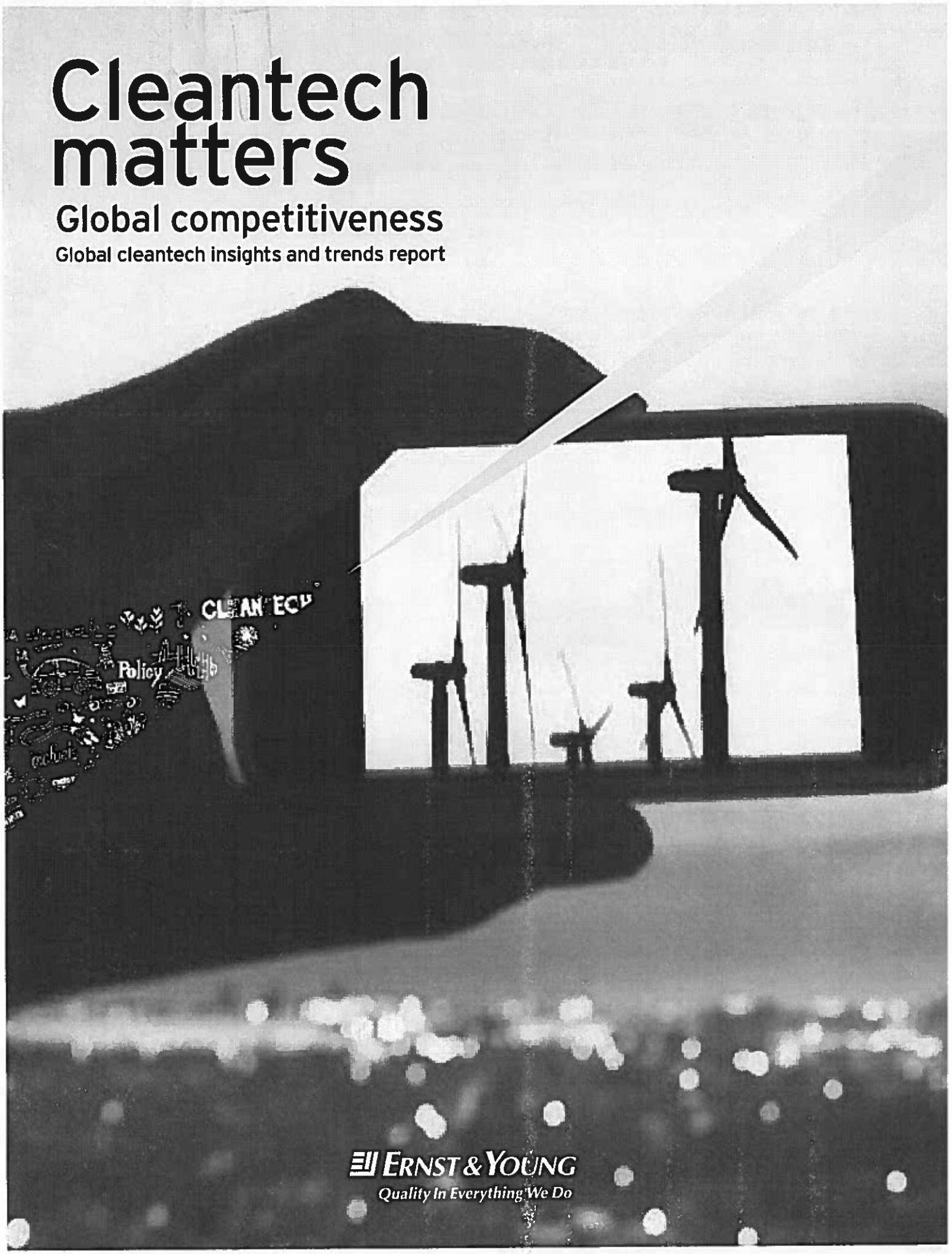
Cleantech matters

Global competitiveness

Global cleantech insights and trends report



Ernst & Young

Quality In Everything We Do

Foreword: Global competitiveness

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The business landscape these days presents a new reality that forces us to face new business, financial, strategic and operational risks. These risks stem from various dynamic market and economic factors and trends, such as the cost of energy, energy security concerns and constraints on natural resources, as well as environmental regulations. In addition, consumer demand for greener products and services, population growth and urbanization, and the purchasing power of the middle class in emerging markets all provide challenges. At the same time, the new reality also presents exciting opportunities that can drive sustainable growth and development. No business or government can afford to ignore either these risks or these opportunities.

The new reality continues to drive the global transformation toward a more resource-efficient and low-carbon economy. Many governments and corporations recognize the need to develop and implement cleantech and sustainability strategies to mitigate the risks and seize the opportunities at both national and global levels.

In the near term, however, cleantech market participants operate in a business environment that is increasingly competitive along a number of dimensions. This report – our fifth annual – explores the theme of global competitiveness, for it can be argued that achieving competitiveness – with existing technologies and within the sector – is the strongest force at work in cleantech today.

First, cleantech must compete with incumbent technologies on an unsubsidized basis. As we observe in our analysis of pure-play cleantech public companies (see p. 7), the combination of economic recession and diminishing governmental financial support in the US and Europe is taking a toll on financial results. Yet business leaders in a number of the cleantech verticals are coming to the seemingly contrarian conclusion that now is the time to develop a roadmap to the end of subsidies rather than ask for more. They recognize that success depends on driving the efficiencies, innovations and business models needed to compete head-on with traditional technologies.

Then, there is greater competition in the sector than ever before. As cleantech matures, the field has become crowded in many of the industry verticals. With the sluggish economy and waning subsidies, competition has become intense, particularly in wind and solar. While the restructuring occurring in these two industries is painful, stronger global players will emerge from the process. And as we note in our article on solar and wind (see p. 25), the resulting fall in prices for renewable generating equipment is hastening installations and competitive prices for renewable energy in markets around the world.

Countries continue to vie for competitive advantage through cleantech. Over the past year, we have seen significant new national commitments to cleantech, such as China's clean energy and efficiency initiatives under its 12th Five Year Plan and Saudi Arabia's US$100 billion solar development plan. In the report, we focus on Brazil's efforts to promote wind and biofuels to meet its burgeoning eneokrgy needs, enhance energy security and provide economic development (see p. 41).

Corporations, too, are increasingly treating their energy strategy as a competitive differentiator. As we highlight in the findings of our global survey of corporate energy executives (see p. 1), the energy mix has become a strategic issue at the C-suite level of billion-dollar corporations, especially given that a considerable – and growing – share of operating costs is spent on energy. Energy efficiency measures and the use of renewable energy by corporations are set to rise significantly over the next five years. In this context, only those corporations with a comprehensive and diverse energy strategy will be able to create a competitive advantage in a more resource-efficient and low-carbon economy.

While the failures sometimes garner more attention than the successes in times like these, it is important to recognize the rapidly emerging cleantech market of stronger players with greater scale, who are better able to compete with industry incumbents on price and performance.

In this report, you will find in-depth articles providing insight into different facets of the cleantech market, interviews with leading cleantech executives, roundtable discussions among key market participants and perspectives from Ernst & Young's global cleantech leaders. We hope that our report proves to be a valuable source of cleantech business insight and a helpful contribution to the ongoing discussion of how to advance the cleantech agenda globally. //

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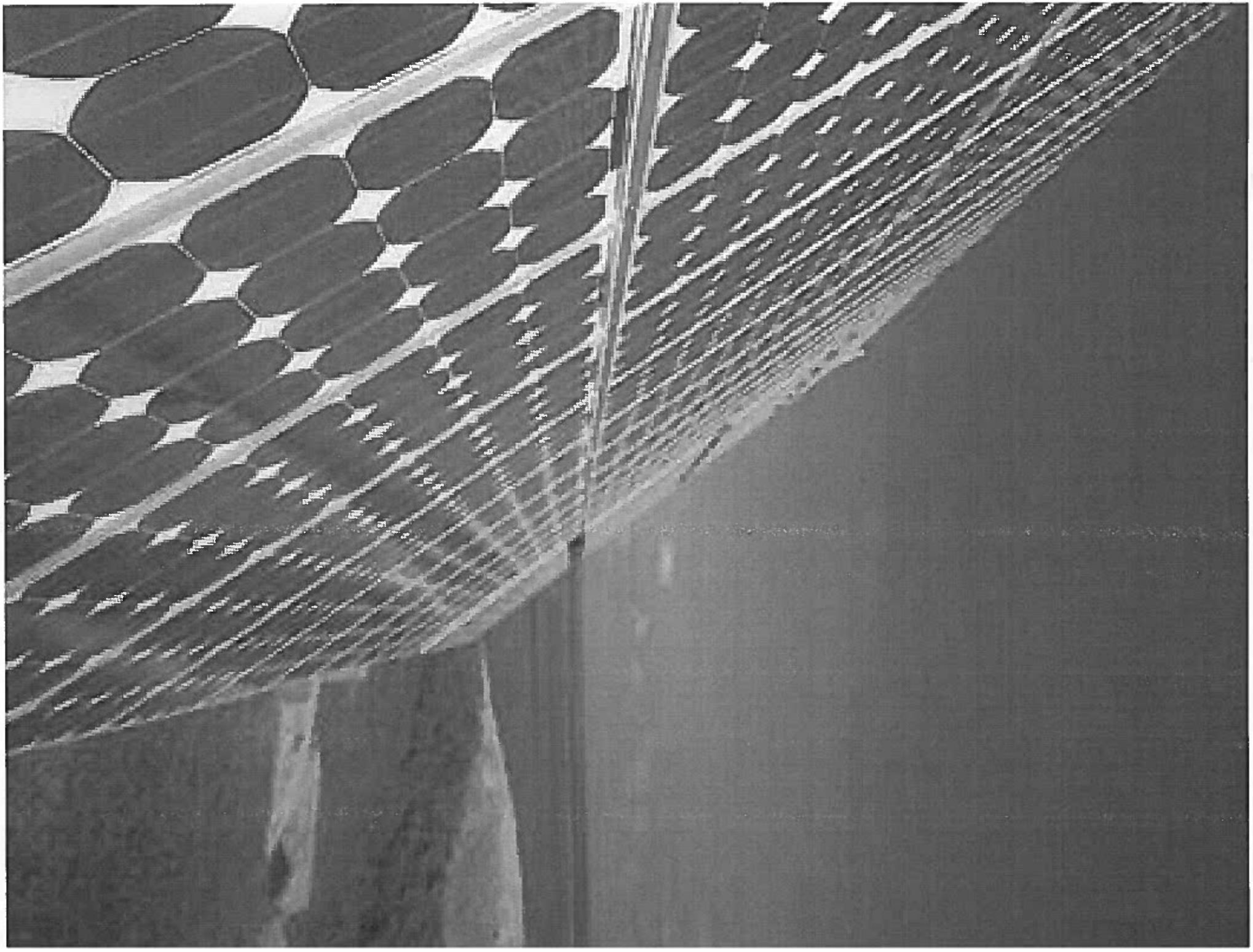


Billion-dollar corporations prioritize energy mix strategy

by Ben Warren, Global Energy and Environmental Finance Leader, Ernst & Young, and John de Yonge, Director of Account Enablement, Ernst & Young Global Cleantech Center

The largest global corporations are meeting the challenge of transitioning to a low-carbon and resource-efficient economy through proactive energy strategies with C-suite engagement. Improving energy efficiency to mitigate energy cost hikes, increasing use of renewable energy and growing energy self-generation form the foundation of corporate energy strategies worldwide. These are some of the key findings arising from Ernst & Young's recent global energy mix survey of billion-dollar corporations.

Global energy mix survey

Ernst & Young worked with a market research firm to conduct a telephone survey of executives involved in setting corporate energy strategy at 100 companies with revenues of US$1 billion or more. Questions focused on energy spend, types of energy consumed, energy strategy formulation and outlook.

The company population was limited to companies in energy-intensive sectors with a balanced distribution around the globe. In the final tally, 72% of the responding companies have revenues exceeding US$1 billion and another 28% revenues of US$10 billion or more. Survey respondents are spread among North America (35%), EMEA (35%) and Asia-Pacific (30%). The largest industry groups are diversified industrial products (29%), retail and wholesale (16%) and automotive (9%).

While our survey was conducted at arm's length to ensure the participants' confidentiality and anonymity, respondents who opted to disclose their participation include Celgene, Goodyear Tire & Rubber Company, Arvind Ltd, Marks & Spencer Group and Rete Ferroviaria Italiana SpA.

Global survey reveals focus on efficiency, increasing use of renewable energy and growing corporate self-generation

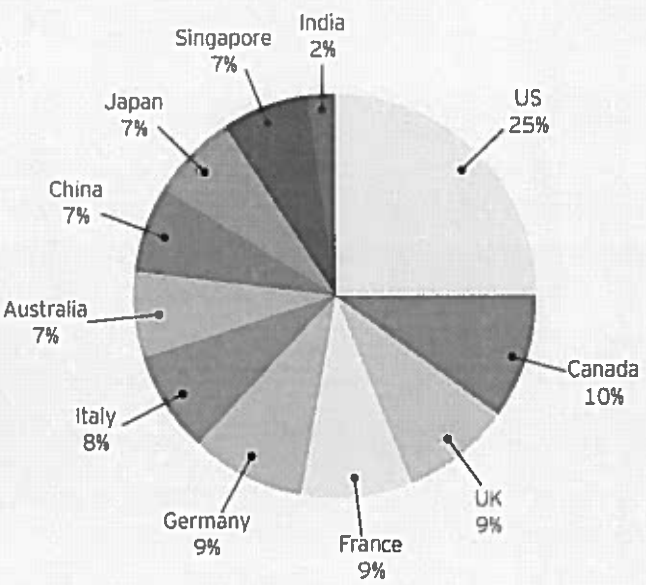
Key business risks

Energy mix strategy is an integral part of addressing key financial, energy security, brand, regulatory and competitive risks.

- Energy expenditures are becoming a growing share of operational costs as fossil fuel-based energy prices increase and price fluctuations in traditional energy sources impact the bottom line.
- The Fukushima disaster in Japan and political turmoil in the Middle East highlight energy availability risks.
- Increased consumer focus on sustainability is changing how industry leadership is being defined.
- Long-term carbon penalties and license-to-operate risks arise as governments focus on energy efficiency and environmental objectives.
- The new reality of the resource-constrained, low-carbon economy changes the basis of competitive advantage.

Figure 1.

Survey respondents by country



High energy costs

High energy costs that are expected to go even higher set the context for the discussion of corporate strategy on the energy mix. For half of our survey respondents, energy expenditures represent 5% or more of operating costs. A smaller but significant subset (22%) report that 20% or more of operating costs go to energy.

In absolute terms, this translates into an annual energy spend of at least US$50 million for 40% of respondents. Nearly a third (27%) spend US$100 million or more on energy.

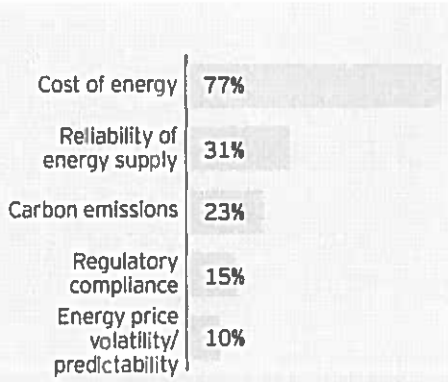
The majority (73%) of our respondents foresee their already substantial energy costs rising over the next five years. A large percentage (38%) expect that energy costs will rise by 15% or more during this period.

Formal energy strategy and implementation plan

Given such high energy costs, it is no surprise that the majority of respondents (70%) have a formal strategy and implementation plan to manage the mix of different energy sources they use. Slightly over half (51%) have a strategy that applies to their company globally; 46% say that energy strategy applies at the country or business-unit level.

Figure 2.

Most important drivers for composition of energy mix



Energy strategy objectives – respondent comments

"To see how energy costs will develop over the next two to three years and to ensure a high level of [energy] security"

"First, to reduce energy use; second, to increase the usage of renewable energy"

"To phase out older technology and equipment and replace it with more energy-efficient equipment."

"To help us achieve three targets: reduce energy consumption by 15%; reduce greenhouse gases by 20%; and increase the renewable energy mix by 5%."

Interestingly, 16% of respondents report that their energy strategy isn't limited to their own operations but also extends to their supply chain.

Energy strategy objectives

Asked to comment on the objectives of their energy strategies, a majority of respondents indicated that cost reduction through efficiency was the primary objective of the strategy. Energy conservation and minimization of carbon footprint followed cost reduction as other key objectives. Many companies have targets to meet a portion of their energy needs through renewable sources with implementation of their energy mix strategy. Ensuring reliability of energy supply is another major objective.

Key implementation challenges

Respondents identified financing and capital issues related to energy projects as the most important challenges to the implementation of energy strategies:

- Financing and capital issues related to energy mix projects (47%)
- Identifying and accessing government grants and incentives (40%)
- Assessing and selecting technologies (39%)
- Measuring or tracking progress in meeting energy mix strategy objectives (37%)

C-suite input and oversight

Decision-making with regard to energy mix strategy is not limited to the procurement or facilities management functions but rises to the highest levels of the corporation. For more than one-third of respondents (36%), the CEO makes the final decisions on energy mix strategy. For another 40%, energy mix strategy is decided by the COO, CFO, GM or board chairman.

Company self-generation of energy

A number of well-known large corporations have launched initiatives to generate their own energy for a variety of reasons. Among them are reducing energy price volatility, increasing security of supply, decreasing costs and meeting carbon-reduction objectives. Examples of corporations with company-owned renewable energy generation include Toyota, eBay, Kimberly-Clark, BMW and PepsiCo.

Our survey suggests that this practice is not yet widespread, but is likely to grow over the next several years. Slightly over half (51%) of respondents report no self-generation at all, and only 20% of respondents generate more than 10% of their companies' total energy needs. That said, one-third of respondents expect to meet a greater share of their energy needs through self-generation over the next five years.

Key barriers – return and risk concerns

Asked why they had opted not to invest in self-generation capacity, survey respondents highlight financial return and risk concerns. The leading reason given is the payback period is too long for such investments, followed by risk considerations and internal rate of return calculations.

Figure 3.

Primary reasons for not investing in self-generation

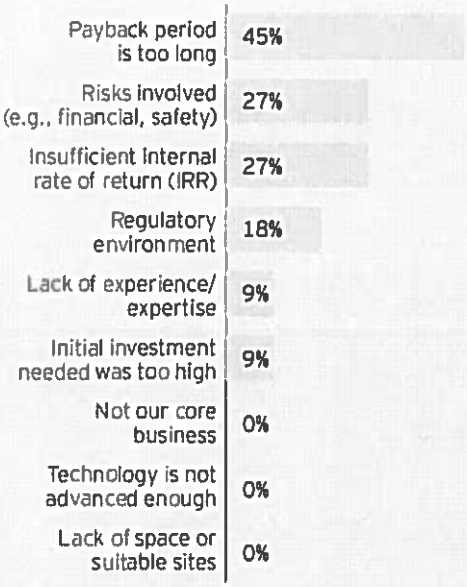


Figure 4.

Renewables as a percentage of company energy generation

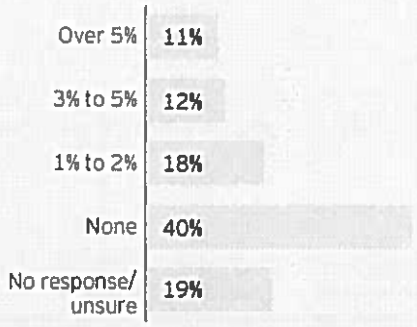
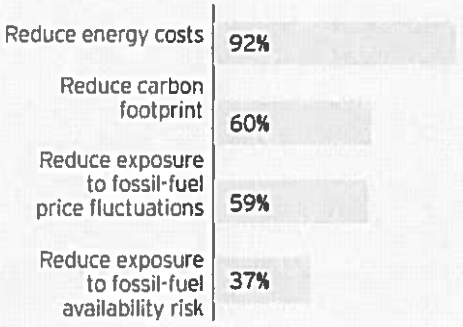


Figure 5.

Top energy efficiency objectives



Note: response totals exceed 100% as respondents could select more than one option

Such factors as the upfront investment amount, the company's level of experience with energy projects, site availability and technology readiness are relatively unimportant, suggesting that the right financial models could unlock corporate investments in energy generation.

Energy efficiency

Given current energy spending and anticipated increases, reducing energy costs remains the nearly universal primary objective of energy efficiency initiatives. However, important subsidiary objectives include shrinking the company's carbon footprint, limiting exposure to fluctuating fossil-fuel prices and reducing risk related to fuel availability.

Respondents deploy a variety of technologies to achieve their energy efficiency objectives, including energy demand management (47%), building energy management systems (20%), energy-efficient lighting (18%) and building automation (18%).

A large majority of respondents anticipate increasing energy efficiency over the next five years – 60% say that initiatives to reduce energy consumption through efficiency will increase, and another 22% say that such initiatives will increase significantly.

Use of renewable energy

Our energy mix survey examined the use of renewable energy from two perspectives: energy generated by company-owned or controlled assets and energy purchased from outside parties. From either perspective, the survey indicates that renewable energy use among large corporations is set to rise over the next five years from an already substantial base.

Renewables in company energy generation
Whether solar, wind, bio-energy or other kinds of renewables, 41% of respondents report generating some form of renewable energy with company-owned or controlled resources. The greatest number of respondents generate power with photovoltaic solar (25%), followed by biomass or biogas generation (20%) and the use of biofuels in company-owned fleets (19%). Wind and geothermal have a 7% uptake.

However, renewable energy still makes up a relatively small proportion of total company generation. Only 11% of respondents say that renewables account for more than 5% of their companies' total energy production.

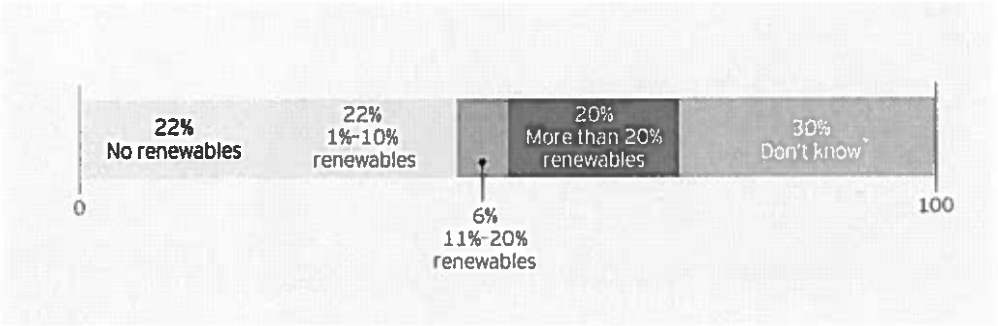
Although corporate renewable energy generation currently can be said to be wider than it is deep, this looks set to change:

- Across the total survey population, 51% of respondents say that company-owned renewable generation will increase over the next five years.
- Another 16% expect renewable generation to significantly increase.

This suggests that other corporations will experiment with renewable generation in the near future, and companies currently deploying it will become more deeply involved.

Figure 6.

Renewables as a percentage of purchased electricity



Renewables in purchased electricity
In contrast to company-owned generation, nearly half of respondents (48%) purchase some amount of electricity generated from renewable sources. In terms of total consumption, this population divides itself into those who consume just a little renewable electricity and those who consume a lot.

Pricing remains a key factor in the adoption of renewable energy. Only 39% of all respondents say they would be willing to pay a premium for renewables, highlighting the importance of achieving grid parity and developing innovative project-financing models.

Nonetheless, as with corporate generation, survey respondents predict growing use of renewables in purchased electricity over the next five years – 59% say that their use will increase or increase significantly.

Energy audit issues

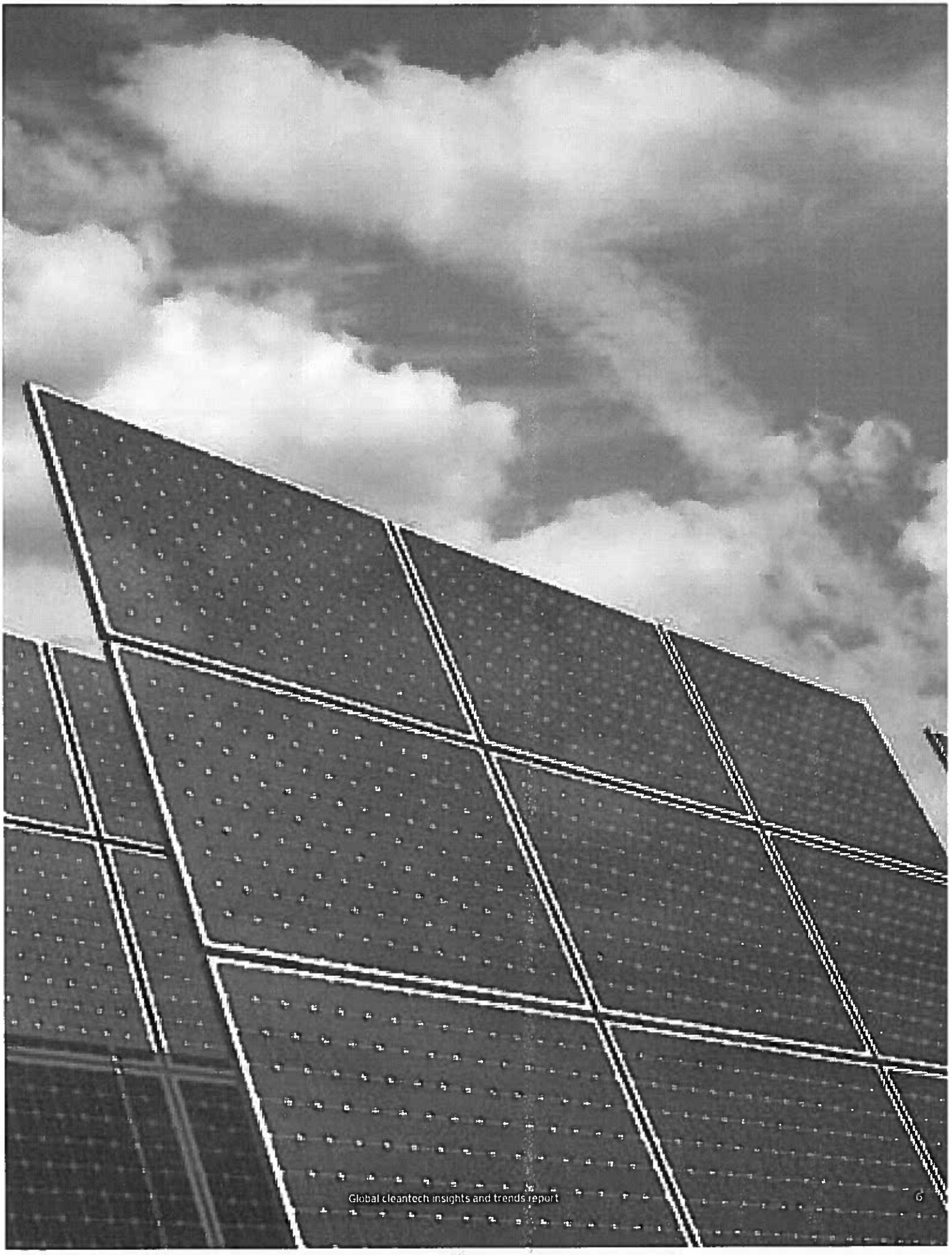
Survey respondents were invited to comment on the key issues revealed in their companies' latest energy audit. Taken together, the energy audit issues revealed the difficulty of implementing a global energy mix strategy. Common challenges highlighted by the respondents include:

- Need to develop a structured approach to meeting energy targets
- A greater focus on implementation of energy conservation programs
- Better understanding of energy usage profile
- Improvement in monitoring and tracking energy metrics
- Understanding of the opportunity to increase the proportion of self-generated energy and renewable energy in the mix
- Better understanding of technology to optimize efficiency and replace aging or low-performing equipment
- Need for energy security in terms of both supply and cost
- Funding and access to capital

Conclusions

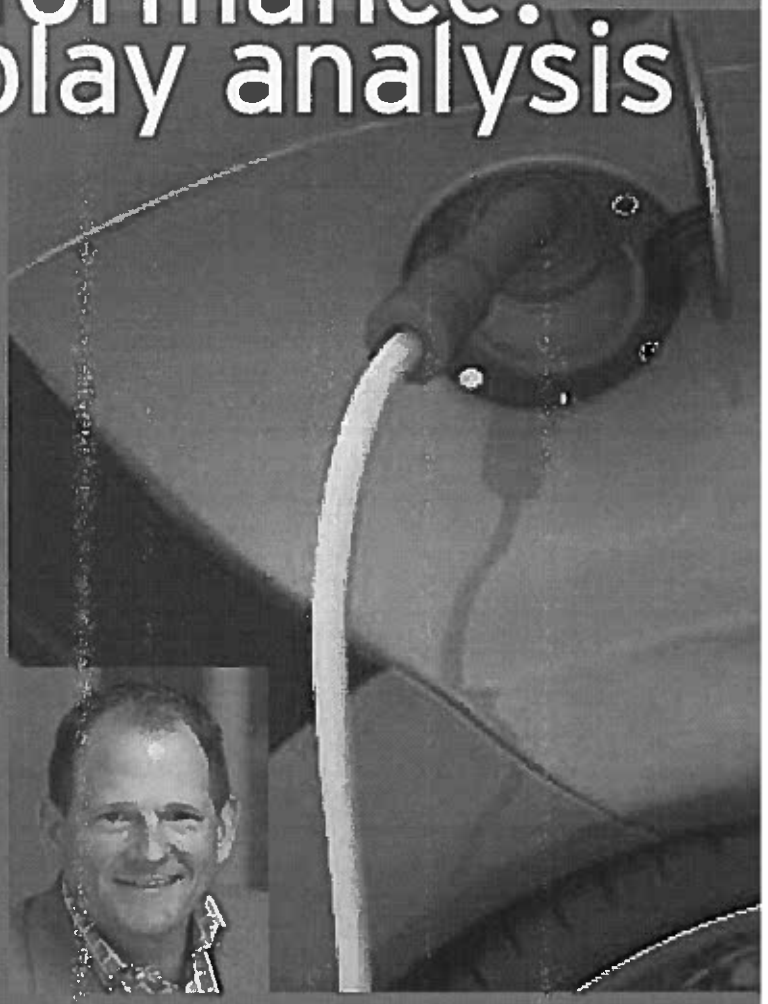
Energy mix has become a strategic issue at the C-suite level of billion-dollar corporations as a significant – and rising – share of operating costs go to energy. While reducing energy costs through energy efficiency measures is often the foremost objective of energy strategy, a number of other subsidiary goals are also driving strategy, such as energy security, carbon reduction and price stability. Regulatory compliance, together with reputational and brand aspects, also plays a part.

Company self-generation of energy and integration of renewables into the energy supply have been implemented at significant rates to meet these ends, with these practices set to accelerate over the next five years. The main barriers to self-generation and use of renewables are mostly related to risk and financial returns, suggesting that adoption could come even faster with financing innovations and increasing cost-competitiveness of renewables. In summary, only those corporations that have a comprehensive and diverse energy strategy will be able to create a competitive advantage in the new world of a more resource-efficient and low-carbon economy. //



Cleantech industry performance: global pure-play analysis

by Scott Sarazen, Markets Leader, Global Cleantech Center, Ernst & Young



In this second year of tracking the performance of pure-play public cleantech companies, we observe significant changes in our annual industry benchmark – major drops in valuation and revenues and significant churn from one year to the next in the benchmark constituents. With little or no growth in the major developed economies, waning or uncertain policy supports for clean energy in many jurisdictions as a result of government austerity measures, and an oversupply of solar and wind generating equipment, cleantech is a tough business to be in these days. Yet we also observe new leaders arriving in the marketplace and pockets of resiliency in dynamic cleantech-sector verticals.

Ernst & Young follows pure-play companies – those whose value is primarily derived from clean energy – because they represent the vanguard in the global transition to a resource-efficient and low-carbon economy. This benchmark is an indication of companies driving clean technology and business-model innovation around the world. For this study, "pure-play" companies are defined as those whose clean energy focus is designated A-1 Main Driver (50%-100% of value) by Bloomberg New Energy Finance (BNEF).

The public pure-play population, however, represents only a small part 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. BNEF designates more than 650 other public companies as having either a considerable (25%-49% of value) or moderate (10%-24% of value) clean energy focus. Our research reveals that nearly 1,400 VC-backed companies worldwide target cleantech markets.

The public pure-play companies provide a gauge of the industry's ability to evolve, adapt and create new market leaders in the face of challenging market conditions. The objective of our benchmark is to provide annual quantitative measurements of the pure-play cleantech population as it evolves – including the number of companies, headcount, revenues, net income, market capitalization and debt – and to offer insights into unique geographic and sector sub-segments.

Figure 1

2012 benchmark – company additions and deletions

	Bankruptcy, delisted, defunct or quoted OTC	Private, restructured, acquired or merged	No longer A1; no longer classified as pure play	Total
Deleted companies	32	24	46	102
Percentage	31%	24%	45%	100%

	IPO or new A1 cleantech entity post-merger	Public company reclassified as A1	Total
Added companies	24	98	122
Percentage	20%	80%	100%

While our analysis of this universe of public pure-play companies shows a few nodes of growth in some categories, the overall results suggest that a high degree of competitiveness is required to attain growth and a leadership position in this dynamic market.

New entrants, churn and reconstitution

From 2011 to 2012, the benchmark population of pure-play public cleantech companies shifted considerably. In this year's reconstitution of our list of pure-play companies, we removed 102 companies from the 399 constituents of 2011 and added 122 new ones – a churn of 31%.

A large proportion of the deletions from the company population were a result of financial duress – companies delisting, moving to OTC trading or going bankrupt. Other companies were removed from the list because they were acquired, merged or went private. The majority of deletions, however, came from changes in the clean energy focus classification provided by BNEF. Many companies that had been designated A1 (i.e., deriving 50% or more of their value from clean energy activities) were reclassified as A2, A3 or A4 companies (i.e., deriving less than 50% of their value from clean energy activities).

Similarly, additions to the 2012 universe came mostly from new A1 designations – 80% of the new entrants this year were public companies that received a higher clean energy focus classification from BNEF. The remaining 20% of new entrants were a result of IPOs or were new pure-play companies emerging from a merger or restructuring.

Global cleantech landscape

Compared to the previous year, the financial results of our pure-play population paint a sobering picture of the cleantech marketplace. While aggregate revenues fell by just 3% to US$148 billion, net income swung from a positive US$5.1 billion last year to a US$6.6 billion loss. Market capitalization fell 41% to US$143 billion. Although some of the declines can be attributed to changes resulting from the annual benchmark reconstitution, as discussed earlier, the dramatic drop in net income and market capitalization reflects trends across the industry.

Market valuations and net income declines are evidence of the difficulties cleantech companies have had in competing for customers and financing, as well as adjusting to a post-recession economy marked by fiscal austerity. Despite a few large renewable generation and efficiency companies that experienced gains in income, many incumbent wind and solar companies faced losses that brought down the sector's financials over all.

At the same time, debt financing increased, rising 14% to US$114.8 billion, suggesting that borrowing was making up for some of the losses in net income and fueling continuing expansion in some companies.

Total reported industry headcount fell 10% to 457,808 even as the total number of companies in the benchmark increased by 5% to 499. At the same time, the company population became younger, moving from a median 13 years since incorporation to a median of 12. Despite the economic headwinds that are forcing bigger, more established companies to make painful headcount adjustments, emerging companies continue to enter the cleantech universe in significant numbers.

Asia-Pacific

With 152 pure-play public cleantech companies, the Asia-Pacific region continues to host the largest share of the population, with the pool having expanded marginally from 149 companies. As might be expected, the region also has the highest market capitalization and revenue (see Figure 2). This year, regional revenues of US$56 billion were considerably larger – by 20% – compared with last year's benchmark. Asia-Pacific was also the only region that had a positive change in median revenue, which increased by 16% compared with last year.

However, Asia-Pacific net income declined due to losses among some of the larger companies in the solar sector. Debt levels in the region increased significantly, rising 73% to US$59 billion.

Asia-Pacific companies remain the youngest on a median basis – 11 years since incorporation – as a result of new entrants from mainland China, Australia and Taiwan in recent years. The median headcount among Asia-Pacific companies is 457, far higher than in EMEA or North America, largely

Figure 2

Global public pure-play cleantech companies

	2011	2012	Annual change
Number of companies	399	419	5%
Median age (years)	13	12	-8%
Total headcount	496,311	457,808	-10%
Median headcount	203	214	5%
Market capitalization (US$ billions)	$243.2	$143.5	-41%
Annual revenues (US$ billions)	$152.8	$148.1	-3%
Net income (US$ billions)	$5.1	($6.60)	-229%
Debt (US$ billions)	$100.8	$114.8	14%

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; annual change represents the difference between the 2012 benchmark and the 2011 benchmark in aggregate. The populations of 2011 and 2012 differ as a result of the annual reconstitution process (see sidebar below).

because of the low-cost work force of Chinese manufacturers. Chinese and Hong Kong solar and wind companies consistently placed among the top 10 positions in the region in revenue, net income and debt, with the exception of India's Suzlon, which held the top position for revenue earned in the region.

Europe, Middle East and Africa (EMEA)

Government fiscal austerity measures in the region, such as reductions in feed-in tariffs in European countries against the last year, have altered the financial dynamics of EMEA companies a great deal.

From 2011 to 2012, the total market capitalization of EMEA companies fell 57% to US$36 billion, and revenues fell 32% to US$49.4 billion. Total net income showed losses of US$3.5 billion – the highest among all regions. European solar- and wind-equipment manufactures faced rapidly falling prices because of global production overcapacity and slackening demand. At the same time, large renewable energy project developers encountered a rapidly shifting regulatory landscape, with cuts to financial supports in Spain, Ireland, the UK and Germany.

Despite the challenging market conditions, the EMEA pure-play population actually grew, increasing 15% to 147 companies. Given the European Union's carbon-reduction commitments and major new cleantech initiatives in the Middle East and North Africa, such as Saudi Arabia's US$109 billion plan to create a domestic solar industry, new entrants continue to be attracted by the potential of the EMEA market.

North America

North America's public pure-play cleantech company population numbers 114, down 3%. The region's companies reported mixed results this year, showing US$3.1 billion in losses in aggregate. However, total revenues grew 30% to US$30.2 billion, partly due to the new inclusion of high-revenue companies, such as Brookfield Renewable Partners and GT Advanced Technologies, in this year's population and partly to the revenue growth in the energy efficiency sector. Interestingly, despite the drop in the number of companies, the region's headcount actually grew 4% to 72,000 people. This reflects North America's greater diversity in the types of companies represented in its base of cleantech companies compared with other regions, resulting in a smaller impact from the decline in renewables.

While US and Canadian companies were not spared in the broad declines in market capitalization, valuations did not fall as steeply as in Europe; the total market capitalization of cleantech in North America is now almost on par with that of Europe. In terms of median market capitalization, North America's US$47.0 million exceeds Europe's US$33.0 million.

Against the backdrop of volatile markets and uncertain policy support, North American companies increased their debt level by 79% to US$18.4 billion, indicating that this year's benchmark companies have been able to tap into debt markets for expansion or to cover shortfalls. However, median per-company debt levels in the region remain low at just US$5 million – well below those of other regions.

Central and South America

The pure-play population in Central and South America is small – just six companies – and dominated by large Brazilian ethanol producers such as Cosan. The region's companies have shown relative resilience, and these companies were able to secure a positive net income figure of US$288 million with revenues of almost US$12.5 billion. The six companies also have a higher market capitalization, at US$7.3 billion in 2012, as compared with the five companies that had US$6.0 billion in market cap in 2010. The median measures for this group of companies are not readily comparable to those in other regions due to the distorting effects of the very small population.

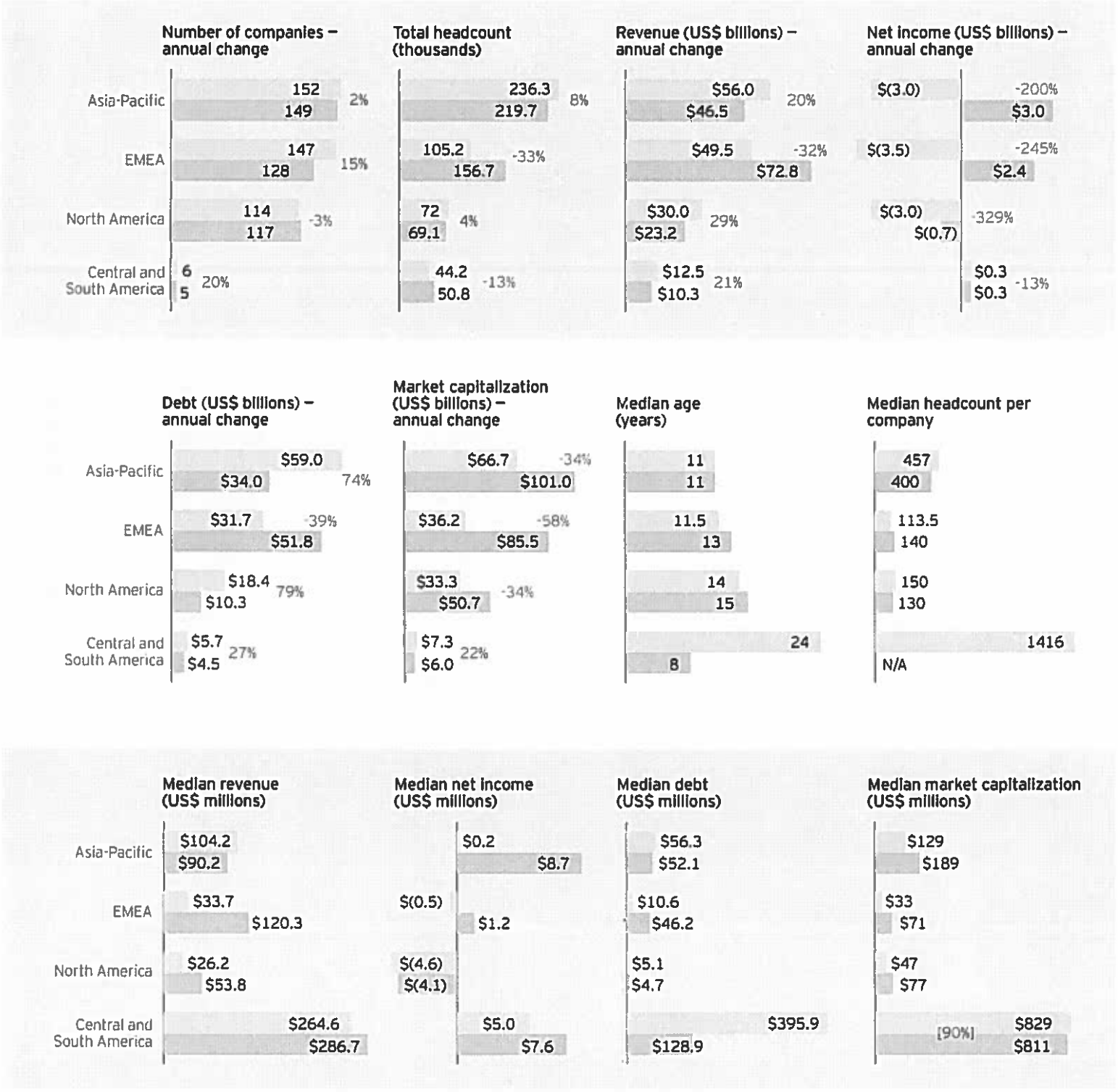
Country landscape

Further distinctions can be made at the country level (see Figure 3). China and the US make up a first market tier in terms of company population and market capitalization. Like last year, the US has the largest number of companies at 73, while China has the greatest market capitalization value at US$42.1 billion. China's headcount is also several times larger than that of any other market.

Germany and Canada form the next tier in terms of number of companies, with 42 and 41 pure-play cleantech companies, respectively.

Figure 3

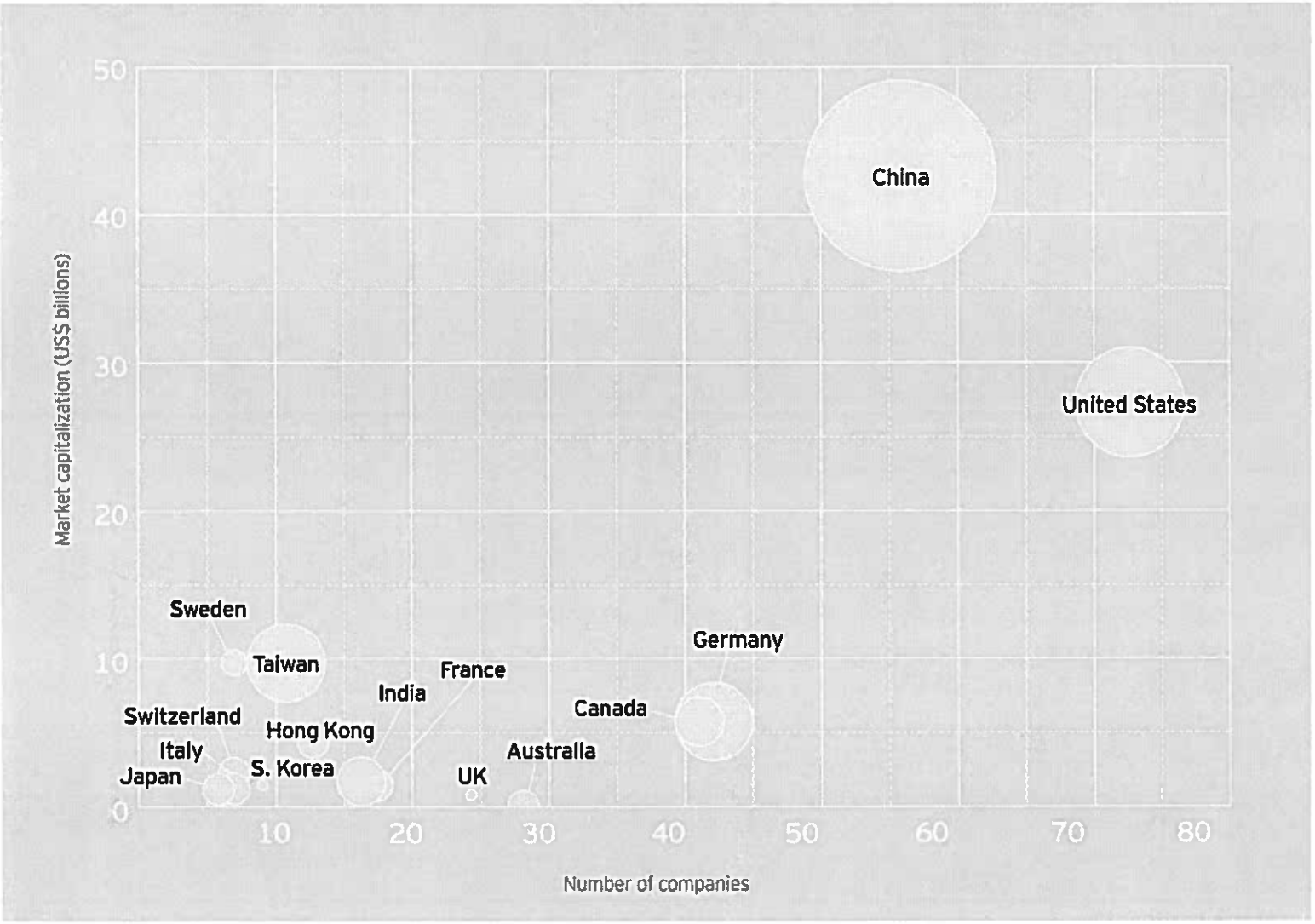
Global public pure-play company landscape by region



Note: Market caps as on 9 April 2012 and 8 April 2011

Figure 4.

Cleantech country landscape



A third tier is composed of markets with fewer than 30 companies. The leaders in this tier include Australia (28), the United Kingdom (24), France (18) and India (17).

Italy and Sweden join the list of the top 15 countries in terms of number of companies while Spain drops off the list as the result of mergers that reduced its company population.

Cleantech segments: solar leads decline; pockets of resiliency remain

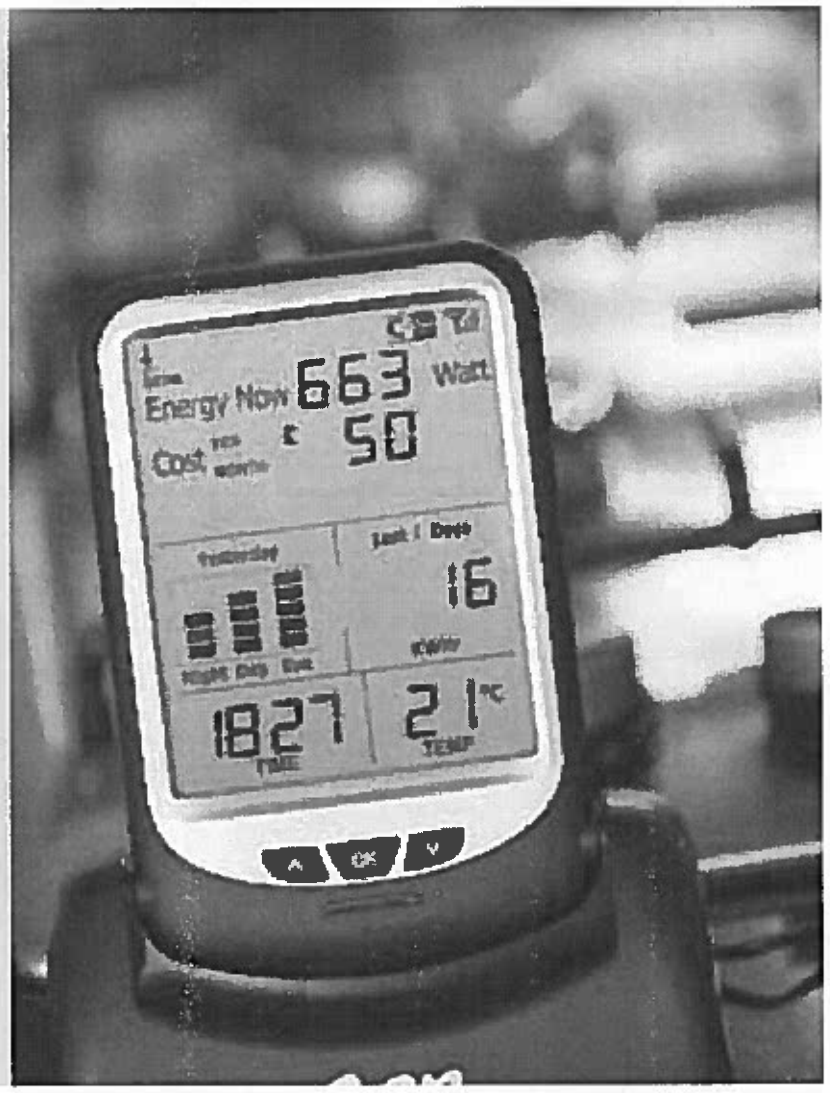
The solar segment has seen the greatest alteration since last year. While solar continues to dominate the global public pure-play population in terms of the total number of companies (107), people employed (179,500) and total revenues (US$50.6 billion), other performance measurements highlight the difficult and competitive environment solar companies faced in 2011. Aggregate net income plunged from US$1.2 billion in 2010 to a US$6.8 billion loss last year, bringing down the overall figures for cleantech despite some gains in other segments. And the market capitalization of the solar segment has been reduced by almost a third from last year to US$25.2 billion. But despite its declining financial performance, the number of solar companies actually increased by 5% and headcount grew by 11% – largely the result of new entrants from Asia. Further, consolidation in the solar industry due to declining financial performance is still in the early stages and will likely be reflected in next year's benchmark results.

Wind, the second-largest segment, with 54 companies, showed more resilience in 2011 than the solar segment. The wind segment's revenues remained relatively flat at US$31 billion, losing just 3% compared to the

Country	Companies	Market cap (US$b)	Headcount ('000)
United States	73	$27.2	61.6
China	55	$42.1	166.5
Germany	42	$5.8	28.2
Canada	41	$6.1	10.5
Australia	28	$0.1	3.1
United Kingdom	24	$1.1	1.5
France	18	$1.5	6.2
India	17	$1.9	14.7
Hong Kong	12	$4.0	5.3
Taiwan	11	$8.9	36.0
South Korea	9	$2.4	1.0
Sweden	7	$9.7	3.5
Switzerland	7	$2.1	6.4
Italy	7	$1.1	4.0
Japan	6	$1.2	5.8

Bubble volume = cleantech company headcount

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



previous year. Wind companies employ some 74,300 workers, a 9% decline that indicates the ongoing restructuring in the wind industry to increase production efficiency and align production with demand. Total net income for wind companies was US$471 million, a decline of 58% but still positive. As fiscal austerity and competition increase, the financial resiliency of wind companies might yet prove to be short-lived. Debt financing, however, may still shore up the wind segment as wind companies have led other verticals in their ability to attract almost US$33.7 billion – nearly a third of the total debt in pure-play cleantech.

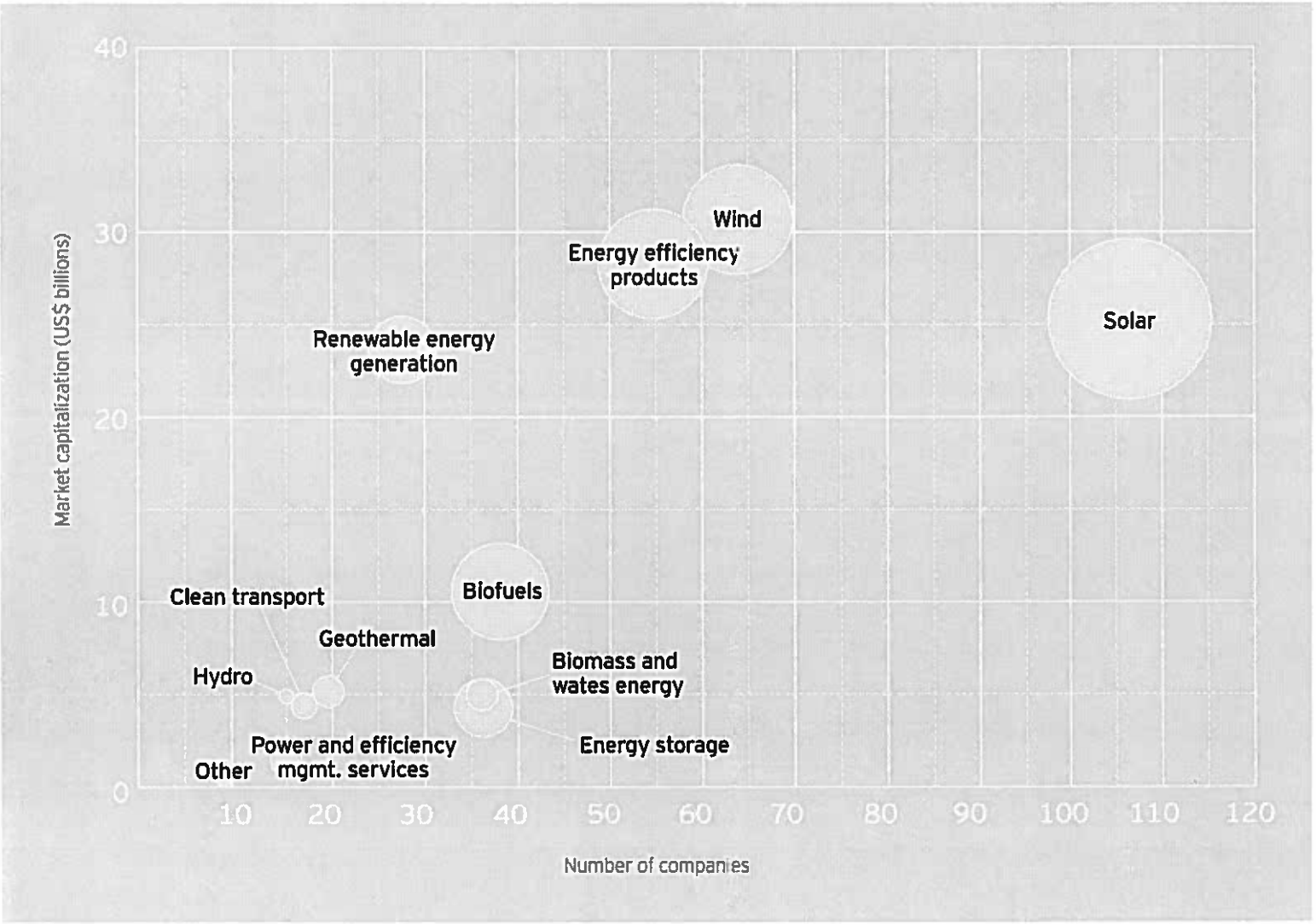
A number of segments show gains in revenue but declines in net income, indicating expanding businesses but eroding margins in the face of fiercer competition and difficult economic conditions. In this category are energy efficiency products, biofuels, renewable energy generation, geothermal and hydro.

One segment stands out for having both revenue and net income growth: biomass/waste-to-energy, which saw revenues grow by 78% to US$4.0 billion and net income go from a US$0.8 million loss to a positive US$263 million. The financial performance of biomass/waste-to-energy companies illustrates the attractive economics in this segment, which is supported by strong corporate and municipal demand as waste-to-energy becomes a key part of integrated waste management strategies.

The youngest of all the segments in terms of the amount of time since company incorporation is biofuels, with a median of eight years. Water treatment and conservation, although represented by a small number of public pure-play companies, is by far the most mature cleantech segment, composed of companies with a median age of 47.5 years.

Figure 5

Cleantech segment landscape



Initial public offerings – China continues to dominate

As 2011 was not the best year for cleantech IPOs, only 22 companies were added to the 2012 pure-play benchmark population through new listings, compared to 38 last year. Nearly half of these offerings were conducted by Chinese companies, which together raised US$3.8 billion, or 85% of the total IPO equity raised globally over the year (Figure 8). The largest IPO came from the Chinese wind developer and equipment manufacturer Sinovel, which raised US$1.4 billion on the Shanghai Stock Exchange (Figure 9). An interesting new entrant to the list of countries in terms of cleantech IPO activity, displacing the US from second place, was Poland, with the listing of three biomass and waste-energy companies on the Warsaw Stock Exchange.

While the solar segment had the largest number of IPOs (six), companies in the wind segment raised the most capital, at US$2.8 billion as compared with a little over US$1 billion in solar. The biggest growth in deal activity came from the biofuels segment, which had five IPOs in 2011, including KIOR and Gevo, as compared to two last year.

Segment	Companies	Market cap (US$b)	Headcount ('000)
Solar	107	25.2	179.5
Wind	54	30.3	74.3
Energy efficiency products	44	27.7	81.6
Biofuels	38	10.5	49.9
Biomass and waste energy	36	4.8	9.0
Energy storage	36	4.5	18.0
Renewable energy generation	28	23.6	24.9
Geothermal	20	5.0	6.0
Clean transport	17	4.5	4.0
Hydro	15	4.6	1.5
Power and efficiency management services	15	2.0	5.3
Other	9	0.9	3.9

Bubble volume = cleantech company headcount

Note: Includes public companies designated as clean energy A-1 Main Driver (50%-100% of value) by BNEF; market capitalization data as of 9 April 2012.

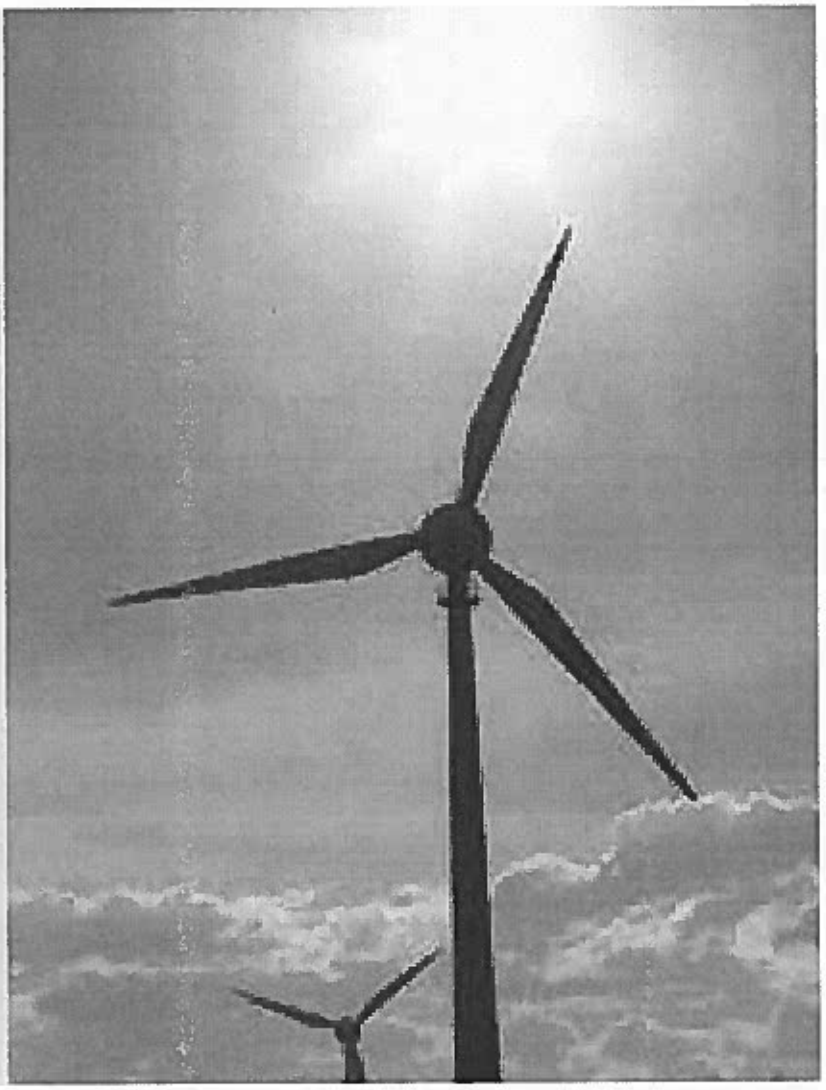


Figure 6

Selected top pure-play companies by market capitalization

Company	Market	Cleantech segment	Market cap (US$b)	Stock exchange
China Longyuan Power Group Corporation Limited	China	Wind	$6.3	The Stock Exchange of Hong Kong Ltd.
Sinovel Wind Group Co. Ltd.	China	Wind	$4.8	Shanghai Stock Exchange
GCL-Poly Energy Holdings Ltd.	Hong Kong	Renewable energy generation	$4.5	The Stock Exchange of Hong Kong Ltd.
EDP Renováveis	Spain	Renewable energy generation	$4.1	Euronext Lisbon
Cosan Ltd.	Brazil	Biofuels	$4.0	Bolsa de Valores de São Paulo
Tesla Motors Inc.	United States	Clean transport	$3.5	NASDAQ Global Select
Sanan Optoelectronics Co. Ltd.	China	Energy efficiency products	$2.5	Shanghai Stock Exchange
Epistar Corp	Taiwan	Energy efficiency products	$2.1	Taiwan Stock Exchange
Huaneng Renewables Corporation	China	Wind	$2.0	The Stock Exchange of Hong Kong
Vestas Wind Systems	Denmark	Wind	$1.9	OMX Nordic Exchange Copenhagen

Note: Market cap as of 9 April 2012

Figure 7

Global public pure-play cleantech companies by segment

	No. of companies		Median age	Headcount		Market cap (US$b)		Revenue (US$b)		Net income (US$m)		Debt (US$b)	
	2012	% change		2012	% change	2012	% change	2011	% change	2011	% change	2011	% change
Solar	107	5%	11	179,486	11%	25.2	-63%	50.6	-4%	-6796	-578%	28.4	-11%
Wind	54	4%	16	74,320	-9%	30.3	-36%	31.0	-3%	471	-58%	33.7	33%
Energy efficiency products	44	5%	20	81,601	23%	27.7	-5%	19.9	55%	603	-28%	6.2	77%
Biofuels	38	15%	8	49,889	-4%	10.5	0%	22.8	47%	-48	-137%	7.5	26%
Biomass and waste energy	36	64%	9	8,974	40%	4.8	30%	4.0	74%	263	526%	3.4	36%
Energy storage	36	-23%	14	18,029	-70%	4.5	-67%	2.5	-67%	-827		1.5	-27%
Renewable energy generation	28	22%	10.5	24,923	8%	23.6	-44%	9.0	5%	1063	-18%	22.5	-4%
Geothermal	20	0%	9.5	5,991	39%	5.0	-4%	1.8	53%	-495	-605%	4.1	78%
Clean transport	17	13%	19	3,971	2%	4.5	2%	0.8	-17%	-382		0.4	85%
Hydro	15	36%	9.5	1,493	-68%	4.6	84%	1.7	235%	-539	-1,248%	6.5	367%
Power and efficiency management services	15	7%	11	5,267	-47%	2.0	-44%	2.3	-23%	41	-39%	0.5	8%
Environment	5	-44%	21.5	2,241	-83%	0.4	-95%	0.8	-94%	-25	-108%	0.1	-93%
Carbon capture and storage	2		20			0.0		0.0		-2		0.0	
Water treatment and conservation	2	-78%	47.5	1,623	-84%	0.4	-96%	0.9	-68%	28	-77%	0.0	-92%

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 9 April 2012. % change compares the difference between the 2012 benchmark and the 2011 benchmark.

Outlook

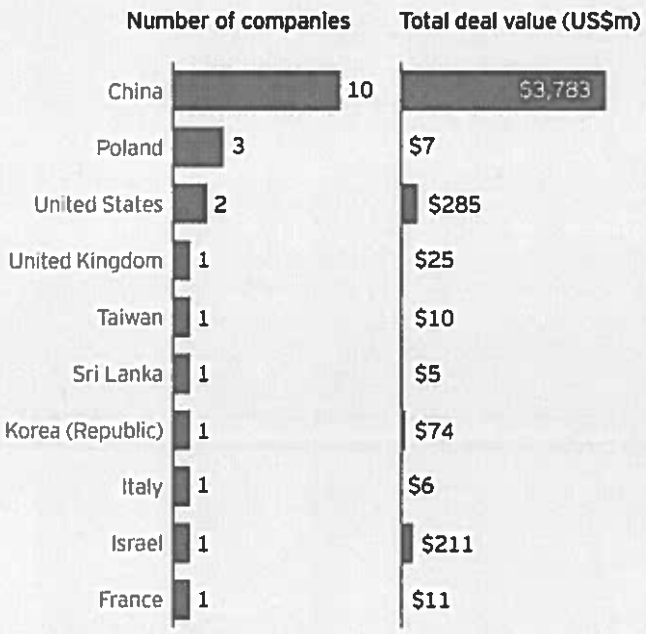
As evidenced in this year's analysis, the global population of public pure-play cleantech companies is experiencing dynamic change. We will likely continue to see a cleantech population in flux as consolidation and restructuring continue among solar and wind equipment manufacturers; renewable energy generators adapt to a post-subsidy business environment; market momentum shifts even further in favor of emerging markets; and competition increases across the board.

At the same time, the number of pure-play companies is set for continued growth as new entrants – whether emerging companies or those that increase their focus on cleantech – are attracted by the market opportunities created by resource scarcity and the low-carbon transformation.

While global economic conditions will put downward pressure on financial results for at least the near term, new market leaders across cleantech segments will emerge from this period of transition with the scale, efficiency and competitiveness necessary to drive improved performance across all of our benchmark measurements. //

Figure 8

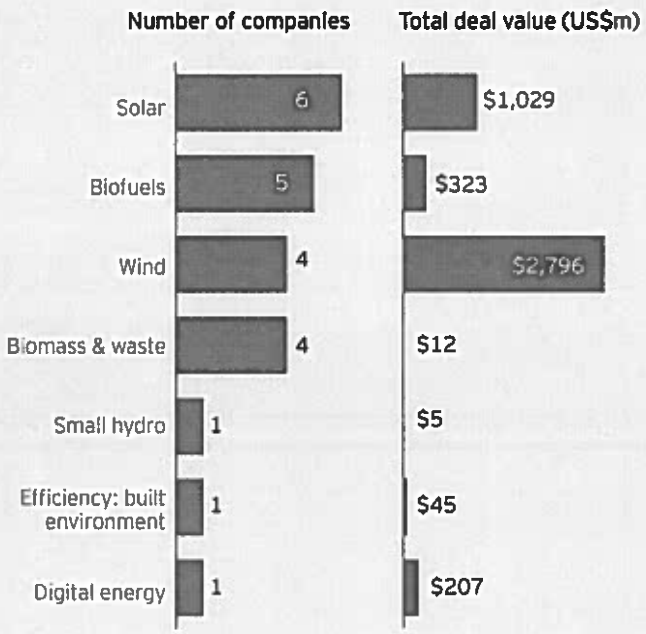
2011 cleantech pure-play IPOs by market



Note: includes public companies designated as clean energy A-1 Main Driver (50%-100% of value) by BNEF.

Figure 9

2011 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.

Figure 10

Top pure-play cleantech IPOs in 2011

Company	Market	Cleantech segment	Stock exchange	Pricing date	Total deal value (US$m)	Market cap (US$m)
Sinovel Wind Group Co. Ltd.	China	Wind	Shanghai Stock Exchange	13 Jan 11	$1,432	$4,814
Huaneng Renewables Corp. Ltd.	China	Wind	Hong Kong Stock Exchange	10 Jun 11	$850	$2,045
Beijing Jingyuntong Technology Co. Ltd.	China	Solar	Shanghai Stock Exchange	8 Sep 11	$394	$1,602
Guodian Technology & Environment Group Co. Ltd.	China	Wind	Hong Kong Stock Exchange	30 Dec 11	$337	$1,679
Sungrow Power Supply Co. Ltd.	China	Solar	Shenzhen Stock Exchange – Main Board	2 Nov 11	$215	$658
Energix-Renewable Energies Ltd.	Israel	Solar	Tel Aviv Stock Exchange	13 Apr 11	$211	$32
Ningbo Sanxing Electric Co. Ltd.	China	Digital energy	Shanghai Stock Exchange	15 Jun 11	$207	$576
Jiangsu Jixin Wind Energy Technology Co. Ltd.	China	Wind	Shanghai Stock Exchange	6 May 11	$176	$836
KIOR Inc.	United States	Biofuels	NASDAQ Global Select Market	23 Jun 11	$162	$1,092

Note: Market cap as of 9 April 2012

Interview with Paul Ho, Managing Director, Hudson Clean Energy Partners

Hudson Clean Energy Partners is a leading private equity firm formed to make private investments in the dynamic and high-growth clean energy industry. Global in scope, Hudson is dedicated to investing exclusively in renewable power, alternative fuels and smart technologies in sectors that include wind and solar, biofuels, biomass, hydroelectric, geothermal, energy efficiency and storage.

Ernst & Young: **How do you see uncertain or declining incentive or policy supports for renewables in developed markets affecting project developers' strategies?**

Paul Ho: No doubt it impacts them negatively, both in the US and in Europe. On the US side, the impending expiration of the wind production tax credits at the end of the year and uncertainty about their renewal is creating uncertainty in the industry, making any long-term project planning very difficult. The Solyndra debacle has hamstrung the DOE in its loan guarantee programs. Unfortunately, although clean energy is not at the very top of the policy agenda of either of the two parties in this election year, that has not stopped some from using it as a political tool.

The same goes for Europe. Retroactive cuts to the solar PV feed-in tariff in Spain, for example, jeopardized existing investments in renewable energy assets and set a terrible precedent for future investments in the country. When governments unilaterally change the laws of the game mid-way, they are seriously undermining investors' confidence in those markets. But such actions are the rare exception rather than the rule.

For developers with a one-region strategy, there is not much that they can do – they just have to wait it out or try to push projects through before the rule changes. In the US, developers are accelerating completion of projects this year so that they can qualify for the expiring PTC (Production Tax Credit). In Southern Europe, it is unclear whether the scale-back is temporary or permanent, but developers are putting projects in the pipeline on hold, not willing to invest more without knowing the parameters of the prospective regulatory landscape.

We believe that a good strategy is for our portfolio companies to diversify our investments across multiple jurisdictions, even continents, to mitigate the regional or country-specific risks. That is what we are doing in our portfolio companies in wind and solar development. In this case, even if some markets are shut down, our portfolio companies can still divert resources and capital to geographical regions where market conditions remain attractive.

Ernst & Young: **We've seen wind turbine and solar equipment prices falling. What's going to be the market outcome of this and what are the pros and cons?**

Paul Ho: The pro is that the renewable energy cost curve is continuing to decline faster and more dramatically than people ever thought it could, which is a good thing. For example, the cost of solar photovoltaic modules has fallen by 75% since 2008. Wind capital costs are also trending down. The softening of demand due to the global economic slowdown has shifted leverage to the buyer. At the same time, equipment manufacturers want to keep their factories running, especially after rapid production capacity buildups in recent years, so they are willing to sell at marginal profitability or even at a loss in some cases. That's good from a consumer and project developer standpoint, assuming the same power purchase agreement (PPA) pricing, because with lower marginal costs you can improve your own project equity return.

From a manufacturer's standpoint, it's a negative, obviously. We are expecting a lot of capacity consolidation and the survival of only the fittest. The weaker companies are already falling by the wayside. Having a strong balance sheet and access to capital is key to survival.

While the next couple of years will be challenging, we think the current supply-demand imbalance is a cyclical swing that will correct as the industry continues to consolidate and mature.

Ernst & Young: **Switching gears, what do you see as the prospects and drivers in the biofuels market?**

Paul Ho: On the surface, the prospects for the biofuels market are attractive because this market is largely driven by the price of oil, which has remained relatively high. So until there is viable technology to synthesize low-cost natural gas into liquid fuel at moderate scale, or people use more natural gas vehicles, the biofuels outlook is fairly robust, particularly given the continued geopolitical uncertainty in the Middle East. Some people are even finding ways to make use of lower-cost waste feedstocks to make biofuels and, therefore, are insulated from grain price volatility.

The undercurrent, though, is that the US Renewable Fuel Standard that replaced the blenders' tax credit for ethanol and biodiesel (which expired at the end of last year) as the main regulatory support driver for biofuels is seen by many industry participants as too stringent. Under this standard, a certain amount of advanced biofuels must be blended into mainstream fuels, yet there is simply not enough production to meet the statutory requirement. Advanced biofuels production capacity has not come online as quickly as anticipated a few years ago. As a result, blenders are forced to pay a penalty even though they can't find the advanced biofuels that they need. There is a risk that the law may be challenged, which could really impact the viability of the biofuels industry, at least until the advanced biofuel technologies have scaled up economically.

Ernst & Young: **Speaking of advanced biofuels, are companies focused on advanced biofuels technologies succeeding in raising the capital they need to scale up production?**

Paul Ho: The venture capital providers have been very supportive and have invested huge amounts of capital, but the private equity providers are generally not willing to put money to work in the space because there is still too much technology or scale-up risk. But surprisingly, some biofuels companies have been able to skip the private equity stage of their funding and go directly from venture capital to an IPO, much like some technology companies.

While companies would normally need some track record of profitability before going public, to date a half dozen or so new-generation biofuel companies have been able to go public without any track record of profitability at all. Some of the investors are really biotech investors who are comfortable with this scenario. That IPO window, though, seems to have been narrowed significantly due to some recently pulled IPOs.

The addressable market is huge. If things pan out, these public companies will have tremendous production cost advantages. But the problem so far is that not a whole lot of these companies have been able to live up to their promises and achieve their scale-up milestones.

Ernst & Young: **What about strategic money for biofuels? Is there a parallel with biotech here as well?**

Paul Ho: Yes, given the lack of private equity money and the needed check size getting to be in the hundreds of million dollars to build out the first commercial-scale plant, many biofuels companies are turning to the equivalent of the big pharmas in the energy space – big oil companies who are willing to fund a significant portion of the scale-up.

Some companies are trying to position themselves as more than just biofuel companies, but as biochemical or even environmental or pharmaceutical companies, because their engineered organisms are able to synthesize molecules in such a way that you can make different end-products out of them. In these cases they actually do pair up with the big pharmas. In essence, these advanced biofuels companies are replicating what the small biotech R&D shops did in terms of borrowing the balance sheet of the bigger players to validate their technologies.

Ernst & Young: **Looking out over the next five years, what markets do you think will yield the most interesting investment opportunities?**

Paul Ho: I believe that the US market will continue to be attractive, particularly in solar development. The solar investment tax credits are in place at least through 2016, and the cost of PV is expected to continue to fall during this time period. There is a lot of industry support, a lot of utilities willing to sign PPAs, and a lot of developers continuing to build viable projects. Not only will the US market gain from efficiencies in installation practices, but financing and customer acquisition costs are also falling, opening up new sales channels in the residential market.

Northern Europe is still very robust. These countries have a very firm commitment to the EU's 2020 renewable energy target and are fiscally sound.

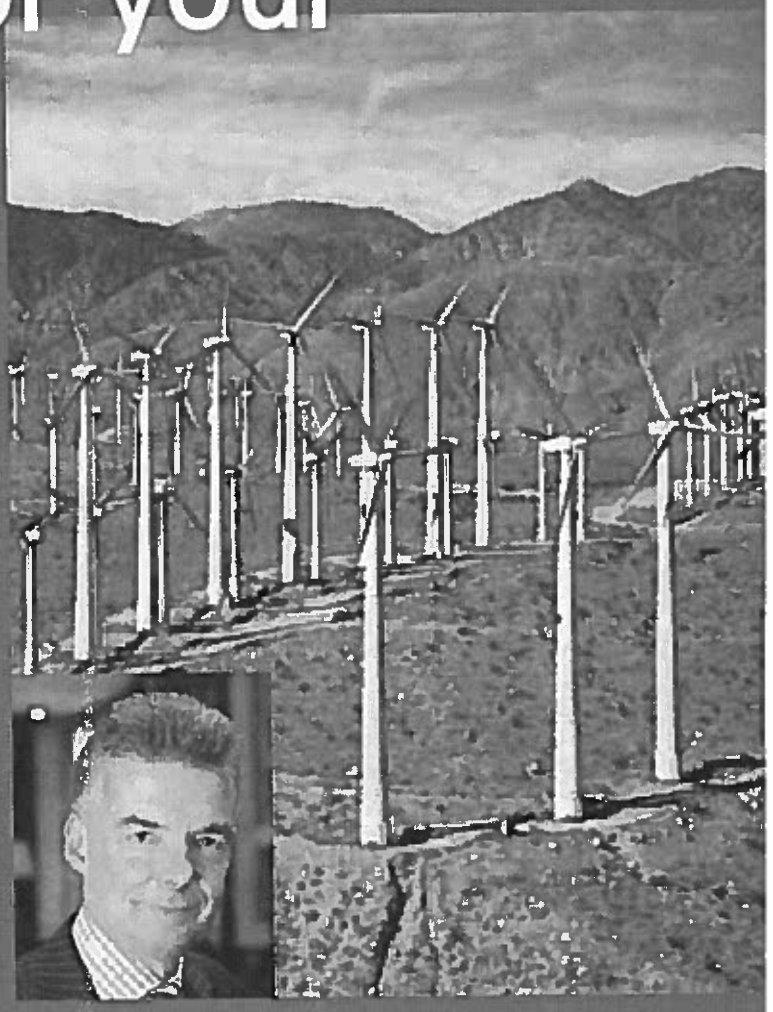
We are also positive on selected Latin American markets, particularly Brazil's hydro, biomass and wind sectors. Chile is also an attractive market given its high-priced power and robust economy.

China has emerged as a leader in the global clean energy market, second only to the US in 2011 with total investment of US$45b. From a developer's perspective, China is hard to break into as a foreigner because the big state-owned enterprises are so dominant. However, we think China is going to continue playing a crucial role in the manufacturing value chain, as well as in project development. It is hard to beat China's low cost of capital and scale, particularly in the basic manufacturing areas like wind turbines and solar panels. Although consolidation is imminent, we expect successful Chinese value chain companies to continue to increase their global market shares. Unknowns include exogenous factors, such as political intervention by way of trade barriers, anti-trust issues and national security concerns related to the electric grid.

But overall, from a clean energy investor's standpoint, the current market malaise provides a unique opportunity to invest at a lower point of the cycle at attractive valuations in many areas. For those who have conviction about the clean energy market and a good read on potential winners, this is a great time to invest. //

Solar and wind – more bang for your buck

by Angus McCrone, Chief Editor, Bloomberg New Energy Finance



Renewable energy – nice idea, but expensive, intermittent, unreliable and immature; better to give our consumers and industries the cheapest electricity we can, by sticking to tried and trusted generation technologies, such as nuclear, coal and gas.

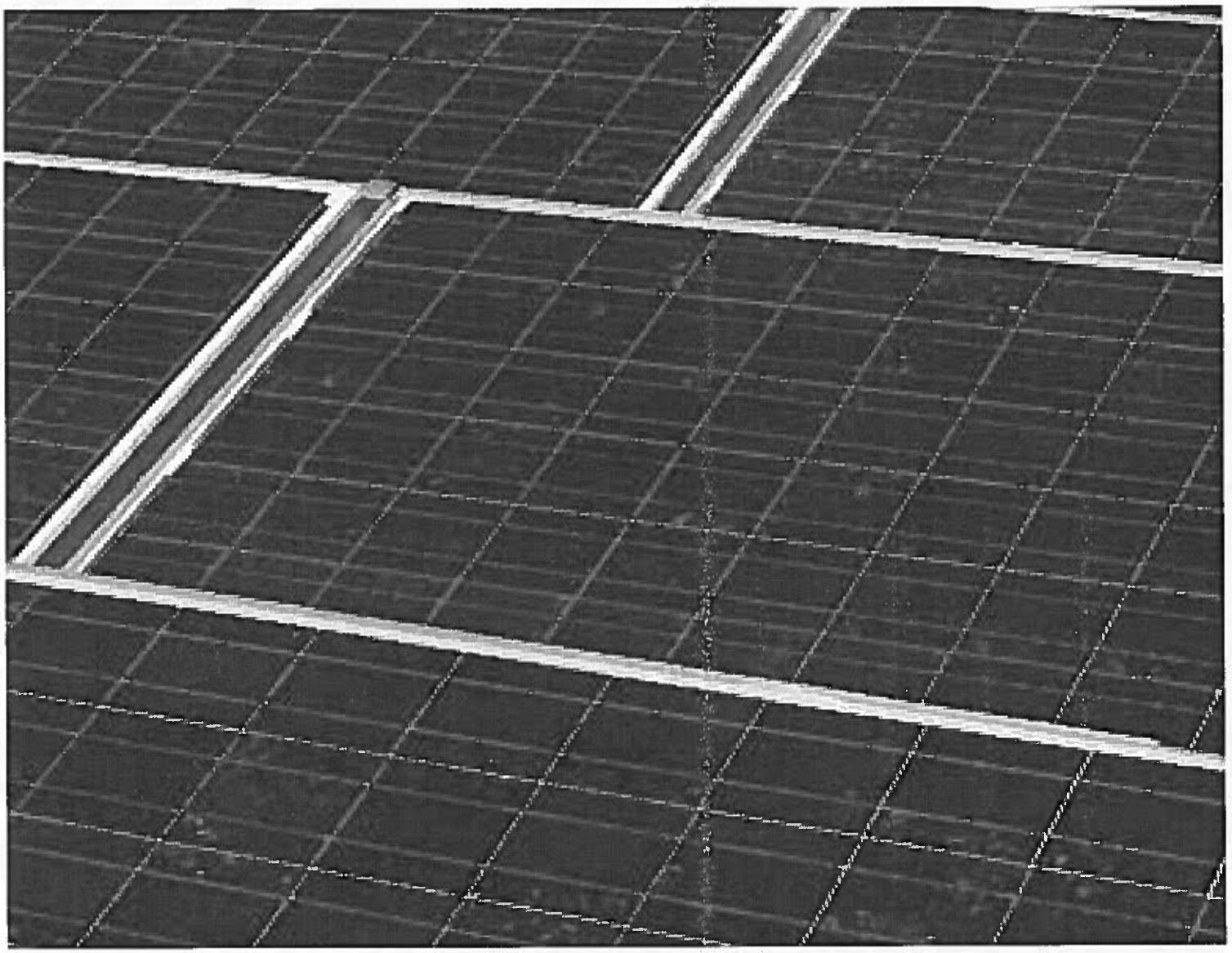
That is a widely held view. Since the economic recovery from the 2008–09 recession started to stumble, it is a line that is increasingly heard from politicians and members of the public.

Ironically, just as that opinion is being voiced more often, the factual foundations supporting it have been crumbling. Renewable power was certainly expensive and immature 10 years ago, but its competitiveness has changed significantly in the last four years – brought about by a combination of technological improvement, economies of scale in manufacturing and low-cost Asian production.

The transformation has further to go, however, and it has not applied to all renewable power technologies. Small and large hydroelectric, for instance, is a mature sector and remains broadly where it has been for decades – competitive with fossil fuels. Geothermal is also mature and can be one of the cheapest forms of generation in the best locations. Wave and tidal technologies are still costly, with dozens of rival devices at the prototype or pilot stage, vying for what could be a big market in the future. Biomass and waste-to-power are types of generation with a wide range of costs per megawatt-hour, depending on the feedstock used and the size of the plant. Offshore wind has seen costs increase recently, as projects have moved into deeper water, but like solar thermal, or CSP, it has the potential to improve cost-competitiveness in the next decade.

The big changes have occurred in the two renewable power technologies that have attracted by far the biggest shares of investment over recent years – onshore wind and solar photovoltaics (PV).

Between them, onshore wind and PV accounted for some US$220 billion of the US$240 billion invested in renewable power and fuels capacity (excluding large hydro) in 2011, according to figures from the Bloomberg New Energy Finance database. By comparison, the amount invested in fossil-fuel generation, including replacement capacity, was US$302 billion last year.



Onshore wind farms vary from the single-turbine projects of one or two megawatts to the world's largest, such as the 600MW Cogealac installation in Romania or the 782MW Roscoe Wind Farm in Texas. PV has even more size variation, from large-scale plants such as the 85MW Montalto di Castro complex in Italy to rooftop installations of just three, two or even one panel on residential rooftops from California to Sydney.

Looking at PV first, because it shows the most striking shift in price-competitiveness in recent years, the cost of a solar module has been in long-term decline since its invention in the 1950s. But in the mid-2000s, this trend stopped for a while. The German, and then Spanish, subsidy programs for PV were so popular that there was severe excess demand in the industry, affecting the cost of everything from polysilicon raw material to ingots, wafers, cells, modules, inverters and installation.

Then, after Spain's generous feed-in tariff expired in the third quarter of 2008, the industry switched suddenly from excess demand to excess supply. Huge amounts of new production capacity, particularly in China, came on stream, and even though world demand was still rising, supply was increasing much more quickly.

Since that third quarter of 2008, the average price of a PV module has fallen by 75% – and the reduction in the calendar year 2011 alone was nearly 50%. This is not quite the same as the cost of generation, since that also includes the expenses of development and installation, operation and maintenance. Nevertheless, according to Bloomberg New Energy Finance's levelized cost-of-energy model, which compares the competitiveness of different generation sources, PV electricity fell by between 20% and 26% – depending on the exact technology used – in the year ending the fourth quarter of 2011.

Nonetheless, PV remains significantly more expensive than coal- or gas-fired generation as a way of producing wholesale electricity. Even if the gap is narrowing, it is still more than twice as costly, on average. However, there are three important factors to bear in mind. The first is that there is also the carbon cost of gas and coal power. This is not imposed on the power sector in many countries, and even where it is, as in the European Union, market prices of carbon

credits appear to be much lower than the real cost of the emissions to the planet.

The second is that PV's competitiveness is expected to continue to improve as the technology matures. Bloomberg New Energy Finance forecasts that the utility-scale system cost of PV, including balance-of-plant, will fall from an average of US$2.65 per watt in 2011 to US$1.44 per watt by 2020. Meanwhile, the costs of rooftop installation are also likely to decline sharply, as panels become easier to link up and teams become more efficient at installing them.

The third, and most significant, factor is that even if the cost of PV power remains well above the wholesale price of electricity, in many countries it is already competitive with the retail price of electricity. This means that households and small businesses will save money if they install PV on their rooftops and use it to generate a part of their own power. This is the case even without subsidies.

According to our calculations, by 2012 this point had already been reached in some countries in Europe where electricity is costly, such as Denmark, Germany, Italy and Spain, and in Australia and Brazil. By 2015, with further cost improvements, it will also apply to France, Israel, Japan and many states of the US.

In onshore wind, the cost shift has been quieter and more subtle. As with PV, there was a period (in this case, up to the first half of 2009) in which wind turbine prices actually increased as demand ran ahead of supply.

However, since then, turbine prices per megawatt have fallen steadily – from €1.21 million, to €0.93 million in the first half of this year, and €0.91 million for turbines already ordered but not due to be delivered until the second half of next year. These figures are given in euros, not dollars, since Europe is a bigger manufacturing center for turbines than the US is. But the decline in dollar terms would be similar – between 20% and 25% since early 2009.

The same levelized cost-of-energy model as used for PV shows that the cost of generating electricity from onshore wind fell 9% in the year ending the fourth quarter of 2011, edging its cost per megawatt-hour closer to that of combined-cycle gas turbines and coal-fired power stations. The analysis of Bloomberg New Energy Finance suggests that wind farms in the best locations are already competitive with coal and gas generation, even without subsidies or carbon prices, and that by 2016, this will be the case with average onshore wind projects worldwide. Similar factors will be at work as in PV, particularly improving technology, with bigger and better-sited turbines, low-cost manufacturing, particularly in Chinese factories, and efficiencies in operations and maintenance.

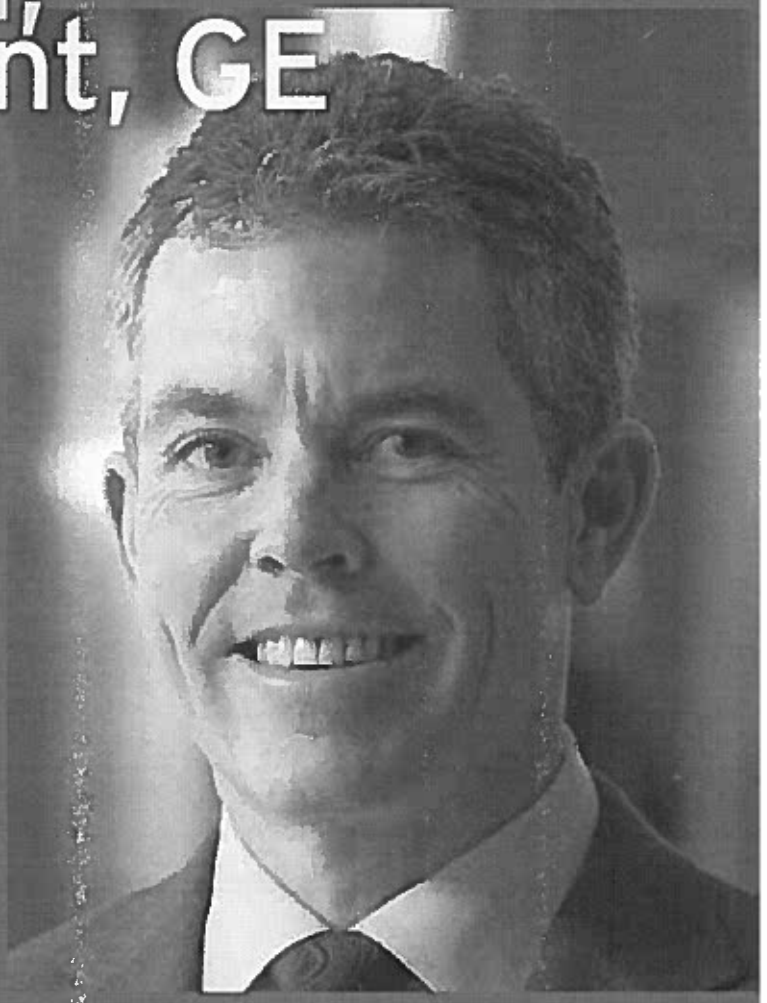
With these improvements achieved, or in sight, why aren't champagne corks popping in the renewable energy sector? One reason is that the same industry changes that have fueled the cost improvements in onshore wind and PV have been painful for manufacturers and their finances – so much so that in 2011, there was a string of bankruptcies in the solar supply chain, and clean energy share prices plunged 40%.

Even more important is that while the long term looks very promising for renewable power, the short term appears uncertain and even troubled. The subsidies that have helped take onshore wind and PV to the brink of competitiveness are under pressure in both Europe and North America, as governments respond to the continuing distress of consumers and businesses four years after the start of the recession. And while prospects for both coal and nuclear power stations look bleak in developed economies, shale gas discoveries in recent years have strengthened the appeal of gas-fired generation – in the US, in particular.

From 2012 onward, it looks like the growth of renewable power will be led not by the European Union or North America, or even by China, which has been by far the largest investor in wind in recent years, but by what used to be called in the sector the "rest of the world."

India was the country that saw the sharpest percentage rise in renewable energy investment in 2011, up 62% to US$12.3 billion, and Brazil was another strong player, with a 9% rise to US$7.5 billion. From Morocco to South Africa, Japan to Mexico, electricity sectors are preparing to make step-increases in renewable power investment – often after carefully absorbing the lessons from Europe and North America on how to ensure the greatest deployment at the lowest cost to the consumer. //

Interview with Mark Vachon, Vice President, GE ecomagination



Mark Vachon, a 29-year GE veteran, Corporate Officer and member of GE's Corporate Executive Council, leads ecomagination, GE's business strategy that has invested more than US$5 billion in cleantech research and development and generated US$105 billion in revenues through 2011.

Ernst & Young: **There have been big changes in the US renewable energy marketplace over the past year. How has GE responded?**

Mark Vachon: To start, the elimination of the production tax credit (PTC) accelerated orders, which in the near term has been fabulous. We will book record sales this year in wind, in part because of that credit. The downside is that the big sales this year point to a slowdown in 2013.

More broadly, in both solar and wind, overcapacity and the retreat of incentives will lead to a shakeout. Would we prefer a smoother industry performance? Yes, but in some respects, the company with the strongest technology and healthiest balance sheet will be best able to withstand the shakeout. Survivors will be well-positioned on the other side.

GE's strength, broadly, is to drive down the cost curve while driving up quality and reliability. We've done it in wind and are confident we can do it in solar too. We are committed to the space and, therefore, plan on being one of the winners left standing when it all shakes out.

Ernst & Young: **GE's growth in wind is an example of how the ecomagination strategy has been a success. What lessons were learned from the effort?**

Mark Vachon: This is hard work. But ecomagination works because it is more than a sustainability initiative. Interestingly enough, something like two-thirds of sustainability-based programs will fail. And the reason they will fail is that there isn't an economic imperative there. GE has always been unapologetic that ecomagination is a business strategy with a commercial foundation. Through ecomagination, we can deliver increased efficiency based on environmental design requirements.

We bring to the challenge great leadership in environment, health and safety compliance. We don't talk about that a whole lot. But we have done some great things in all of these areas. Another strength of ecomagination is that it brings a portfolio of real solutions that have a significant environmental value proposition for our customer base. And there are not a lot of customers or companies that have that third tier of opportunity.

In terms of lessons, efforts like ecomagination cannot be led from the environmental, health and safety (EHS) department. They have to be led by the CEO. For us, Jeff [Immelt] led and supported ecomagination from the very beginning. Those factors are the reason ecomagination has been successful.

Ernst & Young: **Looking ahead into the next year or two, will there be any changes to ecomagination in terms of focus on R&D or investment?**

Mark Vachon: The level of resource commitment won't change. GE has a public commitment to spend US$10 billion from 2010 to 2015 – that's double the prior five-year period. Geographic priorities will continue to shift. I have been in the role a year and a half, and I have spent most of my time outside of the United States, whether in China, Australia or Canada. In the US, one of the macro dynamics is the natural gas revolution. This is creating consternation, of course, as a threat to renewables. But it's also a huge opportunity. Europe remains a focus – particularly as a regulatory leader. And we will focus on Brazil too.

Ernst & Young: **How is the natural gas rush affecting your business?**

Mark Vachon: Given our commitment to renewables, it may seem counterintuitive, but the gas boom has the potential to be positive. Last year, we announced our Flex 50 gas turbine, which was developed using technology borrowed from our aviation business. If you fly planes, you know the importance of flexible capability. Being able to power up a jet engine and then throttle back is similar to the challenge facing a utility that has to ramp up a turbine in less than 30 minutes to pump out significant megawatts. This is a perfect solution to help balance out generation when the wind dies down and wind turbines stop spinning. The shift away from other fossil fuels that aren't as clean as natural gas will be really important too.

Ernst & Young: **As you travel, what are the key issues in other markets?**

Mark Vachon: It varies by region. In Germany, when you decide to exit nuclear, you get a huge generation challenge that will probably result in more distributed energy. When you look at Australia, we believe the pricing of carbon will hold there, even as the government changes, and that means more renewables.

In China, it is all the above with coal at the center and a growing commitment to renewables and nuclear. We will certainly do some experiments in electric vehicles and continue to push renewables there. But, if we can get the gas mix there up substantially, that will help them. That's certainly part of Beijing's 12th Five Year Plan.

In Brazil, you'll find more biofuels as a mix of priorities. In Canada, the challenge is how to manage the oil sands and other resources in an environmentally sensitive way. Here in the US, with shale gas, the question is, how do we manage the water challenges associated with that while tapping into an amazing resource.

Ernst & Young: **How have the financial crisis and economic recession altered concerns around climate change, renewables and efficiency?**

Mark Vachon: We believe in climate science. At GE, we made that decision seven years ago and have been acting on it since. Yet, in the broader community, what you find is those who want to keep pounding the climate change science drum are losing credibility. That's because they're pounding the drum, but are not acting.

Our belief is: let's get busy with the answer. Whether you believe in climate change or not, resource efficiency is a classic business productivity focus that has always been relevant. Customers are very interested in that conversation no matter what their take on climate change. To the extent that climate change can lay a heavy burden of "saving the world" on a conversation, we lose time and we lose focus on real solutions to real problems.

When I was in Brussels a few weeks ago, meeting with the EU Commissioner of Environment, they were saying the same thing. They have the same market focus as GE on energy efficiency. So I think if there has been a shift away from climate change and toward efficiency, it would have happened even without the economic downturn.

Ernst & Young: **Another effect of this crisis has been the retreat of government leadership on some energy and environment issues. Have we seen a shift in the role business must play?**

Mark Vachon: Yes, business increasingly needs to be the leader. That's about innovating and delivering solutions that speak to the reality of constrained resources, regardless of government engagement. We are planning on very little government role. That said, this will cycle over time. In five years or so, the momentum may have returned to the government.

Ernst & Young: **The market difficulties of the past few years have meant a shortage of capital and the need for new funding models. How do you see the capital drought playing out in the energy space?**

Mark Vachon: We play in this space through Energy Financial Services, which does a lot of project financing. In this area, I think the opportunities will be fewer and more focused near term, but we will still play there. We do equity investing as well, and we will continue to do it. We've also developed a competency in crowd sourcing new innovation in this energy space through the ecomagination Challenge. Our role there will continue to identify and cultivate new ideas.

More importantly though, there is huge pent-up demand for later-stage financing among venture-capital-financed energy start-ups. The phone calls that are coming in to us are increasingly voluminous and desperate. I think there is going to be a bit of a crash on some of the stuff that has received early funding, but that can't find mid-stage capital. There's certainly going to be a lot better deals, and I think corporations such as GE will be natural

potential partners. But in considering acquisitions, we will be very selective.

Beyond money, I would also say we have a real ability to help develop these ideas through a phase of reducing their technology risk, and also help debug their business models. Through our ecomagination Challenge, we help accelerate innovation by providing a bit of money and actually working with our partners to get them to scale faster.

Ernst & Young: **Given instability in the Mideast, we've returned to a time of heightened anxiety around oil supplies, as well as renewed worries about nuclear in the wake of Fukushima. What are you seeing among your clients in terms of energy strategy?**

Mark Vachon: Talking about this globally, it's a challenge to move individual wedges of the total pie of energy use in any short period of time. But looking at what's in motion, I think gas will take a bigger share in time. Renewables will continue, if not as robustly as in the past. Nuclear will certainly go sideways for a while.

Stepping back a bit further, thinking about the long term in our lifetimes and our children's too, the world will continue to be based on fossil fuels.

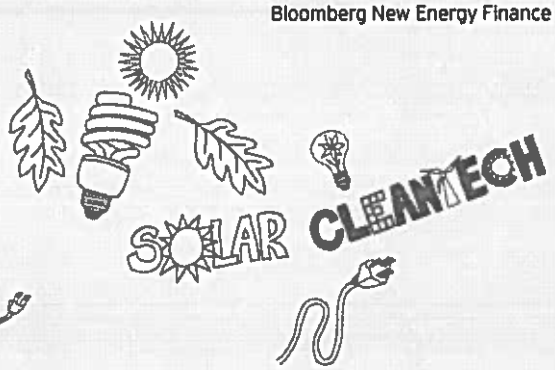
So at GE, through our ecomagination strategy, we're looking at how we help manage that reality in terms of extraction, distribution, utilization, re-use. We're at work on the innovations and technologies that we can apply to make this as environmentally productive as possible. //

Capital roundtable: key trends in the cleantech value chain

Michael Liebreich
Chief Executive
Bloomberg New Energy Finance

Our annual roundtable discussion among investors and market observers on key cleantech trends covered a range of topics, from technology cost curves to the growing role of emerging markets in investing and innovation, to new financing structures and utility business models.

Moderator
Gil Forer
Global Cleantech Leader
Ernst & Young



Gil Forer: **What has changed over the last year across cleantech segments and globally?**

Michael Liebreich: Today brings better costs and efficiencies, particularly in wind. Demonstration projects are also moving beyond experiments.

Sure, the bloodbath on the solar supply side is bad news for investors in assets with decimated valuations. The real story, however, is the dramatically and permanently reduced cost of equipment, which is good news for installers. As Foxconn gets into manufacturing and the Chinese scale up silicon manufacturing, this curve of 18% to 19% will continue. It's Moore's Law.

Our analysis also shows that wind turbines now yield far more than before. In fact, between 1984 and 2010, wind farm yields grew to 34% percent from 22%. The first 7% experience curve gain – the price per kilowatt hour of turbine capacity – stems from longer blades, better electronics, better power conversion and taller towers, just as wind turbine prices fell at 7% per doubling. Thus, cost reductions and performance increases add up to a 14% experience curve for wind, not 7%. So for a 100-megawatt wind farm, that price is a turbine cost indicator. And the press and politicians totally missed it.

Moreover, a lithium ion battery price crash looms for the same reason solar crashed in 2008 – far more investment on the supply side than the electric vehicle industry can absorb. EVs are limited by consumer behavior, range anxiety and subsidy levels, resulting in battery overcapacity. Also, LEDs are coming of age.

Finally, many next-generation fuel demonstration plants are hitting proper scale. They're no longer lab experiments on kitchen tables, but real plants. Learning from those demos will follow, along with talk about the next set of plants, which will be much more competitive with gasoline prices, without subsidies.

Stephan Dolezalek: New this year are perceptions lagging reality as they concern costs, more interest in LED and storage and a looming retrofit boom. Solar panel prices have fallen to levels far below those

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anticipated by the markets. So while we focus on negative European tariff developments and continued economic woes, we've overlooked how cheap some technologies are and will become. But beyond lower solar panel costs, with US$2.60-a-watt installed prices in Germany, the balance of systems has also come down dramatically.

Add in rising oil prices, which could again rejuvenate cleantech or drive economies further into the ground, and it's impossible to know if this is good, bad or indifferent. Other uncertainties stem from technology learning curves and how much manufacturing scale will push prices to rational levels.

So with solar, most assumed we'd reached the scale required to drive costs down. But higher manufacturing supply in China and elsewhere over the last 18 months has pushed prices through the floor. The press completely missed that.

As for segment moves, massively more money and time are spent on power storage on the heels of more wind and solar power. Though the storage learning curve is a few years away, the increased attention and research on storage is starting to tilt the learning curve in the same direction. This is a game changer because it enables dispatchable wind and solar power. Moreover, LED or solid state lighting is rapidly following that same curve despite the US undoing the incandescent light bulb ban.

Finally, we're entering the enterprise software phase for lighting, HVAC retrofits or whole-building energy. Costs have fallen enough with sufficient deployed nodes so that managing those intelligently may suddenly produce a much higher return than was possible even two years ago. This other accelerator was dependent on first driving hardware prices down.

Gil Forer: **What has the impact of emerging markets been?**

Stephan Dolezalek: We see the increasing importance of investment in and innovation by developing countries. We need to rethink the developing world as the growing world and G8 countries as non-growing countries.

Country development banks are fueling big changes. Flush capital in China, India, the Middle East, maybe even Brazil, will help scale technologies there, so they will own these technologies. The resulting balance-of-power shift will push many of us into the middle of that battle, which dwarfs efforts in private finance. Thus, pension assets are shifting toward countries with greater political certainty and political support for new infrastructure assets. This further exacerbates the movement of capital from the US and Europe.

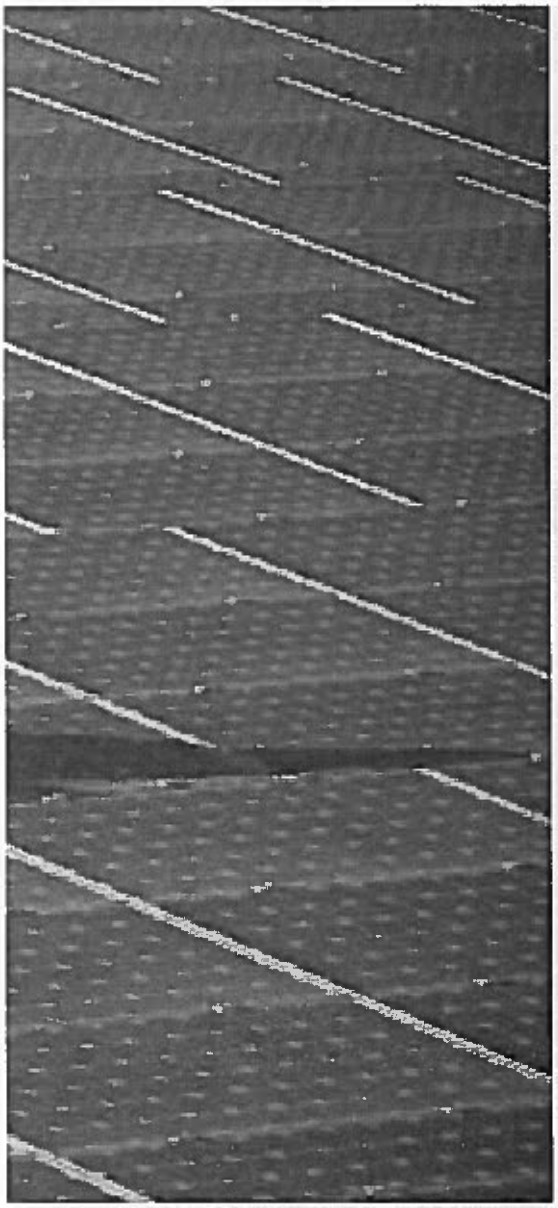
Mark Fulton: Incentives occur in many different forms. Beyond feed-in tariffs and tax equity is a huge amount of cheap debt from global development banks, including Chinese state banks.

So while we focus on falling costs, the supply buildup and the whole cost-cutting push, many technologies globally are at end phase and still require some government support. Brazilian wind, for example, wouldn't be possible without BNDES [National Bank for Economic and Social Development] financing.

Michael Liebreich: To Stephan's point about developing vs. developed, many smaller markets are putting in interesting volumes. The Ukraine's solar installations of 200 megawatts are nothing compared to Germany's. But just seven years ago, that was Germany's market.

This reflects a much larger shift in overall capital flows. I reckon we're in a prolonged recession because in 2004, the developed world spent roughly US$200 billion on oil and gas. That flowed back to European luxury goods and investment in America then. Now, our US$800 billion spend returns to Asian manufactured automobiles and investment. We're losing financing capital of up to US$800 billion per year. That has a huge macro effect.

So Mexico, Chile, Kenya, South Africa, India, other parts of Southeast Asia, Thailand and Vietnam are now markets. Add in North Africa, Morocco and Egypt, and it's significant. Since these countries are not primary manufacturers of renewable equipment, they benefit from cheap supply and huge competition.



Gil Forer: What is your assessment of the cleantech investment climate?

Mark Fulton: The continued and accelerated squeeze between policy incentives and cost reductions, between investment and deployment, is altering the playing field. What's new is the accelerated pace.

US incentives are under severe pressure amid pushbacks in other markets. Feed-in tariffs are being cut aggressively. Meanwhile, uncertainty persists in the capital markets. That leaves an investor skittish about the next two to three years. So banks, fund investors, pension funds and insurance companies view cleantech as more uncertain, short term.

Investors want to ensure financially feasible projects. They're very careful about where they place their bets, particularly linked to incentive changes versus costs. Thus, project financing must be planned very carefully. That's pushing cleantech companies to fine-tune incentives, to accelerate them and to be in the best markets at levels nearing commercialization.

But the strategic investors, corporations and development banks with potentially deep pockets are charging ahead.

Banks are also exploring the securitization of the project-debt market. Debt markets still account for roughly 70% of project finance. That's where the action is. So a better way to reach debt markets for better liquidity and rates on renewables would be significant.

In the medium term, risk aversion will shift toward a good, balanced risk-adjusted return.

In the US, as a result of grant programs, several years of projects were able to monetize much of their tax, some at fairly attractive cash yields. So this year, I'm hopeful that we'll see the entry of US and Canadian retail investors to provide equity financing for wind and solar projects.

These very attractive yields may drive down costs even further because of the cheaper cost of equity. For example, Canada's Brookfield Asset Management merged its renewable power fund's hydro and wind assets into its Brookfield Renewable Power subsidiary. Many consider that asset a good comparable for future vehicles. This year, some companies may follow. It will probably begin in wind. But more scale in the solar sector and projects coming on line and yielding cash will open up previously unavailable pockets of capital.

Brian Bolster: Between oversupply and current demand, the market isn't acting irrationally as it considers allocating capital for solar and wind. But capital for new technologies falls in four buckets: government and development banks, strategic investors, public equity and private equity.

Views among private and public equity are linked. If the public equity market and strategic investors aren't there to provide an exit, private equity gets skittish. The biofuels and biochemical markets are an interesting example. For many of our companies that IPO'd over the last two years in biofuels and chemicals, it's too early to know if investments were successful because two- to three-year time horizons are required. But the public market has lost patience and sold them off. As a result, in that sector, the private market is getting more selective.

Interestingly, at the same time, strategic investors are getting more aggressive.

Michael Liebreich: Amazingly, financings keep getting done. Last year was a new record. But there's far more risk aversion. It's a very discontinuous period. So incumbents are fighting back.

The era of large-scale subsidies is over; it's gone. Distortions, regulatory constraints and bottlenecks will always exist. But the idea that a wind farm can earn 75% of its money from renewable obligation certificates and one-quarter from electricity sales makes it unbelievably politically risky. Around 40% is much more reasonable. So subsidies will be much lower, approaching the tenths, if not the hundredths of a percent level.

Generally, there's a lot of nervousness. Look at Greece, Iran and uncertainty around next-generation biofuels technologies. Or the US election. Less risk aversion is unlikely.

This perception that the industry is subsidy dependent – the fight to retain subsidies by policymakers and non-specialist investors and the assertion that survival is impossible without subsidies – enormously increases risk perception. The industry has to get serious, grow up, and understand that subsidies are transitional and minor and must be justified monthly and by sector. There are no free lunches. The industry would do itself a favor to take this onboard. Don't fight that trend – go with it and lead it.

Gil Forer: How can we unlock or create the right breakthroughs to enable capital flow from the sidelines into investment?

Michael Liebreich: What would unlock capital? Many with a Western and investor-centric view see the industry rushing out of control, particularly in countries where it is difficult to make money. So they ask, "How do we advise our clients how to play this?" Because a Chinese turbine with BNDES financing doesn't help Western investors.

But the interesting, though boring, story is a shift in utilities. More Warren Buffetts and money created, more sources, buckets – private and public – now own infrastructure. This shift from traditional pension fund ownership of power infrastructure in a utility, or a bucket with layers of management and many assets, is huge.

Now, suddenly, utilities lack balance sheets. Bundled assets differ from utilities in their speciation. Old ones are stressed as lucrative revenue is siphoned off to rooftop solar while new, ruthless, strict, agile utilities – so-called "infrastructure funds" – are slowly replacing them, be they a bundle of solar or solar and wind assets or coal-fired, fossil fuel power stations. The traditional generator business model will explode. The utility, the distribution-transmission grid operator, may protect it. But investors wouldn't want to own any fossil-fuel generating capacity in that scenario.

A pension fund considering maintaining energy sector exposure can put money in revenue-losing fossil generators or utilities with big capital requirements and falling yields – or new investment vehicles holding clean assets.

Today, nobody cares about yield, just capital protection and inflation. So wind farms yielding 7% put them in Danish Government bond territory. But liquidity is the issue. You can sell Danish Government bonds quickly. But not a wind farm.

Mark Fulton: Pure renewable energy infrastructure funds exist. Many have renewable parts in their mandates beyond PE to operating infrastructure. So they can hold renewable projects. But a massive, mature, renewable infrastructure fund launch hasn't happened. The long-term development of this infrastructure asset class and rising interest in infrastructure plays by investing institutions globally versus very low bond rates are promising.

After the venture capital and private equity stages, these are infrastructure plays. Good stable assets performing well in long-term contracts should be very attractive to infrastructure investors, meaning pension funds, insurance companies and high net worth individuals. But risk aversion prevails. Those "in the know" – corporate insiders and developers – get it.

Another interesting financing structure is energy service agreements. These help overcome barriers to the retrofit market to finance energy efficiency projects without incentives or subsidies. However, to reach commercial breakevens, digging into project finance is critical.

The middle ground could offer infrastructure-style returns with lower risk and decent long-term contracts and yields. Some portfolio holdings must be longer term. Bigger institutions do asset-liability modeling. That means long liabilities must match long assets. Pension funds have long liabilities, so they need assets with a decent yield.

Gil Forer: **How are utilities reacting, and what is their future?**

Stephan Dolezalek: Utilities are stuck in the paradigm of providing expensive peak power to customers who on a net metered basis essentially pay nothing. So if utilities overcharge for connection fees, that same customer moving to solar rooftop panels will add battery storage to self-serve through the peak. Add an EV, and connection charges in this market will drive them completely off-grid.

Which begs the question: can demand response be more valuable than gas peaking plants? That financing equation is very interesting. It's more valuable to the utility and cheaper to implement. Sufficient volume to manage intelligently is critical. But if used as a substitute for gas peaking, this crosses over to the smart grid.

Today, some utilities are seeing close to 50% of their most lucrative customers switch to solar. It's similar to the experience of telecoms, supplying landlines over the cellular switch. They began forcing connection charges. Today, many utilities are waking up to this reality through connection charges – because they are getting stuck.

Michael Liebreich: It has been an acid-test period for smart grid companies. Stimulus funds were launched in 2008, so 2009 to 2011 was a golden period for smart grid companies to find utilities, get regulatory approval and create programs. It was like a slot machine – the money just came out. With stimulus funds largely spent now, that scenario is no longer the case. Hardware costs have fallen sharply, but companies must now be able to get real clients for real technologies. Some will manage it domestically or go overseas or won't make it. A reality crunch is coming.

I don't have a landline. It took me 10 years from my first mobile to forego a landline. When will utility customers say, "With these batteries, we're better off off-grid"? There's an ignition point, linked to demand response. Today, marketing and integrating the option make sense.

Brian Bolster: Certain US utilities are ill-prepared for the upcoming revolution.

A utility's eroding rate base, rising costs and falling returns are not attractive to investors. Moving power from A to B with aging infrastructure requires more capital – not counting energy efficiency improvements. This utility must invest more for a basic standard of service. In tandem, customers use less power, resulting in higher fixed charges with lower usage. The result will either be higher prices or lower returns.

I would not want to be a utility in California now. The state is relatively isolated from an interconnection perspective, so it's not easy to wheel power into California. Add in a high solar and EV penetration, some wind, the economics of solar, plus smart grid issues, and executives accustomed to a central station model – producing and shipping power in a very straightforward way – are facing a very different world.

Gil Forer: **What do you expect in the coming 12 to 18 months?**

Mark Fulton: We will increasingly return to a more normalized investment scenario as risk aversion falls and investors pursue well-balanced risks and returns. That suits both the renewable and the energy efficiency markets, which will attract investors, even with the liquidity premium.

But this will occur in markets and geographies with subsidies at 30%, not 70% levels. Investors will still favor markets with TLC: transparency, longevity and certainty.

Brian Bolster: As oil prices rise, interest in the so-called "biomass conversion" – biomass to fuels or to chemicals – will rise. Oil prices are moving in the right direction.

Several companies will try to scale up those technologies. Successes will generate excitement in the capital markets. Also, this year, solar will start to rationalize itself, buoyed by trade disputes.

Michael Liebreich: A bias against innovation and risk-taking, linked partly to career risk for portfolio managers, will persist. We face a few difficult, nervous and jumpy years, until roughly 2014, when things become blindingly obvious to the dumbest of the dumb – that certain things work and some don't; that some are cheap and some traditional companies are in trouble. A tectonic-plate shift will follow. But not this year.

Stephan Dolezalek: Everywhere, globally, the pace of change is accelerating. It's odd that the country that was all about pioneering is now afraid to take risks. Not taking risks stems from a massively conservative view at a time when the single most important thing is to change rapidly. While we fail to take risks, much of the game simply moves elsewhere. //