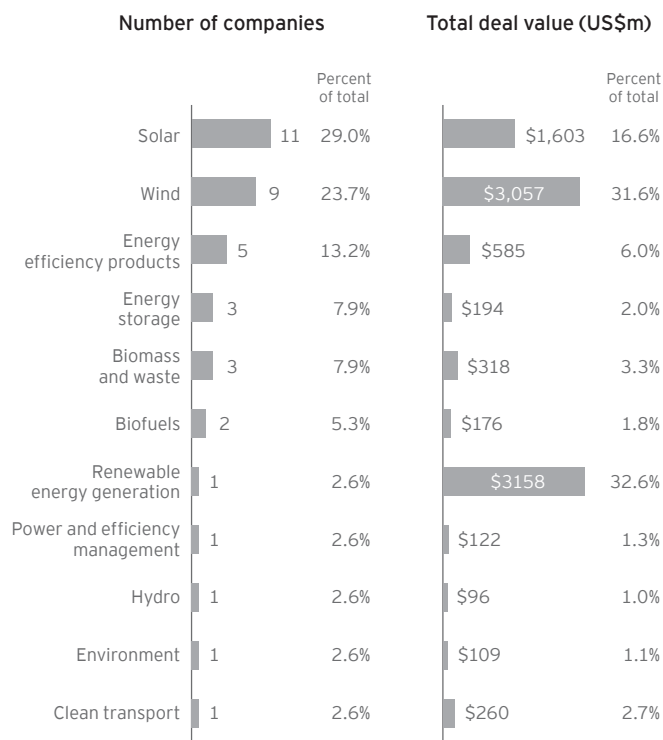
At the same time, the segment analysis illustrates another dimension of cleantech: many of the companies existed long before the word cleantech was coined. For example, energy efficiency products constitutes the fourth-largest segment with 42 companies worldwide generating US\$12.9 billion in revenues. In contrast to solar or wind, the median time since incorporation

Figure 6. 2010 cleantech pure-play IPOs by market



Note: includes public companies designated as clean energy A-1 Main Driver (50%-100% of value) by BNEF; percentages may not equal 100% due to rounding.

Figure 7. 2010 pure-play cleantech IPOs by segment



Note: includes public companies designated as clean energy A-1 Main Driver (50%-100% of value) by BNEF; percentages may not equal 100% due to rounding.

for this segment is 22 years. Efficiency was simply smart business before it was cleantech.

New entrants

New entrants to the pure-play population through IPOs numbered 38 in 2010, increasing the overall population by nearly 10%. IPO activity was propelled by a spate of listings by Chinese companies. The 20 Chinese IPOs in 2010 raised US\$4.7 billion, accounting for 52.6% of the deal activity and 48.8% of the capital raised (see Figure 5).²

The solar segment saw the largest number of IPOs in 2010, with 11 deals representing 29.0% of activity and 16.6% of capital raised (see Figure 7). Wind offerings, however, raised the most capital – US\$3.1 billion, 31.6% of all IPO proceeds, thanks to several large deals from China.

The US\$3.2 billion IPO by Enel Green Power SpA on the Milan Stock Exchange was the largest cleantech IPO of 2010. Seven of the top 10 offerings in terms of capital raised were conducted

by Chinese companies (see Figure 8), underscoring the rapid emergence and importance of the cleantech market in China.

Outlook

As evidenced in our analysis, the global population of public pure-play companies comes into 2011 with significant positive momentum. We can expect continued growth in this population and improvement in its financial performance as economic recovery continues, increasing demand for energy and resources. Energy security concerns, brought into relief by recent political events in the Middle East and the disasters in Japan, will likely cause national governments to accelerate or enhance already-substantial initiatives to promote domestic cleantech industries.³ With global IPO activity having returned to pre-downturn levels⁴ and a strong pipeline of cleantech offerings in China, there will likely be a number of new entrants to the public pure-play population as investors recognize the potential of companies that can enable the transformation to a resource-efficient and low-carbon economy.

² For further discussion of Chinese IPO activity, see “China: the new global leader in cleantech IPOs” on p. 35 of this report

³ For a discussion of national cleantech strategies, see “National strategies for competitive advantage and growth through cleantech” on page 12 of this report.

⁴ According to the Ernst & Young *Global IPO trends report 2011*

Figure 8. Top 10 cleantech IPOs in 2010

Company	Market	Cleantech segment	Stock exchange	Pricing date	Total value including non-deal (US\$m)	Market cap (US\$m)
Enel Green Power SpA	Italy	Renewable energy generation	Milan SE	1 Nov 10	\$3,157.82	\$11,158.38
Xinjiang Goldwind Science & Technology Co. Ltd.	China	Wind	Hong Kong SE	8 Oct 10	\$1,053.56	\$6,107.58
China Datang Corp. Renewable Power Co. Ltd.	China	Wind	Hong Kong SE	16 Dec 10	\$642.23	\$2,140.93
China Suntien Green Energy Corp. Ltd.	China	Wind	Hong Kong SE	13 Oct 10	\$424.74	\$1,055.27
Shanghai Chaori Solar Energy Science & Technology Co. Ltd.	China	Solar	Shenzhen: Main Board	18 Nov 10	\$355.96	\$1,421.69
China Ming Yang Wind Power Group Ltd.	China	Wind	NYSE/Euronext: New York	30 Sep 10	\$350.00	\$1,750.00
Risen Energy Co. Ltd.	China	Solar	Shenzhen: Main Board	2 Sep 10	\$278.34	\$1,082.44
Tesla Motors Inc.	US	Clean transport	NASDAQ/OMX: New York	28 Jun 10	\$260.02	\$1,589.14
Trony Solar Holdings Co. Ltd.	China	Solar	Hong Kong SE	7 Oct 10	\$256.81	\$885.73
Elster Group SE	Germany	Energy efficiency products	NYSE/Euronext: New York	29 Sep 10	\$242.19	\$1,299.76

National strategies for competitive advantage and growth through cleantech



*John de Yonge
Director, Account Enablement
Global Cleantech Center
Ernst & Young*

As the world shifts to a resource-efficient and low-carbon economy to address the rising consumption of energy and raw materials, many countries are embracing national cleantech strategies to position themselves for economic competitiveness and growth. For reasons ranging from creating jobs, to incubating high-value industries, to achieving energy security, gaining efficiencies or combating environmental degradation, many governments are making cleantech innovation, adoption and exports a top priority.

While each country is pursuing a different path to cleantech adoption for national advantage, their governments have played pivotal roles in the sector's development. From Denmark's pioneering embrace of wind energy to China's massive cleantech investment, here are several snapshots of national processes and plans in pursuit of cleantech-driven development.

Denmark: an early cleantech adopter moves into electric vehicles

Decades ago, Denmark set itself apart by embracing wind as an energy, jobs and economic engine. Denmark's early renewables success shows that even small countries can achieve great things with a coherent cleantech strategy.

The 1970s oil crisis first sparked Denmark's determination to be energy independent. Today, wind generates 20% of Denmark's energy from over 5,000 turbines, a percentage pegged to rise to 50% by 2020 with a growing portion from offshore. To boost offshore wind production, new government incentives include citizen share-price purchases of turbines, loan guarantees and a scrapping scheme with payments for owners of older turbines who retire them.

Along with reducing Denmark's dependence on fossil fuels, these initiatives have made Denmark the world leader in the wind industry, with a 40% share of the global wind turbine market. Danish company Vestas is the world's largest wind turbine manufacturer. The country also boasts world-class and comparatively low-cost wind research and development (R&D) clusters that draw investments from big names including Suzlon, Siemens Wind Power and Gamesa. As a result, since 2000, cleantech exports have grown three times faster than total exports to reach US\$11.7 billion in 2008 – the largest quantity of European exports in that category. New, more efficient turbines portend even greater growth.

To build on these achievements in its quest for 100% fossil fuel independence by 2050, Denmark's Government has committed US\$2 billion to cleantech. The country's ambitious goals include deploying 400 megawatts (MW) of new offshore wind turbines by 2012; renewables kicking in 10% of total energy for transport; cutting greenhouse gas emissions 20% from 2005 levels; reducing energy use 4% by 2020 from volumes consumed in 2006; and tripling wind capacity by 2030.

In transportation, the Danish Government is encouraging electric vehicle (EV) adoption through fossil fuel taxes, tax-free sales of hydrogen vehicles and EVs through 2012, and the provision of EV research funds. As a result, big names like Mercedes-Benz, Better Place (with DONG Energy and Renault Nissan), Saab, Volvo, Tesla and BYD plan to enter Denmark's hybrid and EV markets. Subsidies are also flowing into municipalities, companies and industry associations for R&D and tests on the required infrastructure, and to study the potential of storing and sending excess EV power back to the grid when wind energy falls.

Collectively, Denmark's showcase cleantech and fuel efficiency programs – which drove consumption down more than 2% from 2007 to 2008 – have made it a global model for cleantech-led development.

China: the emerging clean energy leader

When it comes to size, population and output, China is all superlatives. And energy is no exception. China's energy consumption is expected to surge 75% by 2035, according to the International Energy Agency. Today, roughly 75% of China's electricity comes from coal.

To meet its vast energy needs, curb pollution from coal, cut foreign oil dependence and spark innovation and economic growth, China's Government is taking an orchestrated approach through clean energy-friendly laws, funds, incentives and standards. Renewables now rank as a key development sector to meet the needs of a country that is both industrializing rapidly and urbanizing rapidly as citizens migrate from rural areas to join the growing middle classes in its densely populated cities. China's US\$586 billion economic stimulus plan alone earmarks roughly 37% of spending for cleantech projects, mostly in the renewable energy and smart grid areas. As a result of such initiatives, China scored the number one spot on Ernst & Young's global *Renewable Energy Country Attractiveness Index* in 2010.

Driving long-term action is China's 12th Five-Year Renewable Energy Plan, which calls for boosting renewables use, improving energy efficiency, and fostering cleantech R&D. The country's energy plan targets renewables as 15% of China's energy mix by 2020 and 33% by 2050, from nearly 10% in 2009, as well as shrinking the country's energy carbon intensity 45% by 2020. Regulations now require that grid companies purchase all renewable energy generated locally, and provide new state incentives and funds for cleantech projects such as the construction of independent power systems in remote areas and islands, often with regionally produced machinery.

Though China's solar sector caught the world's eye several years ago, wind is now at China's back. China was home to half of all newly operational wind turbines worldwide in 2010 and has plans to grow its installed capacity for wind to 100 gigawatts (GW), and for solar to 20GW by 2020.

Offshore wind is a particular priority, and bidding and tenders are underway in 11 provinces. Noteworthy projects include China's first offshore demonstration project near the East China Sea Bridge in Shanghai, and Sinovel's planned 5MW turbine manufacturing plant in Yangcheng for the country's first offshore wind-powered high-tech industrial base. Other big wind turbine makers, such as CNOOC, Vestas and Siemens, are leading or eyeing opportunities stemming from the country's target of 5GW of offshore capacity by 2015.

Other growing cleantech focus areas include electric vehicles (EVs) and smart grids. A US\$15 billion government plan aims to have 5 million electric and plug-in vehicles and 15 million conventional hybrids on the road by 2020. To boost the production capacity of hybrids and EVs to about 500,000, the state will spend US\$1.4 billion in the coming three years alone. China's State Grid Corporation also plans US\$586 billion in smart grid R&D and rollout investments by 2020.

But solar is still a focus. The country's "Golden Sun" program provides subsidies for 500MW or more of photovoltaic (PV) power projects by 2011. They are earmarked for building-mounted, grid-connected PV, stand-alone PV power, large-scale grid-connected PV solar farms and other projects, with half of total PV project investment and transmission costs covered in cities and 70% in rural areas. China is also funneling about US\$12.2 billion into emissions reduction and conservation spending.

Chinese clean energy companies and projects received investment of US\$51.1 billion in 2010 – 21% of all global investments in clean energy, according to Bloomberg New Energy Finance (BNEF). With an expected US\$738 billion spend on clean energy sources over the next decade, China is the global cleantech opportunity.

India: a national solar mission

Ramping up India's power supply to accelerate industrialization, create new cleantech industry clusters, serve its growing cities, and cut poverty and CO2 emissions drives India's interest in renewables. The power deficit in the world's second most-populated country averaged nearly 13% during peak hours in the year ending March 2010. India is also the world's fourth most-polluting nation.

India imports almost 75% of its oil, with renewables contributing just 10% of its energy mix. Reducing renewable energy technology costs is thus a top state goal. Given India's success with software and business process outsourcing, its potential is promising, particularly in solar, a relatively untapped and unlimited resource.

Investors see opportunity. Clean energy asset financing in India skyrocketed to US\$3.4 billion in 2010 from just US\$560 million in 2004, according to BNEF, for a robust 35% compound annual growth rate.

Wind accounts for 70% of the renewables mix in India, followed by hydro (16%), waste-to-energy and biomass. But to accelerate cleantech adoption at its factories and farms, the nation recently singled out solar energy for development.

India's National Solar Mission (NSM) targets a twentyfold growth in its installed solar capacity sourced from the country's abundant solar irradiance. As many as 330 average sunny days a year in India at many sites make solar energy an attractive proposition. The country's average daily insolation of 4-7 kWh/m² adds up to a potential of more than 100GW.

In particular, the NSM seeks 1GW in installed solar capacity, of which 60% would be solar thermal and 40% PV, respectively. Key goals to get there include improving solar cell efficiencies by 15%, achieving grid parity by 2022 and fostering entrepreneurship and technology transfer. Some 1,100MW for India's grid-connection plants is targeted for the first NSM phase through 2013, encompassing roughly 100MW of rooftop and small tail-end solar plants.



Companies such as Tata BP Solar, Websol and Titan Energy are eyeing technology and manufacturing joint ventures and partnerships to participate in NSM project allocations.

Finally, India, like China, is prioritizing power for remote rural villages, via solar PV home-lighting systems, small hydropower projects, biomass gasification and biogas engines. It also plans to replace diesel with PV systems in industry and telecommunications towers. The Government hopes to electrify 10,000 villages by 2012.

South Korea: smart grid and electric vehicles pave the way

When it comes to small countries making big moves, South Korea is today's front runner. This often-overlooked electronics powerhouse – which ranks 10th globally for energy consumption and 9th for CO2 emissions – plans to plow some US\$36 billion into alternative energy by 2015, led by the private sector.

Driving interest and investment in Asia's fourth-biggest economy are its 50% dependence on energy imports, growing population, rising incomes and CO2 emissions. The country also seeks to grow its global share of the renewables market by developing innovative wind, solar, hydrogen fuel cell, smart grid and EV products.

South Korea's ambitious Green Growth program aims to make South Korea the world's seventh green power by 2020, and its fifth by 2050. The Government believes some 500,000 new jobs, 230 million tons less carbon dioxide, and 440 billion fewer imported barrels of oil will result from its smart grid efforts by 2030 in a market it values at US\$54 billion. Other expected benefits include a 3% fall in power consumption, a 4% drop in emissions from 2005 levels by 2020, and a 15% decline in consumer electricity bills.

A particular focus is on EVs and smart grids, with domestic leaders Hyundai and GM Daewoo championing EVs through their BlueON and Lacetti cars, respectively. The country hopes to produce 1 million EVs and install 2.2 million charging points by 2020, encouraged by tax benefits for EV owners.

Finally, South Korea's US\$24 billion plan for a nationwide smart grid by 2030 – the world's first – aims for 30,000 charging

stations at malls, parking lots, gas stations and public buildings by then. The South Korean Government also views smart grids as a strategic export industry.

Brazil: diversifying its renewable energy supply

South America's biggest country is best known for its sugar cane ethanol, which emerged as a petroleum substitute during the 1970s oil crisis. But Brazil has long been a clean energy pioneer. Nearly half its energy is renewable today versus the worldwide average of 13%, led by hydropower.

For Brazil, cleantech is a solution to problems wrought by fast economic and population growth. To meet demand for more varied and greater volumes of energy sources for its rising middle class, burgeoning cities and rapidly industrializing regions, the world's fifth most-populous nation is deploying a coherent and targeted renewables-driven strategy. Brazil is the world's 10th biggest energy user.

Among Brazil's current cleantech sources, its 22 million gallons of ethanol distilled per day make it the world's second-biggest producer and meet roughly half of Brazil's domestic fuel needs. Hydropower from the massive Amazon and its tributaries also provides an impressive 84% of its electricity. Brazil trails only China and Canada in hydropower production.

But deforestation, population displacement and power disruption from drought have pushed Brazil to diversify into small hydro, wind and solar power, and to harness feedstock by-products like sugar cane bagasse.

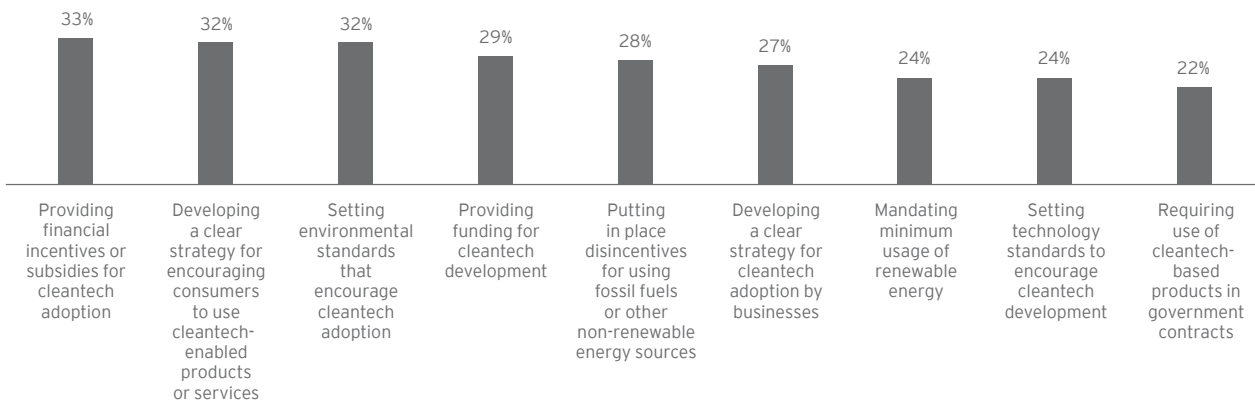
For a sense of the country's commitment to alternative energy, look to Brazil's national cleantech strategy for 2022. Government targets include boosting Brazil's clean energy generation capacity by 11.5GW by 2019, with no new fossil fuel plants commissioned after 2013; installing smart meters in each of its roughly 62 million homes by 2020; cutting carbon dioxide emissions 40%, increasing biomass and wind energy tenfold; and tripling ethanol production to 75 billion liters, all by 2022.

To date, Brazil has captured just a tiny fraction of its total wind potential of 143GW, prompting its Government to focus on this largely untapped resource concentrated on its Eastern coast.

Corporate views on the role of government

Response from the *Ernst & Young annual global corporate cleantech adoption survey*

Which of the following do you believe are the most important roles government plays in supporting cleantech?



Corporate survey respondents say that the most important role for government in supporting cleantech is to provide incentives for cleantech adoption, encourage consumers to use cleantech-enabled products and set environmental standards

that will drive cleantech adoption. For further insights into corporate cleantech adoption, see "Seizing transformational opportunities" on p. 2 of this report.

Wind is a natural complement to hydropower, particularly during dry seasons. The country's September 2010 renewables auction should increase Brazil's installed capacity by 2.9GW of wind, hydroelectric and biomass energy and spark US\$5.5 billion in investment, mostly from the private sector.

Emerging economies seize a transformative opportunity

Denmark engineered a remarkable shift from fossil fuels and established itself as the center of the global wind industry in just 30 years with focused, long-term government support. The Governments of China, India, Korea and Brazil are pursuing similar objectives with massive investment and ambitious timelines. Their large and fast-growing internal markets for cleantech and comparatively lower production costs versus those of developed economies are a clear advantage. If these countries meet their

cleantech goals, the scale of transformation in each will be far greater than Denmark's, positioning them for leadership in our resource-constrained and low-carbon future.

Perspective: accessing global cleantech incentives



*Paul Naumoff
Global Cleantech and Climate Change and
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Cleantech continues to play an important role in governmental policies around the globe, with countries actively encouraging the sector through various tax credits and other incentives to help reduce the payback period for investments in cleantech and renewable energy.

In the US, President Obama recently restated his commitment to the cleantech sector in his State of the Union address by proposing a “clean energy standard” that would set a goal of providing 80% of America’s electricity from clean energy sources by 2035. This new goal is complemented by existing US legislation that provides for investment and production tax credits and grants for renewable energy sources. The US Government’s promotion of the cleantech sector extends beyond the implementation of renewable energy to include the research and development associated with new cleantech products through the Federal Research and Experimentation tax credit, as well as the manufacturing of cleantech products, through a tax credit for manufacturing advanced energy components and products.

Incentives to assist the cleantech industry are not just a US trend, but a global occurrence. The European Union’s FP7 program provides funding for research, with many of the calls for proposals applicable to the cleantech sector. In addition, many European nations offer incentives for renewable energy, either as tax credits, feed-in-tariffs or green-certificate programs.

In China, municipalities have offered cheap land and tax incentives, while Chinese state banks offer low-interest financing for cleantech projects. Furthermore, through the United Nations, the Clean Development Mechanism can provide an incentive to develop renewable energy projects in certain less-developed nations. Cleantech sector investment is expected to attract significant interest and influence additional government action in the form of grants, subsidies and tax incentives as new innovations and renewable energy production efforts lay the foundation for energy independence and spur economic growth within any given country.

Regardless of the geography, companies looking to participate in such incentive programs must first identify projects that may be eligible. Ernst & Young facilitates this by bringing together multiple departments within our clients’ organizations that too often do not interact with each other, such as tax, operations, facilities and sustainability, to discuss potential projects. Based on these discussions, we are able to research and locate available incentives around the globe. Once the projects and related incentives have been identified, we assist clients in securing the incentives by advising on the project, helping to write applications or negotiating with government officials. After the incentive has been secured, Ernst & Young continues to work with clients to help them meet compliance requirements and realize the full value of the incentive.



Cleantech clusters – not companies – drive competitiveness



Mark Johnson
Chairman
Innosight

Mark Johnson is chairman of Innosight, a strategic innovation consulting and investing company with offices in Massachusetts, Singapore and India, which he cofounded with Harvard Business School professor Clayton M. Christensen. He has consulted to the Global 1000 and start-up companies in a wide range of industries and has advised Singapore's Government on innovation and entrepreneurship.

Ernst & Young: What is your view on the cleantech investment landscape?

Mark Johnson: Just about every modern economy is investing staggering sums in developing clean technologies these days. This investment is a wonderful thing: it is widely believed that cleantech is the key to a resource-efficient, sustainable future. The problem is that much of the capital is being invested inefficiently.

Take the United States. Many of our cleantech investments are underwriting very worthy American companies advancing specific clean technologies, such as the Chevy Volt, the electric car batterymaker A123 Systems and the green cement company Calera. Other investments support important basic research occurring in labs and universities. But what these investments miss is the fact that cleantech is not a robust industry yet, but just a series of market segments that are part of a nascent and growing industry. We need more than support for individual players or fundamental research in isolation; we need support for an ecosystem in which such an industry can arise.

Silicon Valley is just such an ecosystem, generating innovation after innovation, new business after new business. These ecosystems naturally emerge around leading companies over time. But it could be possible to accelerate their development.

Ernst & Young: Can you give an example?

Mark Johnson: The government of Abu Dhabi believes so. Its investment in cleantech is centered on the Masdar Initiative, an ambitious program to advance a constellation of clean technologies by building a completely sustainable city. That city, which is now going up and which will generate its own power and reuse and recycle its own waste, is much more than another spectacular and fanciful Gulf real estate development – it is a real-world incubator designed to grow into a world-class cluster of cleantech experience, expertise and value, and all for a tenth of the money devoted to cleantech in the US stimulus bill. Hence, national competitiveness in cleantech will be driven by creating cleantech clusters that will accelerate the development of cleantech companies.

**We need more than support for
individual players or fundamental
research in isolation.**

Green stimulus update: spending to peak in 2011



Anna Czajkowska
Clean Energy Policy Analyst
Bloomberg New Energy Finance

Two and a half years since the darkest days of the world financial crisis, the green stimulus programs of governments around the world are still making an important contribution to the growth of investment in clean energy.

Bloomberg New Energy Finance has been tracking the progress of those stimulus measures in 12 major economies ever since the crisis and estimates that about half of the money – ranging from grants for renewable power projects to subsidies for household energy efficiency – has still to be spent.

That is good news for the clean energy sector, which despite enjoying record investment in 2010, remains vulnerable to changes in subsidy arrangements in its major markets and to competition from power projects using low-priced natural gas.

Late last year, we estimated that the 12 most important green stimulus programs around the world, announced in the wake of the financial crisis, totaled US\$190.3 billion, and that a bit more than 40% of this would have reached projects on the ground by the end of 2010. We forecast that a further 35% of the total, or US\$66 billion, might be spent during 2011.

A threat to the stimulus programs emerged during 2010. Growing concerns over public debt, particularly in Europe, but elsewhere as well, have raised the risk that governments may try to backtrack on commitments and that some of the promised US\$190.3 billion may not be spent.

Global overview

The green stimulus programs that emerged from the financial crisis of late 2008 were an attempt by the governments of leading economies to kill two birds with one stone: to use tax and spending policy to generate jobs and support economic growth while also accelerating their countries' transition to a low-carbon energy future.

In late 2008 and early 2009, the US, China and South Korea announced the three biggest green packages as part of their recovery plans (see Figure 1), with US\$64.4 billion, US\$46.9 billion and US\$29.9 billion respectively.

Spending progress

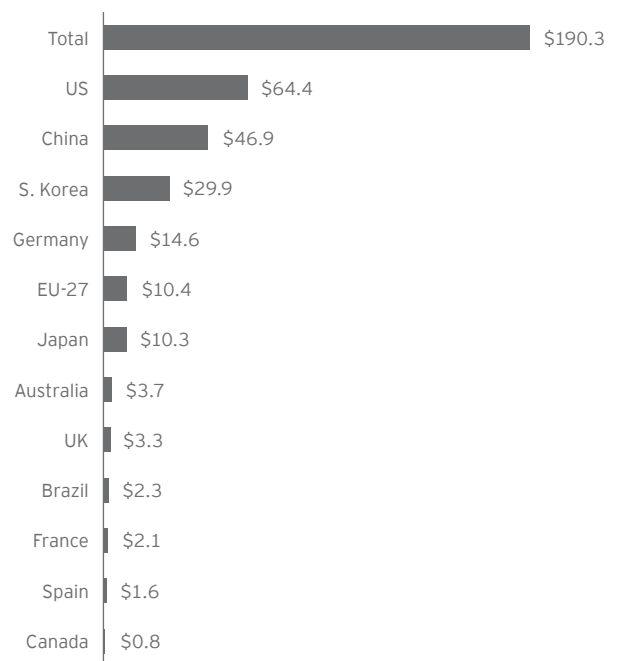
Globally, we saw an increased pace in spending during 2010 – particularly in China, Japan and South Korea. Some 77% of the announced funds had been allocated by year-end, but only 40% had reached the ground (see Figure 2). The delay in actual spending is in part due to difficulties in getting the money out the

door through state and other third-party programs. Such large amounts of money require enormous administrative efforts, as most of the programs first need to be allocated by central administrations to the specific agencies tasked with disbursing the money to individual recipients.

Of the approximately US\$64.4 billion originally announced in the US package, US\$47 billion had been allocated by late 2010 through the Department of Energy, the Department of Defense and other agencies. However, of that total, only about one-third, or approximately US\$15 billion, has been spent. This was far lower than we had earlier anticipated, given that the American Recovery and Reinvestment Act was passed in February 2009.

While the American stimulus program is fairly transparent, the Chinese one was less precise. Our research suggests that much of the Chinese stimulus money is allocated by the National and Reform Commission and then channelled through large state-owned companies. Thus, some 70% of the Chinese US\$46.9 billion stimulus has been allocated to specific projects, and 56%

Figure 1. Green components of national economic stimuli (US\$b)



Source: Governments, Bloomberg New Energy Finance

should have reached them by the end of 2010. We have also learned that most of the remaining funds will be disbursed by local governments and/or in the form of loans from local banks. That means there may be no detailed reporting of the so-far unallocated 30% of the package.

Spending outlook

Given the progress of all the tracked countries in allocating the green stimulus funds to specific programs, we expect even more money to reach clean energy projects in 2011 than in 2010 (see Figure 3). This assumes, however, that the stimulus programs are not changed, reshuffled or cancelled. With the drive for austerity measures in many of the major economies, at least some of these projects could well be axed or temporarily frozen.

Impact

The initial announcement of the green stimulus initiatives sparked a mixed reaction of optimism and disbelief among market participants. As it has turned out, both reactions were justified. On the one hand, many of the programs delivered substantial aid to the clean energy sector in the uncertain times of the financial crisis. But on the other hand, distribution of the funds proved to be an unprecedented administrative challenge for the governments. In fact, most of the money intended to aid the financially strapped sector is reaching it when the overall situation on the markets has improved.

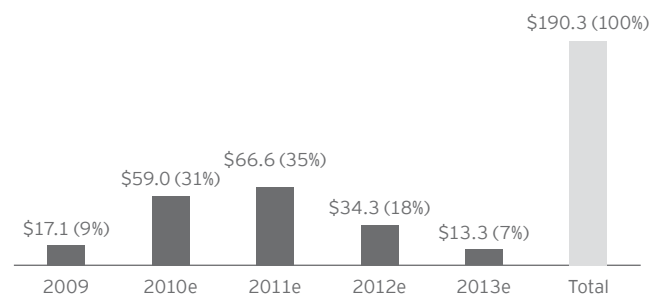
Figure 2. Funds allocated and spent (estimates)

Region	Total allocated (US\$m)	Percent allocated	Total spent	Percent spent
US	47,000	73%	15,050	23%
China	32,841	70%	26,272	56%
S. Korea	29,920	100%	11,968	40%
Germany	8,174	56%	7,930	54%
EU	10,401	100%	3,634	35%
Japan	10,340	100%	6,565	63%
Australia	1,847	50%	1,619	44%
UK	2,044	61%	576	17%
Brazil	392	17%	172	7%
France	2,111	100%	2,111	100%
Spain	738	46%	627	39%
Canada	579	77%	137	18%
Total	145,974	77%	76,034	40%

Source: Bloomberg New Energy Finance estimates

Note: All estimates based on information disclosed by the governments and/or recipients of the funds. Total global green stimulus funds announced amount to US\$190.3b. This total may have slightly increased in the last month of 2010, after this research was completed.

Figure 3. Annual profile of government spending on clean energy stimuli (US\$b)



Source: Bloomberg New Energy Finance

Secondly, the stimulus programs have sometimes deviated from their objective of aiding their national economies. In the US in particular, there was a great deal of controversy over the stimulus grants helping Chinese manufacturers and supporting job creation in China's clean energy sector, rather than in America.

Given the current public debt concerns in many economies, we are unlikely to see any more government spending programs targeting the sector on a comparable scale any time soon. New measures are likely to be tailored more carefully to support national economies without going against the country's commitments to the WTO rules of free trade. Protectionism is clearly an unwelcome policy approach to the sector from a global perspective, but the temptation is great for national policymakers to move in that direction.

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Further details of Bloomberg New Energy Finance's work on green stimulus programs and other extensive research on clean energy and carbon can be found on www.newenergyfinance.com.

Because of our methodology, the green stimulus numbers presented by Bloomberg New Energy Finance often differ from the official government figures. This reflects our strict definition. We include only those economic recovery plans (announced in the form of emergency plans, packages, funds or simply as parts of national budgets) unveiled between September 2008 and the end of 2009. We do not include measures announced later than that, or programs unrelated to the recovery efforts or earlier support for clean energy, such as feed-in tariffs or tax concessions. We have also focused on measures targeting specific sectors – renewable energy generation, energy efficiency, grid development and upgrades, clean transportation and R&D within these sectors. Hence, our figures don't include flood prevention, fast railways or forestry measures, for example, sometimes counted by other analysts as part of the green stimuli.

A conversation with Brice Koch of ABB



*Brice Koch, PhD
Head of Marketing & Customer Solutions and
Member of Group Executive Committee
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*Interviewed by
Jay Spencer, Americas Cleantech Leader
Ernst & Young*

Jay Spencer spoke with Dr. Brice Koch of ABB about the current cleantech landscape. ABB is a global producer of power and automation technologies that enable utility and industry customers to improve their performance while lowering environmental impact.

Jay Spencer: As you look across all of the segments of ABB, what is the significance of cleantech for your global strategy?

Brice Koch: Cleantech is at the heart of our global strategy and plays a central role in all our activities, from R & D through to marketing.

ABB is a merger of two companies, one Swiss and one Swedish. Both of these countries have always had a strong commitment to taking care of the environment.

So it is in the DNA of the company to focus on clean technologies. Right from the start, ABB has focused on technologies that help reduce environmental impact, providing equipment for the reliable and efficient delivery of electricity on the one hand, and technology to automate industrial processes and increase productivity on the other.

Today, a large proportion of our portfolio is linked to energy efficiency and clean technology. In fact, more than half of ABB's revenue is related to energy efficiency, which means our customers can see the competitive returns they can gain by installing new technologies that reduce their energy consumption and costs, and at the same time, reduce the impact of their activities on the environment.

Jay Spencer: What do you see as some of the factors driving global demand for the cleantech products and services ABB produces?

Brice Koch: ABB's cleantech products and services are broadly appealing to a wide range of customers with a variety of needs. However, the overall theme is doing more with less. Whether motivated by the price of raw materials or the need to reduce environmental impact or to raise the standard of living around the globe, the demand for greater productivity is driving demand for ABB's cleantech products.

An additional one gigawatt of power generation and related infrastructure – which is roughly equivalent to a nuclear power station and its grid connections – is in theory needed every week

for the next 20 years to satisfy growing demand for electricity. More than 80% of this demand will come from non-OECD countries, led by China. These populations want the same quality of life and energy availability as people enjoy in today's mature markets, which means, if left unchecked, we can expect CO2 emissions to continue to spiral. Currently, power generation alone accounts for more than 40% of energy-related CO2 emissions, and even if we reduce emissions to the levels that were generated in 2000, we can expect to see average global temperature increases of 3°C by the end of this century.

This combination of environmental perception and economics drives the demand for clean technologies. According to the International Energy Agency, by adopting renewable and energy-efficient technologies, more than 75% of the required emission reductions needed to prevent further temperature increases can be achieved. The lion's share of this would be from increasing energy efficiency.

Jay Spencer: Is it safe to say that you feel energy efficiency is, from a technology perspective, the most important growth opportunity right now in cleantech?

Brice Koch: Definitely. And huge improvements in energy efficiency can be achieved with technologies available today. You see it in the power generation sector, which is by far the largest energy-consuming industry. A round 5% of the electricity generated by these plants is consumed during their operations, but by using sophisticated control systems and installing energy-efficient equipment, between 10% and 30% of the power required to run the facility can be saved.

Similarly, about 8% of the electricity that leaves a power station is lost during its transmission and distribution. This is the global average, and in some countries, it may even be as high as 35%. The huge gap between the best and the worst performers shows what can be done with available technology.

It's much the same story in industry. Can you imagine that 40% of the world's electricity is used by industry, and two-thirds of that is used to power electric motors? But the thing is, many of these motors are running at full speed even when they don't have to. Their speed can be regulated using drives, and this brings surprising savings. The installed base of ABB drives saved an estimated 220 million megawatt hours of electricity in

2009 alone. This is equivalent to the electricity consumption of 54 million European households.

These are just a few examples, but the list of cleantech products currently available is widespread and extends to railways, shipping, buildings and utilities such as water, not to mention the renewable industries, such as wind, hydro, solar and wave power. As you can see, the growth opportunities for cleantech are everywhere.

Jay Spencer: ABB and other companies have offered efficient equipment and efficiency management systems for years. What are the barriers that have prevented these technologies from being adopted more quickly?

Brice Koch: One of the key barriers is lack of information about what exists, for both consumers and for businesses. And another is associated with who purchases the new equipment. The manager who decides what motor to buy is normally in charge of the capital expenditures for the company, but the manager who gets the benefit in the organization is in charge of the operational expenditures. To buy the high-efficiency motor would probably cost 5% more – which could stretch the capex budget – but the manager who is in charge of the opex budget could save that 5% every six months for the operational lifetime of the motor. The challenge is getting businesses to measure the real cost of a product by looking at its entire life cycle, taking into consideration not only the purchase price but also the running costs. A third barrier to adoption – especially for consumers – is the cost of electricity. Look at your home's electric bill. If I look at my own, it is more or less equivalent to a dinner for four every month. Given the low cost, will I ever accept the utility turning off some of my uses – maybe my air conditioning – for a 20% savings per month? As long as we price it that way, we will have an issue.

Jay Spencer: What do you see as China's role in the cleantech market – as an investor, as a user, as an installer, or across the whole value chain?

Brice Koch: It's hard to imagine China restricted to any one of these single roles. It is already a prominent investor, user and installer of cleantech. You see, China has a double motivation to go for clean technologies.

The first one is it wants to be a good global citizen. The Chinese Government is determined to become the world's leader in clean

technology and has set renewable energy targets of 20GW of new solar capacity and 150GW of wind by 2020. Its policies state that non-fossil fuel sources of energy should account for 30% of the overall power supply by 2020. This would be a major shift given that 80% of China's current supply comes from coal. This transformation represents a huge market opportunity.

The second and probably the biggest motivator is that if China wants to maintain an 8%-10% growth rate, it needs to continue in the most environmentally friendly way possible. With 18 million people moving to urban areas every year, China needs as much cleantech as possible. The Chinese fully understand that their energy demands and pollution levels are unsustainable. They know they cannot keep going on that growth path with a non-cleantech industry base.

A further motivation is that China does not have as much raw material as it needs, and this will start to have an impact on growth. Cleantech investment and development is essential to its plans for the future.

Jay Spencer: How do you see ABB's role and opportunities in supporting the capital needs across the cleantech landscape?

Brice Koch: We spend 50% of our R&D budget on energy efficiency-related activities and have special research projects underway with other companies to explore important areas like electric vehicle infrastructure. We are also actively engaged with emerging cleantech companies through our corporate venture capital activities.

In the past several months, ABB Technology Ventures has made investments in companies such as Trilliant, operating in smart grid communications; Power Assure, working on data center power optimization; Pentalum, working on wind turbine and wind farm efficiency technologies; Aquamarine Power, working on wave power technology; and ECOtality, working on electric vehicle infrastructure technologies.

We will support these companies as they approach the market by providing access to customers or projects they would otherwise fail to reach. It's a kind of dual benefit: we not only provide financial investment but also help as a strategy partner – aiding their company's development to gain value.

EVs in commercial fleets: accelerating transportation electrification

Moderator



Jeff Henning
Global Automotive Markets Leader
Ernst & Young



Scott Sarazen
Global Cleantech Markets Leader
Ernst & Young

Participants



Deb Frodl
SVP and Chief Strategist
GE Capital Fleet Services



Bryan Hansel
CEO
Smith Electric Vehicles



Mike O'Connell
Director of Fleet Capability
Frito Lay/PepsiCo



John Schaaf
Vice President, Market Development
Johnson Controls, Inc.

In 2010, for the fifth year, Ernst & Young's Global Cleantech Center hosted a series of executive roundtables that brought together key stakeholders to discuss important cleantech issues. The sessions, held in Munich, Shanghai and Silicon Valley, focused on the "Electrification of Transportation – from Vision to Reality." Over the next five years, electric vehicles (EVs) are expected to account for a growing portion of overall vehicle sales. This transformational change in the industry cuts across many sectors and will require new business models and new partnerships.

One key subsegment of the vehicle market is already showing growing adoption and is anticipated to continue as a catalyst for market growth: the application of EVs in commercial delivery fleets.

To better understand this new market, Ernst & Young's Global Cleantech and Automotive Centers assembled a panel of leading experts to discuss some of the key issues. Highlights of the discussion follow.

Scott Sarazen: Mike, could you share with us the motivation that led Frito Lay/PepsiCo to purchase 176 electric vehicles for your commercial fleet?

Mike O'Connell: We have set some very aggressive goals to reduce our environmental footprint with a strategy we call "The Promise of PepsiCo." One part of it is a focus on running our fleet operations more efficiently. When we introduce any new vehicle technology, we have to ensure that our sales force can deliver products to our customers each and every day. We look at the power train and the business benefit associated with that vehicle. With EVs, it is a win-win – meeting both our business needs and significantly improving our environmental footprint. Our introduction of 176 Smith Electric vehicles will take a half a million gallons of diesel fuel out of our fleet next year. So it is a big win for us.

Jeff Henning: Bryan, as you speak to customers in different markets, what has been most surprising about their perceptions of electric vehicles?

Bryan Hansel: Customers are initially shocked that reliable electric trucks are already in production and ready for delivery. A lot of people perceive EVs as being in the future or envision them as golf carts. So having a truly full-size, operating utility vehicle

available and in production today is a surprise. We have built a vehicle to a specification such that whether you are driving a diesel truck today or you are driving electric, you are not changing your operation. We feel it is critical that our customers not be required to change their business to adopt this technology.

We also find a good deal of surprise when we discuss the financial questions – people don't fully understand the level of impact. True, there are capital premiums, but there are meaningful operational savings that enhance the affordability of the technology.

When we talk to the drivers, the biggest "ah-ha" is that frankly, it is not a lot different from a traditional vehicle other than that it doesn't make a lot of noise, it doesn't pollute and it doesn't get fueled the same way. They love driving the vehicles.

Scott Sarazen: Mike and John, let's dig in a little deeper on this cost-of-ownership question. How did Frito Lay and other similar customers approach the economics of EVs?

Mike O'Connell: Whenever we are looking at replacing vehicles, we look at all the available solutions – their current cost and benefits, including total cost of ownership. Things like maintenance, fuel economy, tires and brake wear are compared with our fleet profile. When we buy replacement vehicles, we expect a certain level of investment and return. With emission standards tightening and fuel prices continuing to escalate, the economic decision to switch to EVs is becoming easier. The benefits of operating an electric vehicle far outweigh the associated up-front acquisition costs.

John Schaaf: Certainly, economics are a tremendous factor, as are the specific infrastructure challenges. So I would first answer that question as a fleet operator. Analyze your current operation to determine the sweet spots in the fleet where, given the current economics and constraints, there is an opportunity for some level of EV penetration. There is a place within most fleets where the economics do work – it is very much a business decision.

Jeff Henning: Deb, considering the higher up-front cost, are there new financing models that companies are using for these vehicles? Are fleet operators gravitating toward leasing?

Deb Frodl: Absolutely. One of the things we are seeing in the early days of this transformation is a higher propensity to lease electric vehicles because of the higher capital cost. And the lease gives the customer more flexibility in the amortization of that vehicle, so we are seeing customers asking more about leasing because there is more pressure on the capex budget. With prices where they are

today, customers are less able to buy vehicles or replace as many as in previous years, and leasing gives them more flexibility. We are also being asked about new and unique models for financing the battery separately from the vehicle. We are in the early stages of exploring these options and solutions, and if there is a demand for battery financing solutions, we will look into it more.

Here in the US, we typically have open-ended leases where customers carry the burden of the upside or downside of the residual. In other regions – Europe, Australia and Japan as examples – GE holds that residual risk. This is a new market and a new technology and, as such, there are new business models being contemplated. But we are starting to see customers deploy, and there is definitely a level of interest in every region.

Jeff Henning: As you look at the market and think about potential residual values associated with EV batteries, how do you see them affecting the holding period or your economic modeling?

Deb Frodl: Residual values are a very important element when you are looking at total cost of ownership. This is an emerging industry and there are a lot of unknowns. We now have five years of experience with hybrid electrics. We have seen that those residuals out-performed and stayed strong. Using what we've learned, we are now working through comprehensive total cost-of-ownership models for EV customers.

Mike O'Connell: At Frito Lay, we own and operate all of our vehicles and look to maximize the life of an EV. We anticipate 10 years for the chassis and at least 5 years, maybe 7 or 10, for the batteries. With the next generation of EVs, we expect there will be a secondary market that will start to stabilize residual values and provide a variety of solutions to help different-sized companies make the economics of EV adoption work.

Bryan Hansel: There are some unique things about an electric vehicle that affect useful life. There is a very long life expectancy. There are only two moving pieces with an electric motor, and there is no transmission, no fuel system and no exhaust system. A lot of the costs that impact a vehicle as it ages, and that would drive down residual value because of replacement costs, simply don't exist. Fast forward five years and I can argue that the vehicle is not even halfway into its life because the power train, which tends to take trucks off the road, isn't a factor here. And the used truck is still going to be 80% cheaper to operate. Even if we put a new set of batteries in it in year five, the customer effectively has an almost-new vehicle that will provide a lot of operational savings.

Electric vehicles: leasing vs. buying

Jeff Henning, Global Automotive Markets Leader, Ernst & Young

As one of our panelists noted, there is expected to be growing interest in leasing electric vehicles for several reasons, including the relatively high initial acquisition cost and the desire for more flexibility in the payment terms. As we talk to participants around the globe in this emerging EV ecosystem, we are also hearing questions and concerns about alternative leasing models that might be uniquely applicable to EVs. Some are considering models that involve separate transaction streams, one for the battery and one for the core vehicle. There are also questions about the implications of the unknown secondary market for batteries, unclear residual values and the anticipated duty life cycles of other components.

One particularly timely issue with which we are assisting our clients is the assessment of the accounting, financial reporting and tax implications of these new models. The evolving EV sales and lease transaction structures have the potential to cause significant impacts on the consumer, the vehicle manufacturer and the financing company. Leasing transaction structures are inherently challenging from a reporting perspective, given the lack of a clear EV residual value history, and this is further complicated by the unique questions that arise should the vehicle lease be separated into battery and chassis components. Recent accounting rule proposals that affect revenue recognition and lease accounting must also be specifically considered when modeling the implications of EV sales today and in the future.

Regardless of the structure, the evolution of new sales or lease models must be designed to manage these parameters for all parties, and the financing sources must be competitive enough to meet the needs of the EV market customer.

Perspective: EVs, utilities and consumer charging



*Dana Hanson
Americas Power & Utility Advisory Leader
Ernst & Young*

It has been reported that each new EV equates to as many as three new households being added to the grid, depending on the region and so forth. As a result, most utilities are considering both the business opportunities and the transmission and distribution challenges related to EVs.

The business opportunity for utilities lies in increased sales of kWhs at existing rates. And as far as the existing infrastructure can support the additional load, most utilities are willing to take the revenue with little or no additional costs. This approach is viable during the era of early EV adoption, but once EVs break through this phase into the mainstream, there is significant concern surrounding their impact on the electric delivery network. The solutions to the challenges vary, and no one solution will fit every utility's circumstance. However, the implementation of infrastructure upgrades, direct load monitoring and control, and economic incentives via time of use rates, or combinations thereof, will allow utilities to meet the needs of their customers with EVs.

One concern that we hear often is about the need for power contract "portability" associated with EVs. Consumers don't drive their houses outside of their utilities' regulatory boundaries, but obviously this will be an issue with EVs.

Do consumers put electricity into their EVs or do they put "fuel" into their EVs? Most associate the energy in an EV as "fuel." An analogy would be when you drive your gasoline-powered vehicle out of state and purchase fuel, do you expect to pay the same price posted at your corner gas station – regardless of the price at the pump you are using? And do you expect the operator of the pump you are using to handle and clear that transaction with your corner station so that you pay the corner station, not the owner of the pump you are using out of state? The answer is clearly no. So why do we feel we need to do so if we put electric "fuel" into an EV?

There is very little difference in the delivery chains of traditional gasoline and electricity. Both fuels are commodities produced and priced at the wholesale level on a regional basis. Both are purchased by intermediaries or retailers in bulk quantities on a regional basis. Both are transported to delivery locations where they are metered at the point of sale. And both are subject to regional price variations at the wholesale and retail levels. Consumers accept this reality with gasoline purchases today. Why does electricity used for charging EVs need to be any different?

The use of a credit or debit card to pay for charging an EV away from the normal "home base" EV location represents the easiest abstraction of complexities and risk for all parties. This method is routine to consumers and merchants, including utilities, and is easily integrated into point-of-sale equipment such as public and retail charging stations. It also allows for differentiation by retailers (not necessarily utilities) through the offering of various charging options at differing price points. This also enables utilities to earn income from non-local purchases through the use of "affinity" cards or fleet cards that could offer fixed prices, rebates or points. The key aspects of the systems and infrastructure required to process and clear these transactions already exist, and there is little, if any, learning curve for consumer adoption.

This option does not address charging the EV from a non-retail point of sale, such as at a relative's home. For those instances, the vehicle's onboard charging meter can calculate the approximate cost, display the total and the parties are free to settle the transaction as they see fit – since the transaction is between the party paying for the energy at the meter (not the utility) and the party using the energy as "fuel."

Focus on fleets in the near term



Sam Ori
 Director of Policy
 Electrification Coalition

Sam Ori is the Director of Policy for the Electrification Coalition and a principal author of the Electrification Roadmap and the Fleet Electrification Roadmap. The Electrification Coalition is a nonpartisan, not-for-profit group of business leaders committed to promoting policies and actions that facilitate the deployment of electric vehicles on a mass scale in order to combat the economic, environmental and national security dangers caused by our nation's dependence on petroleum.

Ernst & Young: What are the most important factors constraining electric vehicle adoption?

Sam Ori: An impressive array of automakers will introduce the first wave of grid-enabled vehicles to American consumers in 2011. These vehicles signal important progress and the successful collaboration of multiple private and public sector entities. But to capitalize on the full economic and security potential of electrification, better coordination and focus will be required, as will penetration of the vehicles at a pace faster than currently projected in typical forecasts.

The most important challenges constraining the growth of the market for grid-enabled vehicles are largely related to the cost and range associated with the first generation of large-format automotive batteries. Costs have already fallen significantly as manufacturers move from pilot-phase projects to market offerings. However, higher volume in battery manufacturing and electric-component supply chains will be required to drive costs down. At the same time, technical advancement can improve the performance of batteries, reducing weight and increasing range.

Ernst & Young: What impact can EV adoption by corporate and government fleets have on the overall market?

Sam Ori: While electrification of the light-duty, personal-use passenger vehicle market is the most important long-term objective for strengthening energy security, the grid-enabled vehicle industry at this early stage will benefit from a more diverse market. During the period from 2011 to 2015, commercial and government vehicle fleets could represent a large share of the market for plug-in hybrid and fully electric vehicles. Recent announcements by commercial and government entities suggest that their fleet adoption is occurring rapidly.

Fleet operators should be well prepared to address a number of the early challenges constraining adoption. By matching the proper vehicle, battery and drivetrain technology to payload requirements, drive cycles and usage profiles, fleet operators can minimize up-front costs. Total investment in public and private charging infrastructure can also be more efficient and better optimized. Perhaps most important, grid-enabled vehicles could appeal to a large number of fleet operators in a short period of time. In that case, fleet operators would create significant early-demand volume in the development of the large-format battery industry, in addition to catalyzing the electric drivetrain-component supply chain.

Ernst & Young: What role should public policy take in promoting EV adoption?

Sam Ori: Public policies can and should play a role in supporting this process. There are federal tax credits for light-duty vehicles, but currently no purchase incentives in place to support adoption of grid-enabled medium- and heavy-duty trucks. This should be rectified. Existing infrastructure tax credits should be expanded and modified so that larger installations qualify for applicable benefits. All federal tax credits should be made transferable so that non-profit and public sector entities can access them, and all qualifying credits can benefit consumers closer to the point of sale. Finally, the federal government can assist in minimizing risk by facilitating the development of a secondary market for large-format automotive batteries.

The analysis in the Electrification Coalition's recently released *Fleet Electrification Roadmap* suggests that even a subset of these policies would have a meaningful impact on vehicle penetration rates. Combined with efficient investment allocation by fleet operators, temporary public policy measures could drive more than 200,000 grid-enabled vehicles into commercial and government fleets by 2015. Penetration rates of this magnitude would have a considerable impact on battery and electric drivetrain-component costs, providing greater certainty for suppliers and lower costs. Such developments, in turn, would benefit the broader consumer market and help to speed adoption.

Key trends in the cleantech capital value chain

Moderator



Gil Forer
Global Cleantech Leader
Ernst & Young

The last issue of Cleantech matters featured a roundtable discussion among investors and market observers focused on key trends in the cleantech marketplace. We reconvened our panel for this year's report to continue the conversation, discuss what's changed in the cleantech marketplace and exchange perspectives on what is perhaps the most important issue in cleantech today – the capital value chain.

Participants



Brian Bolster
Managing Director and Head of
Alternative Energy/Cleantech Investment Banking
Goldman Sachs

Gil Forer: What has changed in the cleantech marketplace since our last roundtable discussion 18 months ago?

James Cameron: Investors have become extremely risk averse and have started to take out private equity from their allocations – in the time between the last conversation and now, we've had very poor capital flow generally.



James Cameron
Executive Director and Vice Chairman
Climate Change Capital

I genuinely believe that the financial crisis and the recessionary experience in most of the developed world – coupled with a universal desire to better manage resource flows, to be more efficient in the use of fossil fuels, to be more intelligent about the systems for power production and consumption and to find ways of allocating capital to reduce dependency upon fossil fuel imports – have all helped the cleantech sector become more than a niche.



Stephan Dolezalek
Managing Director and Group Leader, CleanTech
VantagePoint Venture Partners

However, we still haven't seen capital flows in large enough amounts to know whether the sector's ready to take that amount of capital, because almost everything that looks attractive in the cleantech sphere – from renewable energy to energy efficiency or game-breaking, rule-altering technologies – none of it's been done at scale before.



Mark Fulton
Managing Director and Global Head,
Climate Change Investment Research & Strategy
Deutsche Bank

I see lots of good signs for investment in cleantech. I think it's a solid sector to concentrate on, but I'm very aware of how far short we are of the scale of capital deployment necessary to transform the systems that we have, for delivering clean energy, in particular.



Michael Liebreich
Chief Executive
Bloomberg New Energy Finance

Also, I'm more and more confident now about the idea of resource efficiency. I think the cleantech sector will be a very attractive place for capital to be deployed simply in innovative technologies around the resource depletion issue, and that will be the case for decades, not just the year ahead.

Mark Fulton: There has been concern in markets over the past year about the lack of what we call TLC in policy: transparency, longevity and certainty. In particular, we've been suffering uncertainty around the longevity of policy in some of the key markets and areas. And that is always a problem for the investment markets.

Specific examples include the failure to achieve any high-level global deals from Copenhagen through to Cancun. The United States energy and climate policy was uncertain and delivered very little during 2010. We also have the arrival of a new Congress, which is more hostile to climate and clean energy. And in Europe, there were major changes in renewable energy tariffs.

If you combine the policy uncertainty with what James observed about the general uncertainty in the investment market, it's quite a high barrier to get over. However, the fact that 2011 was the largest year on record for total clean energy investment – the fact that there is still money flowing into cleantech markets – is very encouraging.

The good news is that China continues to move forward on most policy fronts and its deployment of cleantech manufacturing bases, and has turned out to be the world leader in cleantech. The other good news is that Proposition 23 in California was defeated, and that UK green policies came out of the Comprehensive Spending Review in pretty good shape.

Stephan Dolezalek: At the first Ernst & Young ignition event in 2006, someone from one of the big oil majors said, somewhat in jest, "you realize that the entire market capitalization of cleantech is less than one month of profit for us, and so buying up all of cleantech and getting rid of it might be cheaper than having to deal with it." It was a great line because it indicated just how small and meaningless cleantech then appeared to large energy incumbents. What's changed since is that cleantech has been quietly growing to a size where it can't just be pushed aside any more.

At the same time, we're seeing increased political pressure to stop supporting cleantech – pullbacks on feed-in tariffs and legislative difficulties in the US. Yet despite waning pressure, in terms of public opinion on climate change, and pullbacks in policy, solar and wind, all of these things are much more alive and well than one might expect. I think it's very meaningful that cleantech has grown into its own and into a position where it can continue

to grow, regardless of the overall political climate in any given country.

Michael Liebreich: I would build on that by saying, number one, cleantech has survived the crisis actually in better shape than one might have feared. If you look at the investment volumes, we're again in record territory, and there aren't a lot of infrastructure capital goods sectors that can say that. The second thing is that the macroeconomics of cleantech broadly, but particularly around clean energy, had another year to prove themselves – we are seeing continuing progress down the cost curve and increasing knowledge on how little it actually costs to deal with some of the downside of clean energy versus dirty energy. This is a sector that really is at scale: this is not marginal, it's mainstream now.

Mahatma Gandhi said, "First they ignore you, then they laugh at you, then they fight you, and then you win." We're almost in the "then they fight you" phase, and that's why – to Stephan's point – they are trying to reduce subsidies and supports because certain constituencies now realize that the cleantech agenda will dramatically undermine some incumbencies.

And then the third thing is that dealing with climate change has become synonymous with job losses, whereas shifting to clean energy has become in some ways synonymous with job creation and with the vibrancy of economies. And you see that, whether it's in Korea with the Green Growth Initiative or in the various pieces of legislation in the US. The dialogue is all around how do we secure jobs for the future and, more profoundly, for structural competitive advantage. But I think what you're seeing is that you're now getting much more understanding that to solve climate, you have to solve energy. And that means clean energy and that means cleantech, whereas in the past, the two agendas were only very loosely connected.

Gil Forer: There's still a gap between the capital required to enable the transformation to a resource-efficient and low-carbon economy and the capital that is available today. How do you think this gap will be closed or minimized? And are we seeing any beginnings of capital innovation, whether new models, new players or new roles for existing players?

Stephan Dolezalek: I don't know that we're seeing many new players, but we continue to be surprised by the huge number of players participating in cleantech in what we would characterize



as a dabbling fashion, doing one transaction a year. The number of funds that are very active still remains tiny.

What that means is, while the majority of companies likely won't make it across the chasm, there are a small number of companies coming out the other side of the chasm who are growing stronger by the day because they have been able to get financing, to get their projects and factories built. I think 2011 will be the year in which we will see a greater separation between winners and losers. You'll begin to see some of these winners emerge at real scale.

Brian Bolster: We've seen the project finance markets return, so I think we'll start to see large-scale solar and wind financings. But what we haven't seen emerge yet is the source of capital that will help us bridge the technologies that need US\$300, \$500, \$600 million to show proof of concept. We would have hoped that the government would step in here, but we've a lot less government support than we expected.

And so I think Stephan's right about the emergence of winners and losers. A lot of business plans in some of the more capital-intensive areas are being recrafted if they weren't able to get access to sufficient capital. In utility-scale solar, you'll probably have 1 or 2 or 3 remaining players out of a market of 20 or 30 companies currently. In the fuel sector, you see a lot of the players turning to the large corporations making strategic investments to find some support.

James Cameron: We've worked very hard in the UK on a green investment bank idea, which I do think is an idea whose time has come, and not just for the UK. We have over-relied on the capital markets and private investors to deliver the sort of societal change that we now know we need to deal with climate change and resource depletion. Yet we have depleted government coffers in almost all the developed nations, while in the developing world, there are enormous demands for capital to feed growth.

This is an ideal moment to build institutional capacity to channel capital at scale into something that delivers the public good and rewards the expertise, the judgment and the skill associated with investment for financial returns.

We're in a phase now where we can't carry on having discussions on the lines that the private sector will do this or the state will do this. We clearly need some combination of the two.

Mark Fulton: I think there's definitely a concern as to whether there is enough public and private money to really do what seems to be required. The latest data shows we're running in the range of US\$250 billion, but it still seems that a quantum leap is required at some point. We remain sort of cautious as to whether the whole market can step up fast enough and with sufficient size. While we always talk about the policymakers creating the right environment and the right incentives, we've got to maximize the leverage of every public dollar to private investment.

Gil Forer: In 2010, we saw a significant increase in activity by large corporations in the cleantech space. Whether acquisitions, partnerships or investments, what have you seen in terms of changes in the corporate approach, and what do you anticipate in the next couple of years?

Brian Bolster: Our conversations with large corporations about strategic opportunities in cleantech continue to increase. Two things are probably most helpful on that front. One is that valuation expectations have come in a bit as companies realize that they may need the corporate strategic investors who want growth but aren't willing to pay billions of dollars for pre-revenue companies. Second, I think that corporates have become more comfortable with cleantech as it has proven capable of long-term sustainable growth. A third piece is that corporates are feeling better about themselves and increasingly thinking about M&A in general across the spectrum of industries, including cleantech.

Stephan Dolezalek: When we first started visiting multinational corporations in 2002 to discuss cleantech, we kept running into situations where one or two business units were enthusiastic and wanted to participate in some way, while other business units in the same company were hugely skeptical. What we're now seeing is instead of having pro or con business units within a given organization, entire corporations are embracing clean technologies as a meaningful driver of their future results. We now see active cleantech strategies being pursued by certain players in almost every major sector of energy and in other industries like lighting and transport that cleantech touches. There is a growing divide between those companies that are betting on this transformation and those that are betting on the status quo.

Mark Fulton: I think this is really significant. We've got to see corporate balance sheets, we've got to see incumbents, we've got to see the big industries deeply involved in cleantech if we're going

to meet any of these numbers. And the good news is, you do see them there. In project finance, balance sheet activity is very significant. And let's face it, in the end, most of this will become a project finance infrastructure rollout. So that's good news.

The question is: whether they are energy companies, utilities or original equipment manufacturers, will they continue to be active players in the rollout that needs to be done?

James Cameron: Corporate balance sheets are critical right now, and it looks quite optimistic. It goes back to the scale issue. We don't have enough large cleantech companies to receive institutional investor capital so that deployments can take place in pure plays.

I'd like to see some real game changers, and not just emerging from old energy. There are plenty of people who can take on the incumbents in the utility sector. But we might find some very different global corporations dealing with cleantech than the ones we have currently. And that tells you that to encourage innovation and make sure there's sufficient capital deployment from large companies, you need to have a public policy regime that supports competition and rewards capital deployment for innovation, and not just the policy for climate change or clean energy.

Michael Liebreich: In terms of the coming 12 months, we're going to see a ton of quite good companies related to industrial energy efficiency and industrial processes come into the spotlight. Many of these were funded in '05-'06 and are being held on their investors' books at conservatively low values. In the next 12 to 24 months, we're going to see some of these companies gain the attention of corporate strategic investors who will find them complementary to some aspect of their operations. While they are below the radar now, these companies are going to be quite an interesting acquisition pipeline.

Gil Forer: We are midway through most of the governmental stimulus programs and probably will soon see the next wave of energy plans. What has been the impact so far and what is needed? What can we expect going forward?

Stephan Dolezalek: There was quite a bit of optimism that between loan guarantees and grants, the stimulus would provide significant benefits, but we have always been of the view that if you're building a business, you're best off not depending on long-term government subsidies. As has been true of most

conventional energy sources, we'll take what we can get, particularly because we're not yet at a place, in terms of project finance, debt or building larger-scale factories, where you can ignore government support. We are also beginning to see the impact of government support and attractive credit terms in China on domestic job growth and global competition in cleantech. I think there will be a second global wave of government support that is more job-focused than climate change-focused. This will likely provide more long-term benefit than the measures immediately focused on getting through the economic crisis or focused on climate change.

Brian Bolster: I think it's hard to imagine a period when government won't be influential in some way because it's just central to the nature of energy. You really have to go industry by industry to assess the results of the stimulus because its impact was very different in solar, for example, than it was in some of the smart grid applications. So perhaps there's less optimism than there was two years ago. That is to say, there was a great sense of optimism that has probably gone back to kind of moderate optimism.

Michael Liebreich: I think that the cleantech industry has really misplayed the whole debate in the US regarding the stimulus. It may have been a tactical victory, but it was a strategic mistake around the messaging of "give us the money or there's a hundred thousand jobs gone." I don't doubt that jobs were protected and businesses were protected, but it sent a really clear message to the skeptics that said, "ah, without this money, that industry does not exist." And it's not true. While some of the stuff at the margins of this industry wouldn't exist, there's still an industry, a supply chain, projects that make sense, projects that have secured other forms of support. While of course it's always better to have money than not, the messaging of the industry in the US served to really polarize some of the opposition.

Gil Forer: COP16 recently concluded in Cancun, where there was a decision to create a green climate fund although the details of actual implementation are still to be determined. What do you anticipate will be the overall impact of COP16 on the cleantech marketplace?

Michael Liebreich: For me, COP16 was kind of the dog that didn't bark because a lot of people were expecting a real rupture in the global process. So I think the fact that there is a process and that



it continues to have some momentum actually is pretty positive. But in terms of actionable change on the ground for cleantech companies, perhaps something will come out of that process in three or four years that will be worth engaging with, but right now, they're just kind of happy that the process is continuing. And that's pretty much the summary of where we are.

Stephan Dolezalek: From a US perspective, I think that one important thing that emerged is that you no longer have the ability to argue that there's a free-rider problem here and that somehow, Western nations will have to pay for something that the rest of the world will benefit from. And as we move away from a purely climate-centric agenda, you have two separate questions: 1) What is the long-term economic upside that comes from winning in some of these clean technologies? and 2) Is the real fight ultimately going to be in terms of sustainable economic growth, in terms of which countries secure an affordable energy future? Climate change becomes an outgrowth and a benefit, but the real driver is not so much the need to address climate change as it is the fact that there will be winners and losers economically and nationally.

Mark Fulton: I think the good news coming out of Cancun is there are still efforts to make it work. There's the Green Climate Fund that they're talking about, and there is a lot of hope that governments will attempt to fund the US\$100 billion by 2020. That's not over, and a lot of investors like ourselves are working on just the simple realities of project finance de-risking in developing

countries, such as Deutsche Bank's Global Energy Transfer Feed-in Tariffs (GET FIT) initiative.

James Cameron: We should see Cancun as broadly positive for policy developments in emerging markets. Cancun is, first of all, a global agreement. It's not of the type that we expected or wanted in Europe before Copenhagen, but it is a global agreement. You can no longer argue that there is no international agreement on climate change. Now there is one.

The other thing is that you can't argue that nothing is happening in the developing world on climate change. There's now a lot of policy intervention specifically on climate change, specifically favoring investment in cleantech and clean energy in many developing countries, including in the larger and more populous developing countries. And that's all going ahead really quite well in the Philippines, in Indonesia and certainly in Korea and China, but also in Latin America and Mexico.

There's a lot taking place within the emerging markets focused on clean energy and climate, and that is going to create opportunity for capital deployment there. And not just deployment of Western capital, but capital that is formed in those jurisdictions, capital that's moving between sovereign wealth funds in those jurisdictions, capital that's also moving from development bank finance sources that's going to encourage more investment in those markets.



Do you need a chief capital officer?

This recent Ernst & Young white paper discusses our recommendation that emerging cleantech companies should consider the creation of a new executive role: the chief capital officer (CCO). The CCO would possess specialized financing skills and focus exclusively on capital formation and deployment, given the scale of cleantech company capital needs and the competing demands on the CEO and CFO in fast-growing companies. To view this publication, visit www.ey.com/cleantech.

Perspective: renewable energy financing



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The renewable energy sector is massively capital hungry. With nearly US\$250 billion invested worldwide last year in renewable energy, and still more needed, we're seeing a global race for capital, with a large number of jurisdictions around the world competing for green collar jobs, strategic positions around certain technology types and more generally, economic diversification. Over the last 12 to 24 months, divergent policy approaches have emerged in the rapidly growing renewable energy markets of the East – mainland China, Taiwan and South Korea – and the mature Western markets, such as the US and Europe.

Policy-setters in the East are very much focused on driving economic growth to seize advantage from this increasingly important sector – providing an energy policy framework designed to stimulate substantial levels of investment, together with a closely aligned economic and industrial policy geared towards generating jobs in manufacturing, and capturing intellectual property or cost reductions as a source of long-term competitive advantage.

In the West, government policy has included this same strategic focus but with the realization that manufacturing jobs might not be sustainable in the longer run. What we see now in some of the more mature renewable energy markets are policies focusing on security of energy supply and delivering de-carbonized energy at the lowest possible cost. This, then, has implications for technology and capital flows. Much of the intellectual property-driven technology developed in Europe or the US is likely to be transferred, over the longer term, to the developing markets for commercial deployment or industrial-scale manufacturing. At the same time, capital flows will become truly global, with donor organizations and multilaterals helping deploy funds from the developed to the developing world.

From a European or US perspective, the issue for policymakers is how to stimulate investment in areas where value is protected for that local market. So intellectual property-based technology companies, energy efficiency, support services and data management services are probably going to be more of a focus for the Western markets than the manufacturing of equipment such as solar panels or wind turbines, for example.

Despite the recent growth in investment, capital scarcity remains the single biggest inhibitor to growth in renewable energy infrastructure investments. As a result of the recession, corporations and utility companies no longer have the deep balance sheets that they can bring to bear. And with the minimum

capital requirements and liquidity ratios of Basel III coming into play, banks are also busily rebuilding their balance sheets. At the same time, government policy support in the US and Europe is likely to become less generous as the focus shifts from stimulus to austerity and debt reduction.

With these traditional sources of capital for renewable energy infrastructure likely to remain constrained for the foreseeable future, the sector needs new investors and new conduits for their capital. While the gap between needed and available capital remains large, there are some encouraging signs that new sources and conduits will emerge.

Given the very long-term and low-risk nature of renewable energy infrastructure investments, along with the benefit they receive from transparent long-term feed-in tariffs or other forms of government backing, the asset class appears well suited to attract annuity funds, such as defined benefit pension schemes and the like. In the UK, for example, there has been a lot of debate about the proposal to create a green investment bank, whose role, for example, could be to consolidate and repackage existing project finance debt. This would free up banks' balance sheets, and if such an institution had the ability to issue bonds, it could enable pension funds, life and insurance funds and fixed income to invest in the sector.

Spurred by government policy objectives, state-owned banks and multilateral financial institutions are becoming more active players in cleantech. For example, Chinese state-owned banks have stepped up lending to renewable energy companies. Both the European Investment Bank and the European Bank for Reconstruction and Development are focused on stimulating clean energy markets and are actively lending to the sector.

Outside the asset-financing realm, venture and growth capital has a significant role to play. Here, the rather patchy historic performance of listed renewable energy or cleantech company stock can undermine certainty of exit for such investors.

Renewable Energy Country Attractiveness Indices

For further perspectives on global renewable energy, visit www.ey.com/renewables to view the latest edition of the quarterly *Ernst & Young Renewable Energy Country Attractiveness Indices*, which provides scores on the relative attractiveness of national renewable energy markets and renewable energy infrastructure in 30 countries.

Perspective: cleantech in China



Paul Go
AsiaPac and Greater China Cleantech Leader
Ernst & Young

In keeping with China's commitments to the international community, the national energy policy aims to achieve key strategic objectives: to generate 15% of the country's total primary energy from renewable sources by 2020 and to lower the energy intensity of economic growth by 16% in terms of energy consumption and 17% in terms of carbon dioxide emissions by 2015.¹

In this context, the main focus is on developing wind power and resolving critical issues related to connecting wind power generation to the grid and transferring power from offshore wind projects to land. Currently, only 31GW of China's total 41GW of wind generation capacity are connected to the grid.² Developing nuclear power as a safe source of low-carbon energy is another important priority.

China's renewable energy targets will be met through hydropower, nuclear fuels, wind power, solar energy, geothermal power, tidal power and biofuels. Of these, hydropower is expected to provide the largest share of clean energy generation although the fastest growth will occur in nuclear and wind.

Nuclear is expected to account for 4% of total generation by 2020, up from 1% at present. Wind power and other renewables combined will have a 2% share of generation, up from the current 0.5%. Hydropower will provide 9% of power, up from today's 7.5%.³

To achieve the hydropower target will require prioritizing hydropower development and deployment, avoiding the waste of hydro resources and accelerating medium to large standard hydropower projects. Development in this sector will be supported by promoting domestic hydropower technology and construction capacity on the international market.

China's growing market demand for clean, low-carbon energy sources provides important opportunities for cleantech companies. As China continues to implement its strategic energy policy, a complementary objective is to make cleantech a source of economic growth and an enabler of mid- to long-term sustainable development. Four of the seven new priority emerging industries in China are part of cleantech – clean energy, energy efficiency, advanced materials and electric vehicles.

From a global perspective, China is at a key stage of development. Energy demand is outpacing economic growth. With the ever-increasing demand for energy and the complexity of the international energy supply chain, it is time to address the energy issue – to stabilize the economy and promote economic development through clean but safe energy.

China ranks as the number one destination for clean energy technology investment. Key research and innovation areas in China include clean, high-efficiency coal generation – 600MW to 1,000MW super-critical plant units, for example – hydropower, clean energy vehicles, wind power, solar energy, nuclear energy and large-scale environmental projects.

Four of the seven new priority emerging industries in China are part of cleantech.

¹ "Key targets of China's 12th five-year plan," Xinhua News Agency, 3 March 2011.

² "China takes grid connected capacity to 31 GW," *Windpower Monthly*, 17 January 2011.

³ "China's Alternative Power Generation Expansion World-Leading: Top Energy Executive," Xinhua News Agency, 16 September 2010.

China: the new global leader in cleantech IPOs



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China's concerted strategy to foster a cleantech industry has resulted in a market rife with opportunities for cleantech companies: it took the number one spot on Ernst & Young's *Renewable Energy Attractiveness Index* in 2010. China was also the largest recipient of clean energy investment in 2010, garnering US\$51 billion of the US\$243 billion global total.¹ Combined with strong investor interest in China's booming economy, these factors have led to a record-breaking spate of Chinese cleantech IPOs that is likely to continue.

China generated 20 of the 38 global pure-play cleantech IPOs completed in 2010.² Raising US\$4.7 billion, Chinese transactions accounted for 49% of total global cleantech IPO proceeds. Solar, wind, energy storage and energy efficiency companies made up the majority of offerings, reflecting the major areas of cleantech development in China (see Figure 1).

A breakthrough year for wind

Although China's solar company offerings have garnered the most attention in recent years, 2010 was notable as a breakout year for wind financings. The six Chinese wind offerings raised US\$2.8 billion, 59% of the cleantech total (see Figure 2). Largest among them was the US\$1.0 billion offering on the Hong Kong Stock Exchange by Xinjiang Goldwind Science & Technology Co. Ltd. This 2010 activity builds on the momentum generated by the US\$2.2 billion IPO of the wind-power generator China Longyuan Power Group Corporation in December 2009.

The market view is that these are just the beginning of a long line of wind company IPOs. The biggest deals are seen likely to come from wind farm operators and developers rather than wind technology companies. Analysts point to a pipeline of big wind offerings that could include spin-offs of the subsidiaries of China's five large generating companies or the renewable units of other energy conglomerates.

Investors are bullish on wind because the Chinese government is targeting steep increases in wind energy production by 2015, suggesting that government financial support for the industry will remain stable, at least for the medium term. Also, many of the large wind players are state-owned enterprises, which provides further assurance that they will enjoy continuing government support. Finally, the Chinese wind industry is just beginning the process of meeting the technological capabilities of Western

competitors and then beating them on price, suggesting strong future gains in market share for Chinese wind companies.

Chinese solar companies conducted six IPOs raising a total of US\$1.2 billion. Notable among them were the US\$356 million offering by Shanghai Chaori Solar Energy Science & Technology Co. Ltd. and the US\$278 million offering by Risen Energy Co. Ltd., both on the Shenzhen exchange. While solar offerings were as numerous as wind offerings, they raised less than half the capital.

The market view on potential solar IPOs is less bullish. While solar companies drove cleantech IPO activity in China and globally during the period 2005-2007, the key Chinese solar players are now listed. Following years of falling solar module prices and margin contraction, there is likely to be some consolidation and shake-out in the solar industry in China and elsewhere. Further, Chinese solar companies have already realized the major gains to be made through achieving technological parity with their Western counterparts at a lower price. It is hard for new entrants to excite the market in such an environment.

Growing mainland China cleantech listings

2010 was also a breakout year for mainland China stock exchanges – the Shenzhen exchange hosted 9 IPOs raising US\$1.6 billion (see Figure 3).

The cleantech IPO activity on mainland exchanges reflects the importance of the domestic cleantech market in China. Companies with a primarily domestic customer base are showing a preference for listing on one of the mainland stock exchanges in order to stay close to clients and suppliers. Some state-owned enterprises have also decided on mainland listings as a matter of policy. The majority of the Chinese mainland stock exchange trading volumes come from retail (i.e., individual) investors. These investors have provided the mainland exchanges with extra impetus in recent years as they've increased their stakes in domestic companies in the wake of the financial crisis in the US and Europe.

In contrast, Chinese cleantech companies with international market ambitions most frequently list on an "offshore" stock exchange, such as the Hong Kong Stock Exchange, NASDAQ or NYSE, where they demonstrate their ability to operate under the highest levels of corporate governance. As cleantech companies continue to demonstrate the ability to raise significant amounts of capital on the mainland exchanges, ones already listed offshore will likely seek to establish a second domestic listing in the onshore market in China.

¹ BNEF

² Defined as companies designated as clean energy A-1 Main Driver (50%-100% of value) by BNEF



Government policy sets the stage

The recent surge in Chinese cleantech IPO activity is the product of a long-term Chinese Government strategy to develop a cleantech industry and deploy cleantech broadly across the economy.³ For example, the 2010 National Renewable Energy Action Plan allocates US\$735 billion of government spending directly to saving energy, reducing emissions and other energy and ecology projects for 2011-2020. The goal is to increase the use of renewable energy sources (mainly wind, hydro and solar) to 15% of its total energy supply by 2020, from 9% in 2008.

In addition, many cleantech companies enjoy a preferential tax rate of 15% (compared with a 25% tax on other corporations). Cleantech firms are also offered ready access to finance through state-owned bank loans at low interest rates, as well as money for research and development and government power-purchase agreements that guarantee demand.

As a result of government policies such as these, Chinese cleantech companies can grow quickly by tapping into surging demand with significantly lower capital outlays, thus offering investors substantial returns. Investors also have confidence in the stability of government supports.

Venture capital firms building the cleantech IPO pipeline

As little as three years ago, few if any venture capital firms deployed specialized teams to invest in cleantech in China. Investors had hesitations related to their understanding of clean technologies and the suitability of investing in companies that seemed to depend on government subsidies. However, their views changed when it became clear that the Chinese Government was determined to transform the nation's economy to address critical issues with regard to energy and resource scarcity, pollution and carbon emissions, while making cleantech a source of innovation and jobs.

Today, both international and domestic venture capital firms see opportunities to leverage government policies in their cleantech investments and to help China's cleantech sector transform from one based on low-cost manufacturing to one succeeding through innovation. In 2010, Chinese cleantech companies received US\$410 million in venture financing, according to Dow Jones VentureSource, making China the third-largest cleantech venture market after the US and Europe.

Venture investors are focusing on innovative companies with strong near-term IPO prospects in cleantech segments such as energy efficiency, smart grids, offshore wind, electric vehicles and water treatment. A growing trend is venture investors working with established manufacturing companies to convert them into cleantech companies, with a view toward eventual IPOs in Hong Kong or the United States.

Chinese cleantech IPO outlook is highly promising

The fast flow of cleantech IPOs from China looks set to continue, barring a major economic setback or reversal of government policy.

Cleantech is likely to keep benefiting from the current flood of Chinese IPOs across industries. The sector is part and parcel of the China growth story that has made the country the leading generator of IPOs for several years running. It accounted for 36% of global IPO activity last year, according to Ernst & Young's *Global IPO trends report 2011*.

The unparalleled government and private sector investment in cleantech in China is creating an industry that is broad and deep, encompassing a range of segments with promising growth prospects. These include renewable energy to generation, clean water and air, electric vehicles, smart grid, energy storage, energy efficiency and materials science. As the IPO window opens for various clean technologies, China will be able to offer strong companies in each.

The domestic challenges that China's cleantech industry is being developed to address – growing energy consumption, energy security, resource scarcity, environmental degradation and carbon dioxide emissions – are also the world's. China, however, is at the leading edge of these issues in terms of their size and urgency. The cleantech companies that succeed in China will thus be well positioned to compete on a global stage.

³ For a more detailed discussion of Chinese government policy, see "National strategies for competitive advantage and growth through cleantech," p. 12 of this report.

Figure 1. 2010 Chinese pure-play cleantech IPOs

Issuer name	Cleantech segment	Primary exchange	IPO proceeds (US\$m)	Market cap (US\$m)
Xinjiang Goldwind Science & Technology Co. Ltd.	Wind	Hong Kong Stock Exchange	\$1,053.6	\$6,107.6
China Datang Corp Renewable Power Co. Ltd.	Wind	Hong Kong Stock Exchange	\$642.2	\$2,140.9
China Suntien Green Energy Corp. Ltd.	Wind	Hong Kong Stock Exchange	\$424.7	\$1,055.3
Shanghai Chaori Solar Energy Science & Technology Co. Ltd.	Solar	Shenzhen	\$356.0	\$1,421.7
China Ming Yang Wind Power Group Ltd.	Wind	NYSE	\$350.0	\$1,750.0
Risen Energy Co. Ltd.	Solar	Shenzhen	\$278.3	\$1,082.4
Trony Solar Holdings Co. Ltd.	Solar	Hong Kong Stock Exchange	\$256.8	\$885.7
Xiamen Changelight Co. Ltd.	Energy efficiency products	Shenzhen	\$195.8	\$783.3
Titan Wind Energy (Suzhou) Co. Ltd.	Wind	Shenzhen	\$194.5	\$769.7
Shanghai Taisheng Wind Power Equipment Co. Ltd.	Wind	Shenzhen	\$139.0	\$555.9
ZheJiang Sunflower Light Energy Science & Technology Co. Ltd.	Solar	Shenzhen	\$126.5	\$1,262.4
Dalian East New Energy Development Co. Ltd.	Power and efficiency management services	Shenzhen	\$122.4	\$481.5
Shenzhen Green Eco-manufacture Hi-tech Co. Ltd.	Environment	Shenzhen	\$109.3	\$437.3
Beijing Easpring Material Technology Co. Ltd.	Energy storage	Shenzhen	\$105.5	\$422.0
China Hydroelectric Corp.	Hydro	NYSE	\$96.0	\$766.9
Daqo New Energy Corp.	Solar	NYSE	\$87.4	\$322.5
Chaowei Power Holdings Ltd.	Energy storage	Hong Kong Stock Exchange	\$71.5	\$280.1

Figure 2. 2010 Chinese pure-play IPOs by segment

Cleantech segment	IPOs	Pct.	Proceeds (US\$m)	Pct.
Energy efficiency products	3	15%	\$240.7	5%
Energy storage	2	10%	\$177.0	4%
Environment	1	5%	\$109.3	2%
Hydro	1	5%	\$96.0	2%
Power and efficiency management services	1	5%	\$122.4	3%
Solar	6	30%	\$1,169.2	25%
Wind	6	30%	\$2,804.0	59%
Total	20	100%	\$4,718.6	100%

Figure 3. 2010 Chinese pure-play cleantech IPOs by exchange

Exchange	IPOs	Pct.	Market cap. (US\$m)*	Pct.
Hong Kong SE	6	30%	\$10,591	59%
NYSE	5	20%	\$118	4%
Shenzhen	9	45%	\$7,216	40%
Total	20	100%	\$17,925	100%

*Market capitalization at the company IPO date

Source: CapIQ;BNEF

Solar opportunity in India



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India has closely followed China in its economic growth in the last decade. Economic prosperity, along with growing urbanization and changing lifestyles, has resulted in an almost insatiable need for energy. India's electricity requirement is expected to grow about 7% over the next 10 years. To meet this demand will require both conventional and renewable sources of energy. While India's current electricity mix is dominated by conventional fossil-based generation, renewable energy is fast emerging as a sustainable alternative that is beneficial to the environment – and to the economy. In India, renewable energy is not only about going green but is also spurred by another key consideration – energy security.

The renewable energy installed capacity in India has grown at a CAGR of about 24% over the last five years to reach approximately 17,000MW at present. Today, renewable energy sources account for about 10% of the total installed power generation capacity in India.¹ However, in terms of electricity units (kWh) generated, it accounts for only 3%-4%. The Indian Government aims to increase this to 10% by 2015 and 15% by 2020. Until now, wind has dominated renewable energy generation in India, accounting for a share of about 70%.

Solar potential in India

India has abundant solar potential. Many parts of the country receive substantial sunlight for more than 300 days a year. The average annual insolation ranges from approximately 1,460 kWh per square meter to 2,555 kWh per square meter, depending upon the location. While the total potential in GW terms would depend on the amount of area that can be used for solar installations, it is estimated to be greater than 100GW. Thus, based on current estimates, solar has the highest potential among renewable energy sources in India. However, the grid-connected installed capacity stands at a mere 10MW-15MW at present. Consequently, solar power has experienced the greatest gap between potential and achievement. To harness this potential, the Indian Government launched the National Solar Mission

National Solar Mission (NSM)

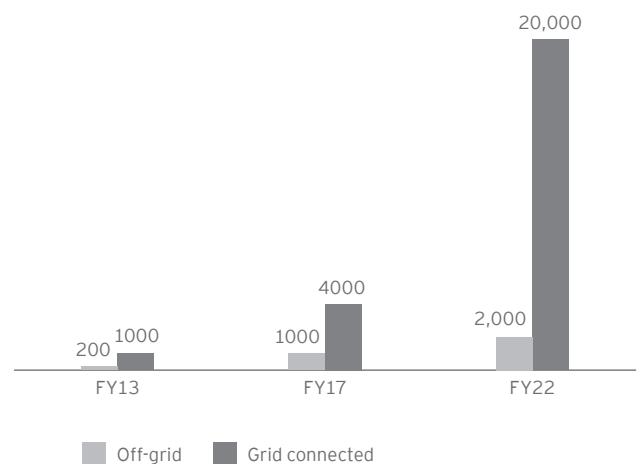
India is thinking big on solar. The NSM envisages an ambitious target of achieving 20,000MW in 10 years' time. The magnitude of the mission can be better understood in view of the fact that the entire global solar installation in 2009 was just above 20,000MW. It is also worth noting that the NSM is not just an announcement of

¹ In India, only the small hydropower projects (less than or equal to 25MW) are accounted for under renewable energy installed generation capacity from an administrative and accounting perspective. If all hydropower capacity is taken into account, the share of renewable energy becomes about 32% of total installed power generation capacity.

intent but a well-drafted operational plan. The mission document comprehensively covers various particulars, such as project allocations, manufacturing, research and development, and skills enhancement.

The NSM was formally launched in January 2010. At the launch, the Prime Minister of India, Dr. Manmohan Singh, emphasized the importance of solar energy by stating that in India's renewable strategy, the sun should occupy center stage, literally being the original source of all energy. He stated that the objective of the solar mission is "to establish India as a global leader in solar energy by creating the policy conditions for its diffusion across the country as quickly as possible." The mission has set out phased targets for off-grid as well as grid-connected solar power by 2022. According to Ernst & Young estimates, achieving these objectives will require a cumulative investment in the range of INR2,500 billion to INR3,000 billion (US\$55 billion to US\$66 billion) by 2022.

Figure 1. Cumulative installed solar capacity roadmap



Source: Bloomberg New Energy Finance

Following the launch of the solar mission, the Government released detailed guidelines and incentives for solar power projects broadly covering three categories of projects: (1) off-grid and decentralized solar applications; (2) rooftop photovoltaic (PV) installations and small solar generation (RPSSGP); and (3) grid-connected solar power projects (PV as well as thermal).

For the first scheme, the financial support entails a combination of one of or both a 30% subsidy and a 5% interest-bearing loan. Solar PV systems up to a maximum capacity of 100 kWp per site and off-grid and decentralized solar thermal applications would be eligible. For mini-grids for rural electrification applications, projects up to a maximum of 250KW per site would be considered. About 20MW worth of solar projects have been sanctioned under this scheme so far.

The second scheme, RPSSGP, aims to promote rooftop solar PV and other small solar power plants connected to the distribution network at voltage levels below 33kV. The Government support here would be in the form of generation-based incentives (GBI). The GBI would be the difference between the tariff determined by the Central Electricity Regulatory Commission (CERC) and a base rate, which has been fixed at INR5.5 per kWh (US\$0.12 per kWh) for fiscal year 2010-11. The RPSSG program, which is being administered by the Indian Renewable Energy Development Agency (IREDA), targets 100MW solar capacity. Eighty projects totaling about 98MW have been approved to date.

The third program, which is also the largest, is for grid-connected solar power projects. Here the government has put in place a mechanism for assured off-take of solar power generated through the projects. NTPC Vidyut Vyapar Nigam Ltd. (NVTN), a public sector entity, will act as the central agency and will purchase power from the solar power project developers. This will be bundled with electricity from conventional sources and sold to distribution utilities. Feed-in tariffs (FITs) will be announced by the CERC on an annual basis. The tariffs for fiscal year 2010-11 have been set at INR17.9 (US\$0.39)/kWh for solar PV and INR15.3 (US\$0.34)/kWh for solar thermal.

Diverse sectors of corporate India have shown significant interest in participating in the grid-connected projects. The first phase of bidding for such projects received 418 applications for a cumulative 150MW in solar PV projects and 470MW in solar thermal projects. NVTN has selected 37 companies for development of solar power projects, based on the reverse bidding. Of the 37 companies, 30 will be developing 5MW of solar PV projects each, totaling 150MW, while seven will develop a total of 470MW of solar thermal plants. The Government had previously approved the migration of 16 projects totaling 84MW from earlier schemes to the NSM. The winning bidders offered discounts of 30%-40% for solar PV and 20%-30% for solar thermal projects compared to the respective CERC-determined base tariffs. There is an implicit hope that the Government of India will play an important role in driving down the cost of solar generation, as it did in the telecom sector.

Overall, the state of Rajasthan leads the allocations and is emerging as the clear favorite among project developers with 571MW or an overwhelming 81% of the total allocations of 704MW made so far, including the projects that have migrated.

Figure 2. Allocation of solar projects by state under current phase of NSM

State	Total PV allocations (MW)	Total CSP allocations (MW)	Total	Percent share of total
Rajasthan	141	430	571	81%
Andhra Pradesh	15	50	65	9%
Gujarat	0	20	20	3%
Maharashtra	16	0	16	2%
Karnataka	10	0	10	1%
Punjab	7	0	7	1%
UP	5	0	5	1%
TN	5	0	5	1%
Orissa	5	0	5	1%
Total	204	500	704	100%

Source: NVTN website, EY analysis

Renewable purchase obligation (RPO) to fuel growth

The Government's RPO policy is designed to ensure that electricity distribution licensees purchase a portion of their electricity from renewable sources. RPO targets will be announced by the different states depending on their renewable energy potential. States will gradually assume solar-specific obligations within the overall RPO. The NSM policy document envisages a solar-specific RPO target of 3% by 2022. Ernst & Young estimates that, with a target range of 2%-3% solar RPO, India would need about 17.5GW-26.2GW of solar power by 2022, which substantiates the NSM target of 20GW.

Figure 3. Solar capacities required by 2022 to meet the RPO estimates

	Solar-specific RPO by 2022 (%)	Solar installed capacity requirement (GW)
Case 1	2%	17.5
Case 2	3%	26.2

Source: EY analysis

The RPO policy will be supported by a renewable energy certificate (REC) mechanism that is similar to the carbon credit mechanism. The REC mechanism was launched recently and will enable states with relatively lower renewable energy potential to meet their RPO targets by buying RECs from other states. Each REC will represent 1MWh of electricity from renewable sources, with a fixed floor price of INR12,000 (US\$264) for solar RECs and INR1,500 (US\$33) for non-solar. The mechanism should encourage states to turn their attention to harnessing their renewable potential. Rolling out supportive policies, such as those on RPO and REC, emphasizes the Government's determination to promote renewable energy.



Enhancing domestic manufacturing

The NSM also aims to boost India's domestic manufacturing capability with regard to components and equipment required by solar power plants. The NSM targets a 4GW-5GW equivalent manufacturing capacity by 2020, including poly-silicon for which India currently relies on imports. As far as possible, project developers are expected to procure their project components from domestic manufacturers. The NSM also lays down certain requirements with respect to domestic content required in solar projects. For example, for the first batch of the grid-connected solar PV projects (selected during FY 2010-11) based on crystalline silicon technology, it will be mandatory to use modules manufactured in India. Solar thermal projects under the first phase of NSM are required to employ 30% of local content in all plants or installations. These requirements may be increased in subsequent phases. The Government is providing subsidies, tax incentives and efficient approval mechanisms to facilitate manufacturing in India. The country is thus set to witness significant progress in domestic solar component and equipment production.

In a related policy initiative, the Government had earlier launched a semiconductor policy aimed at promoting semiconductor and solar PV manufacturing. The policy offered a capital subsidy of 20% for manufacturing plants in special economic zones (SEZs) and 25% for those outside SEZs. The subsidy is based on the condition that the net present value of the investment should be at least INR10 billion (US\$220 million). Many large players have expressed an interest in setting up facilities under this policy. However, in the past year, the Government's concentrated focus on project development has to some degree kept this initiative on the back burner.

State solar policies

In addition to the solar mission at the national level, various Indian states have taken independent steps toward harnessing state solar potential. According to a study being conducted by the Indian Institute of Science (IISc), the states of Rajasthan, Gujarat and Karnataka have been identified as suitable for large commercial-scale solar plants whereas the states of Kerala, Jharkhand, Uttar Pradesh and Andhra Pradesh are more suited for smaller applications.

Among the states, the western state of Gujarat has taken the lead. It announced its state solar policy in 2009 and since that time, has allocated about 700MW of solar power projects. It then

went ahead and signed the power purchase agreements (PPAs) for procurement of approximately 420MW of solar power. The Gujarat state government has also signed a Memorandum of Understanding with the Clinton Climate Initiative to set up five solar parks with a cumulative capacity of 3,000MW. In a separate initiative, the foundation stone was recently laid for a 500MW solar PV park in the state. In the first phase, projects amounting to 176MW are expected to be commissioned by 16 developers within six months time. The state also plans to set up facilities for solar power-related manufacturing and research and development as part of the park. A total investment of about INR100 billion (US\$2.2 billion) is envisaged for developing the park.

Elsewhere, the states of Rajasthan and Madhya Pradesh have released their draft solar policies, which are likely to be finalized shortly. Rajasthan has one of the highest solar potentials in India, and its 2010 draft solar policy targets a solar power capacity of 10GW-12GW over the next 10 to 12 years.

The state of Maharashtra became the first state to introduce a solar-specific component as part of its RPO. The state directed power-distribution license holders to obtain 0.25% of their electricity from solar power. Regulatory authorities in other states are also expected to introduce such solar-specific obligations.

The overall state solar play is important as it provides additional opportunities for solar project developers and product manufacturers. The roll-out of projects under state policies would be in addition to the NSM and could result in the solar power installed capacities exceeding the target of 20GW by 2022.

Focus shifts to financing and execution in 2011

After the substantial number of solar project allocations in 2010, the focus now shifts to the financing and execution of these projects. Contribution and commitment are required from all stakeholders, including the Government, project developers, engineering/procurement/construction players, equipment suppliers and financing agencies. The successful execution of the first set of projects is imperative for the rapid scale-up of solar capacities going forward.

The next innovation wave: by and for emerging markets



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Ernst & Young: While emerging market countries are experiencing fast growth, the conventional wisdom is that local innovation has not progressed at the same pace. Is that a fair assessment?

Martin Haemmig: Not only do China, India, Brazil, Russia and other countries offer companies fast-growth prospects; they also generate opportunities for developing new products, services, manufacturing techniques and business processes. Innovation doesn't happen in black boxes. It happens in markets.

In the Western world and mindset, research on innovation tends to overemphasize patents, inventions and scientific publications coming out of research labs and large multinational firms. High-growth businesses in the BRIC and other countries focus on the middle layer of the innovation game, where products, processes and know-how converge. In addition, businesses in emerging markets adapt to the local market environment and user-level needs and are likely adding a business twist, which is completely novel and often the key element of innovation.

The aspiration of most governments and rising entrepreneurs in the new high-growth BRIC countries is to conquer the Western markets with new products, services, manufacturing techniques and business processes. The larger corporations will likely have the means to do this over time, as great examples have already proven themselves to be truly global players among their Western peers (Huawei, ZTE, Tata, Infosys, Bharti Airtel, Ranbaxy, Embraer, Kaspersky Laboratories, SAB Miller and so on).

However, the next wave of innovation will stem from a new generation of entrepreneurs in these high-growth nations, who will be leading innovative companies, driven by unique opportunities in their local markets. The drivers are provided by their high-growth environment, such as the development of dozens of mega-cities from scratch over the next decades at a pace with which Westerners have no experience. New concepts and processes for water, electricity, transportation, municipal waste and so forth will have to be found. Then there are the

massive problems in the hinterlands, where basic infrastructure, education and modern communication are missing by any dimension for several hundred million people. In addition, there is an endless demand for unlimited products and services for the masses at the bottom of the pyramid at a fraction of the current market prices, hence the quest is "more for less for more," in the words of C.K. Prahalad.

Ernst & Young: Won't Western entrepreneurs see and pursue the same opportunities?

Martin Haemmig: Western innovators and corporations are not exposed to such problems and thus are likely unable to find simple and affordable solutions. Hence, the innovation for the opportunities above will have to come from locals who grew up and/or live in such environments.

Plenty of new entrepreneurial start-up companies with simple and affordable solutions can fix many of the mega-problems in these high-growth and populous nations, and they will benefit from economies of scale that are unprecedented. The domestic markets will first be used to test and deploy new solutions en masse, followed by a rollout from their own emerging market to other emerging nations. Since this new group of entrepreneurs may not be sufficiently trained to compete in the most advanced foreign markets, they will have a chance to learn the traits of international business in other emerging nations first, likely in the absence of any serious competition.

With Chinese and Indian citizens dispersed all over the world in Asia, Africa, the Middle East and Latin America, product adaptation and localization, distribution channels, service and support will be done in a new way, where Western multinational firms or even local players will have little or no chance to compete, given the economies of scale and the understanding of local and consumer needs by their like-minded country fellows as business partners.

Ernst & Young: How would you characterize these emerging-market to emerging-market innovations and what impact will they have in Western markets?

Martin Haemmig: These innovations do not yet involve transformational technological shifts – such inventions remain the preserve of the developed world with its long-established

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Funding cleantech: learning from the UK's social impact bond



Chris Meyer
Founder and CEO
Nerve LLC

Christopher Meyer is a founder of Monitor Talent. Chris' mission is to anticipate and shape the future of business. He has pursued this goal as entrepreneur, executive, consultant, author and as leader of a think tank. Chris' fourth book, Standing on the Sun, will be published by Harvard Business School Press in November 2011.

Ernst & Young: Around the world, the cleantech industry looks to government to play the role of demonstration customer, financial incentive provider or guaranteed source of demand for innovative solutions. But how can government, hemmed in by both straightened finances and political controversy about the value of cleantech, make such a wide range of commitments?

Chris Meyer: The question arises not just in cleantech, but with respect to many social goals. But an innovation in finance called a social impact bond is creating new options. In the first pilot of this arrangement, a philanthropic organization called Social Finance focused on the recidivism rate in UK prisons. It proposed that investing £50 million in rehabilitation work would cut the reoffending rate from 60% to 48%, allowing four prisons to be closed within five years and saving £62 million in annual costs. The Justice Ministry would, of course, welcome such an outcome, but cannot fund the program. The bond provides that if, and only

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universities and commercial laboratories. But the emerging world is spawning product improvements with commercial implications that are game changing. They do not win Nobel prizes but they do make money. The innovations may be simple or incremental, but the effects are not.

In the past, technology was developed in the Western world and deployed in emerging markets, often as product-life cycle extensions. Later, however, these markets moved up the value chain by adding process and improvements and leveraged some of their inherited strength, and then went back to the Western countries as fierce competitors. There is a precedent: in the 1970s, Japanese groups advancing in world markets were often dismissed as low-cost, low-quality copycats. But later, they were recognized as innovators, notably in miniaturization and just-in-time manufacturing. Japanese companies are themselves now under pressure from revived Western groups and new Asian rivals (remember the four tigers?), and today, their innovations are imitated everywhere by the new high-growth nations – China, India, Brazil, Russia and others.

if, the reoffending rates fall by 10% or more, the Ministry will make payouts to the bondholders. These would rise in proportion to the results, but at a 10% reduction, the investment would return 7.5% annually, compounded over eight years.

The idea works for three reasons: (1) it specifies the outcomes desired in measurable terms; (2) it transfers the risk that the program won't work from the government to the investors, so that the only commitment government makes is to pay for bankable results; and (3) it offers philanthropists, who are increasingly only interested in funding measurable results, what they are looking for. An added benefit: over time, the social investors who pick effective programs get their money back to invest again while the less skillful are penalized.

How might this apply to cleantech? Again, there are social goals in which private parties and government bodies share an interest, and unproven approaches to reaching them. Perhaps instruments could be created to monetize government commitments to pay for results; this might de-risk cleantech investments to attract patient, private capital without asking government to take a role it cannot sustain.

Watch the "new generation" of entrepreneurs one or two decades from now as they get business savvy in other emerging markets and as they gain confidence and have loads of cash available. They'll identify a niche where there is demand for radical innovation and then rapidly introduce changes and start challenging leading players to catch up. The top entrepreneurial innovators will benchmark the best in their businesses, as well as in the other lines of business. They'll combine ideas and technologies in novel ways, rather than developing products from scratch. They are using the "principle of the pressure point," which is the tactic of expanding strategically via cost-innovation into the area where the global players are weaker and chipping away at adjacent sectors. The most successful of them focus on high-growth opportunities.

The danger for many Western multinationals is that they don't see the emerging market innovations coming because they are not yet coming directly into their home markets. However, they will, as history has proven.

Middle East and North Africa outlook



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Middle East Cleantech Leader
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Ernst & Young co-hosted the first annual Project Village at the 2011 World Future Energy Summit (WFES) in Abu Dhabi, home to the future Masdar City, the green city being built to research, develop and showcase clean technologies. Hosted by Masdar, the Abu Dhabi government-owned company that is developing Masdar City, WFES attracted 26,000 attendees from more than 100 countries. Project Village is designed to give renewable energy project developers a platform for presenting their projects to potential investors.

To gauge sentiment regarding cleantech development in the Middle East and North Africa (MENA), Ernst & Young surveyed 100 Project Village visitors on their views of clean technologies and their implementation in the region. The majority of respondents (54%) were representatives of cleantech manufacturers; respondents also included executives from cleantech investment firms, government, utilities and service providers. The survey provides insight into the outlook of active cleantech players regarding the MENA region, as represented by WFES participants and exhibitors.

Key technologies: solar, green building, water

In general, the respondents were highly optimistic about the market prospects for a number of technologies in the MENA region. The respondents were nearly unanimous in their view that the region would become a leading global center for solar thermal energy and photovoltaic technologies, with 97% and 94% respectively, indicating strong potential for manufacturing and implementation over the next five years (see Figure 1). Given that solar irradiance levels in this region are among the highest in the world, this projection is very plausible. However, neither technology is established at scale in the region, suggesting that respondents expect a very rapid adoption curve over the coming years.

Green building is another technology area in which respondents said that MENA would likely take a leading role. This optimism seems realistic given that Masdar City is among the world's most ambitious plans for the deployment of green building technology and architecture. Many countries in MENA have rapidly expanding populations that are spurring new building activity. This offers the chance for clean technologies to be integrated into newly constructed buildings, neighborhoods and even entire cities.

The MENA region is also expected to be a leading region for developing water technologies. The region is faced with rapidly expanding populations and overtaxed local water resources. As a result, governments and utilities are investing increasing amounts

to ensure a safe water supply for residents. Innovative and low-cost desalination, filtration and efficiency technologies are being introduced in rapid order.

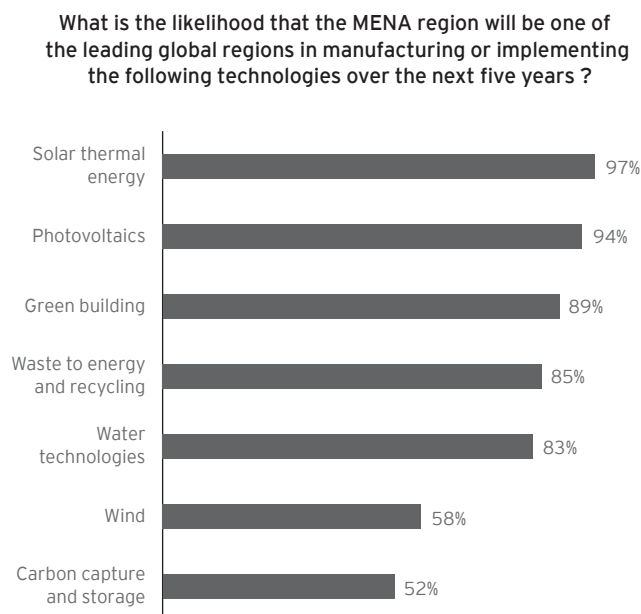
Government: both driver and barrier

Asked to identify the major drivers for the development of clean technologies in MENA, a full 88% of respondents said that government policy was a primary driver for cleantech growth (see Figure 2).

Indeed, MENA countries, both rich and poor in petroleum resources, are pursuing significant cleantech initiatives. One example is Abu Dhabi itself, which possesses significant oil and gas reserves, but is still heavily promoting clean technologies as it seeks to diversify its energy-related revenue sources. Another example is Jordan, which has few conventional oil and gas reserves except for oil shale. It is aggressively seeking to diversify its domestic energy supply using solar energy.

At the same time, the largest percentage of respondents (39%) identified insufficient government support as the single most important barrier to the development of renewable energy globally (see Figure 3). Another 31% said the price competitiveness of

Figure 1. Likely areas of MENA cleantech leadership



renewable compared to traditional sources was the most important barrier. This too has a government dimension, given government's role in establishing a competitive environment for energy sources.

Bullish on Desertec

Survey respondents were bullish on one project with heavy government involvement – the Desertec/Transgreen/Mediterranean Solar Plan. Involving more than 40 countries around the Mediterranean, this initiative calls for the creation of a high-voltage supergrid to pipe solar power from the Sahara to the energy markets of Europe. Queried about the initiative, 89% of respondents felt that the program would be realized, either fully as planned or at a reduced scale. Given the nature of the projects and

the level of coordination involved, the respondents surveyed at WFES are exceptionally positive on the EU-MENA electricity grid.

Positive MENA investment outlook

While the impact of ongoing political events in the region on cleantech remains to be seen, our sampling of WFES participants suggests that the prospects for continued MENA cleantech development are good, with 65% of respondents expecting investment to increase over the next five years and another 29% expecting it to increase strongly in this period.

Figure 2. Drivers of cleantech development in MENA

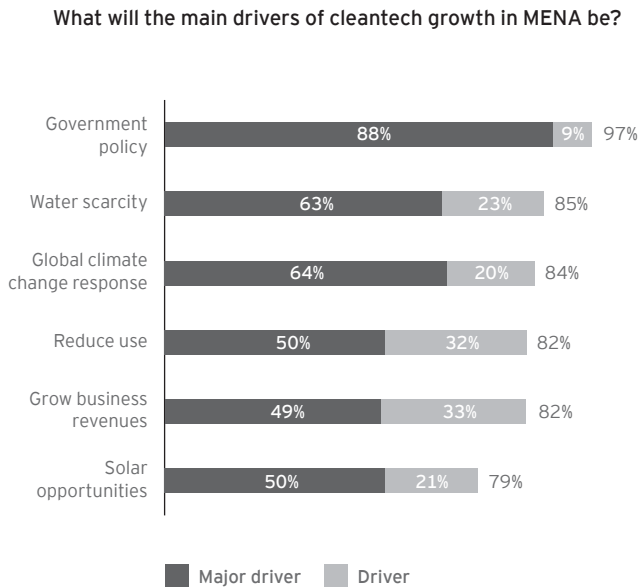
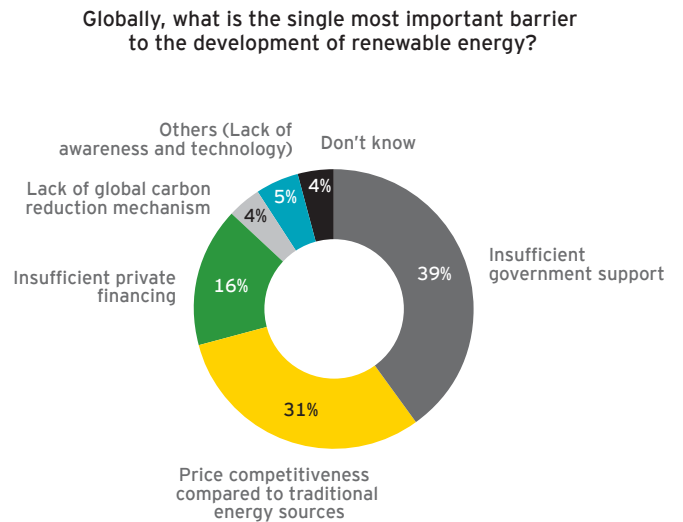


Figure 3. Single most important barrier to development of renewable energy



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