



REPORT

UK

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Conservation

Climate change

Sustainability

Green game-changers

business innovation is flowing in the global economy

INNOVATION FOR RESILIENCE IN A FAST-MOVING WORLD

WWF is at the heart of global efforts to address the world's most important environmental challenges. We work with communities, businesses and governments to help people and nature thrive. Together, we're tackling climate change and encouraging others to act as stewards

of forests, rivers, seas and other natural habitats.

2015 will be a critical year: it's when plans should be put in place for the UN's new Sustainable Development Goals and the elusive global climate deal. We believe that the business community has a crucial role to play in building the stepping stones that will ensure the required level of ambition is achieved in 2015. This will increase the likelihood of governments catching up and providing the long-awaited certainty and policy support that will enable businesses to perform successfully within global natural limits.

In the meantime, the more enlightened businesses are seeking to future-proof themselves over the long term by aiming to decouple business growth from increasing environmental and social damage, eliminate negative impacts, or even generate restorative/net-positive impacts. Others are going even further, innovating entirely new resilient ways of working, and exploiting the opportunities in global trade around solutions that tackle pollution, congestion, resource scarcity and other international challenges. We remain optimistic that many global solutions will come out of the creative parts of the private sector. We continue to work with those companies that have the foresight to transform business for the future.



Verdantix is an independent analyst firm. We provide independent data, analysis and advice to help our clients resolve their energy, environment and sustainability challenges. Through our global primary research and deep domain expertise we provide our clients with strategic advice, revenue generating services, best practice frameworks, industry connections and competitive advantage.

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ASIA – THE LAND OF OPPORTUNITY AND INFLUENCE



“I’m very pleased to release our fourth annual Green game-changers report. Previously, we’ve looked at small start-ups that have the ability to disrupt whole sectors and multinationals that are starting to innovate in significant ways. We’ve worked closely with the Verdantix team to produce this latest collection of innovations, which demonstrate the opportunities for western and Asian firms to learn from each other and collaborate around solutions that tackle various regional, national and international challenges.”

Asian innovations are already sending ripples across the globe.

In China, centralised green policies are accelerating thriving green businesses and clean technologies for the nation and beyond. For example, in 2013, the Chinese

government deployed a policy to offer almost \$10,000 to buyers of electric vehicles (EVs), boosting further those firms such as BYD that have already become giants in manufacturing EVs and batteries. China plans for strong growth in domestic EV sales but also has ground-breaking technology for light and heavy-duty EVs for export that will have implications for the global automotive sector.

India is well known for its entrepreneurial spirit, so vital for building resilience in the face of fast-moving global challenges. Entrepreneurs are embracing ‘frugal innovation’ across the country to achieve more with fewer resources. The Economic Times in India reports multinational businesses have set up over 750 research and development centres over the last two decades to drive innovation for both local and global markets.

In Bangladesh, bottom-of-the-pyramid micro-finance services are highly unconventional and successful in their methods. Borrowers are not required to provide collateral in the traditional sense in order to secure loans. And yet the instances of successful pay back are extremely high, achieved through obligations placed on individuals by the wider community. This model is expanding westwards and also linking up with the financing of micro-renewables.



Asian innovations
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the globe.

There are incoming Asian innovations of this nature to adapt to and work with. There are also export opportunities for western businesses that arise from efforts across Asia to solve pollution, congestion, resource scarcity and other challenges. China is on a big push to cut pollution by cleaning up its transport and energy sectors.

An example of a major opportunity is where some businesses are seeking to electrify the tuk tuk, which could make a huge contribution to cutting smog in Asian cities. And western-born clean tech, car-sharing schemes and various other kinds of solutions are spreading eastwards.

The massive expansion in on and off-grid renewable energy in India and China is an area that presents new avenues for western renewables providers that can bring unique expertise to complement Asian home-grown initiatives. Californian-based firm Solaria is such a business establishing operations in China.

Businesses in Europe and other parts of the west are adapting to incoming innovations and/or exploiting more innovative approaches to business growth in Asia. The green economy has much to offer to those firms that make the most of innovation flows between Asia and the west.

**Dax Lovegrove is head of business sustainability
and innovation, WWF-UK**

INTRODUCTION

The purpose of this report is to highlight green game-changing innovations that are flowing to and from Asia, to inspire and trigger action by firms in the west.

This review follows on from 2012's Green game-changers report, which looked at the adoption of innovative sustainable business models by large companies. And in 2011, we brought to the fore worldwide sustainability innovators with the potential to scale up into game changers. This year we have honed in on green innovations that are flowing between Europe and other parts of the west – and Asia, to draw a parallel with other economic flows between these regions.

Asia's environmental challenges are well documented. Unprecedented smog in China, blackouts in India and floods in Thailand have made headlines the world over. Simultaneously, Asia's role in the global economy is growing phenomenally, with both China and India in the largest 10 global economies and expanding considerably faster than western economies: China's economy doubled in size in just seven years, running up to 2012. This has led to predictions of the emergence and growth of a 630m-strong middle class by 2022, consuming goods and services valued at \$3.4tr according to McKinsey. Such market potential does not leave western firms indifferent.

Labour outsourcing, low-cost manufacturing, and low-cost transport through containerisation are three business trends that have further deepened the economic links between continents – in addition to the complex global supply chains that are a feature of many of the world's largest multinationals. Finally the 'age of information' has made it easier than ever to access new products and services to import, license or adapt – while simultaneously tapping into new markets abroad. These trends open up considerable new opportunities for local innovations to achieve global applicability, flowing both to and from emerging Asian markets.

As such, Asia concurrently presents both potential disruption to western firms, in the shape of new Asian multinationals with innovative models and solutions, and opportunities for western firms in new markets.

This report highlights some of the green game-changing innovations that are moving from Asia over to Europe and other parts of the west, with the potential to disrupt incumbent companies. We also feature examples of the opportunities for firms in the west to enter new markets in Asia.

Methodology

This review is based on primary and secondary market research including:

- A desktop research review of innovations happening worldwide
- The application of screening criteria (see Figure 1)
- In-depth interviews with some of the companies involved in the innovation case studies and with experts in the field

The 16 case studies have been organised by the flow of innovation, whether it is from Asia to western markets or vice versa. Within these two groups, the case studies are further categorised as in previous Green game-changer reports by the type of sustainable innovation they exemplify: dematerialisation, open loop, renewables and low carbon, or restorative/net positive.

Figure 1. Innovation screening criteria

KEY QUESTION	CRITERIA	DEFINITION
IS IT SUSTAINABLE?	Does it achieve one of the four key environmental benefits?	Dematerialisation – business products, services or processes that dramatically cut the use of natural resources
		Open loop – where one company's waste is turned into another's resource
		Renewable energy and low carbon – innovations supportive of a move towards WWF's call for 100% renewable energy future by 2050
		Restorative/net positive – innovations related to net positive environmental impacts, e.g. the restoration of forests, wetlands, biodiversity and watersheds
IS IT A GAME-CHANGING STRATEGIC INNOVATION?	Can the innovation be replicated?	The innovation should be roughly replicable by other companies, allowing whole industries to move towards more sustainable business models
	Is the innovation at scale or does it have the potential to be scaled up?	The innovation should be at scale, or have the potential to be scaled up to a game-changing innovation
IS IT FLOWING BETWEEN ASIA AND EUROPE/NORTH AMERICA?	Does it threaten to disrupt incumbent firms in Europe and other parts of the west?	Potential disruptions by Asian companies in European and other markets
	Does it open up opportunities for western firms in Asia?	Opportunities for western companies in Asian markets



ISTOCKPHOTO

Innovation flows are increasing across the global economy.

Figure 2. Summary of case studies

INNOVATION	INNOVATORS	INNOVATION FLOW	INDUSTRIES	TYPE OF INNOVATION	PAGE
Water-free supply chain innovation disrupts global apparel firms	Yeh Group; Adidas	From Asia	Textiles	Dematerialisation	15
China's astonishing sustainable buildings are ready for international imitation	BSB	From Asia	Construction	Dematerialisation	18
Frugal innovation in India inspires radically sustainable products	Vortex Engineering; GE	From Asia	Various	Dematerialisation	21
Cash for consumer recycling scheme creates replicable economic incentives	Wongpanit	From Asia	Recycling	Open loop	22
Energy stress challenges lead to clean tech business model innovation	Suzlon Energy	From Asia	Energy	Renewables and low carbon	25
Micro-models create inclusive green economies	Grameen America	Mozambique	Biofuels	Renewables and low carbon	26
Chinese experience with electric vehicles reaps benefits in the US market	BYD	From Asia	Transport	Renewables and low carbon	28
Innovative 'payment for ecosystem services' in China achieves restoration at scale	China	From Asia	Various	Restorative/net positive	31

INNOVATION	INNOVATORS	INNOVATION FLOW	INDUSTRIES	TYPE OF INNOVATION	PAGE
Car sharing set to take off globally	iCarsClub; Zoom; 1hai	Towards Asia	Transport	Dematerialisation	38
Opportunities heat up for the circular economy in China	Teijin	Towards Asia	Textiles	Open loop	41
Upcycling meets mass production to create new resource opportunities	Aus Design; Beximco; Trash To Trend	Towards Asia	Textiles	Open loop	44
China's investment in renewables sparks western interest	Solaria	Towards Asia	Energy	Renewables and low carbon	46
Convenient off-grid solutions are solving energy and pollution challenges	BioLite	Towards Asia	Energy	Renewables and low carbon	49
China's commitment to EVs opens doors for innovation	Tesla; Detroit Electric Co; Geely; General Motors	Towards Asia	Transport	Renewables and low carbon	52
Pockets of strategic 'net positive' innovation pop up in Asia	BT; IKEA	Towards Asia	Various	Restorative/net positive	54
Huge market opportunity for restorative, clean-air solutions in China	Philips; IQ Air; Blueair	Towards Asia	Clean tech	Restorative/net positive	56

ASIAN INNOVATIONS FLOWING WESTWARDS





ASIA'S SUSTAINABLE INNOVATIONS THREATEN TO DISRUPT DEVELOPED ECONOMIES

Western companies tend to think of China or India in terms of well-established clichés: as places where fierce competition in markets have led low-cost manufactured goods to take precedence over innovative practices and business models. Yet Asian companies have innovated in different ways from their western counterparts, in the

drive to solve their local challenges.

Both governments and companies in Asia are experienced at dealing with resource scarcity. Why? Fast population growth has resulted in very high regional population densities – nine of the top 10 most densely-populated cities in the world are on the Asian continent – while natural resources available per capita have shrunk commensurately.

Out of this experience, great examples of disruptive dematerialisation have emerged. In the textiles supply chain, Thai supplier Yeh Group's dry-dyed fabric is achieving global scale via its relationship with Adidas. In the green buildings sector, Chinese firm BSB has created a franchise model with the potential to disrupt the western construction industry. Meanwhile numerous firms have seized on India's concept of *jugaad*, or frugal innovation, to completely rethink production using radically fewer resources. These products and services, based on the principles of dematerialisation, will compete in western markets based on both sustainability and economic criteria.

The concept of 'open loop' has arisen in Europe and, as such, examples are less prominent in Asia. But there are pockets of successful open-loop programmes happening in Asia to which European and American firms should take heed. Management consultants McKinsey and the Ellen MacArthur Foundation launched a report in January that estimates the global economic potential for the consumer goods sector alone to be \$700 billion. Industrial symbiosis, discussed in previous reports, has been implemented at scale in China. In this report we look at economic incentives for recycling provided by Wongpanit in Thailand and export of such practices to developed countries.

In the renewables and low-carbon space the local conditions have fostered new models that are relevant in the west. Micro-finance company Grameen has made two interesting advances. First of all it's shown how to apply its core concepts of micro-loans and mobilisation of talent 'at the bottom of the pyramid' to the implementation of renewable energy in Bangladesh through its subsidiary Grameen Shakti. Then by launching the Grameen Foundation in the US, it's demonstrated that micro-finance can be highly relevant in western countries, thereby opening the door to fresh thinking on how to finance the roll-out of renewables.

In a further case study we look at the role of organisational factors that have helped BYD to deliver innovation to three different markets as part of a vertically-integrated model, supporting BYD's ability to compete directly on the business case for EVs in the US public market. Finally, firms show how radical business transformation – such as Suzlon's move from garment manufacturing to renewable energy generation – has been possible in emerging markets. These examples demonstrate how responding to volatile prices and energy security concerns – which are currently issues for major western companies as well – can lead to new business models.

Rapid urbanisation, economic growth and population booms are taking their toll on natural ecosystems and so the environment is rising up the agenda in many Asian countries. Extreme air pollution in Beijing and New Delhi, potable water availability in India, and desertification and water stress in northern China have caught the attention of both companies and governments. This is evidenced by innovations like payment for ecosystem services (PES), which links economics with natural resources.

China's PES projects represent the largest effort in China for environmental innovation, with 61 active water basin payments valued at \$7.5 billion. As businesses globalise and seek to rely on natural assets in new markets, emerging methods of protection and restoration will become increasingly valuable, particularly to forward-looking companies: discussions around the licence to operate become much easier if companies can demonstrate positive impacts.

"When we started we thought this would be a good product for emerging markets in Asia and Africa. Now we're seeing interest from companies in Europe and the US in frugal innovation, but it is for different reasons. Companies there are interested in this as a green product. In India it's simply a necessity."

Vijay Babu, CEO, Vortex Engineering

"People have changed their behaviour and their perceptions towards waste. This has so many benefits, economically, socially and environmentally."

Wimonrat Santadvatan, international coordinator, Wongpanit

"We've got these contracts because the technology and the model just don't exist in the west. This breakthrough innovation will transform the market."

Michael Austin, vice president, BYD

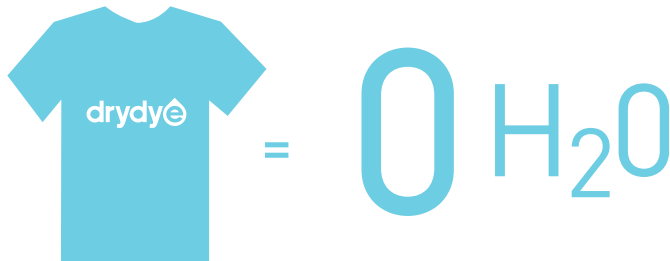
"It's a complicated picture in China. China is paying a lot of money to improve environmental management and is leading the world on things like afforestation and payments for watershed services. But on the other hand it has a lot of catching up to do."

Michael Bennet, senior adviser, Forest Trends Beijing

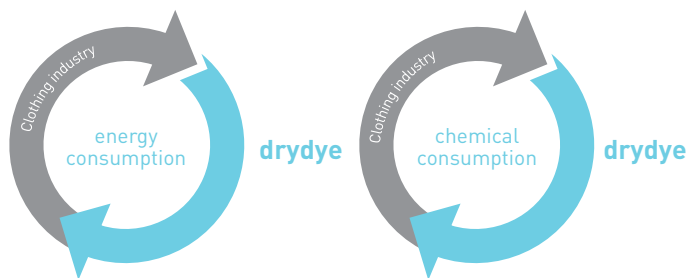
WATER-FREE SUPPLY CHAIN INNOVATION DISRUPTS GLOBAL APPAREL FIRMS

INNOVATOR(S)	Yeh Group & Adidas
DESCRIPTION	<p>Bangkok-based textile mill company Yeh Group launched a new range of fabrics in 2010, made using dry-dye technology. The technology allows a completely water-free dyeing process, using supercritical carbon dioxide (i.e. at a temperature where it behaves as a liquid) to dissolve dyes as would be done with water – but with no additional chemicals, no drying and the process uses less energy than conventional processes. Yeh Group was the first textile mill firm to develop a commercial-scale dry-dyeing system. German apparel giant Adidas, which is supplied by Yeh Group, launched its first range of dry-dye T-shirts in August 2012. Adidas reports that it has already eliminated 25 million litres of water from the dyeing process since it launched the products in 2012. The process is so far only used on synthetic fabrics, for which dyeing is the biggest single water impact during the manufacturing stage.</p>
WHAT ARE THE ENVIRONMENTAL BENEFITS?	<p>The World Bank estimates that 17-20% of industrial water pollution comes from textile dyeing and treatment. Adidas reports that the dry-dye technology produces apparel of the same quality, but uses 50% less energy, 50% fewer chemicals and completely removes the use of water in the dyeing process, which typically accounts for 25 litres of water per T-shirt. This not only conserves water in potentially water-scarce areas but also removes concerns regarding the quality of water effluent and waste water – since water efficiencies combined with water stewardship are required to protect water basins in stressed regions.</p> <p>Dramatic reduction in water use is often the most natural step for companies to target. To maximise their positive impacts leading companies should look beyond this to how textiles use water in the widest sense and deploy water stewardship approaches to promote better governance and management of freshwater systems.</p>

IT TAKES 25 LITRES OF WATER TO COLOUR 1 SHIRT



DRYDYE USES 50% LESS ENERGY AND 50% FEWER CHEMICALS



WHY IS THIS GAME CHANGING?

The textile industry is one of the biggest users of water worldwide. Adidas, in partnership with Yeh Group, plans to scale this technology up, which could eliminate hundreds of millions of litres of water in textile supply chains. Through Yeh Group's supply relationships with firms such as North Face, Puma, Mizuno and Victoria's Secret, the supplier is well-placed to make ripples across the global apparel market. Partnerships are a great way for innovative suppliers in Asia, with new and sustainable technologies and business models, to scale up their innovations to reach a global market.

WHAT ARE THE IMPLICATIONS FOR OTHER COMPANIES?

There has already been evidence of disruption in the apparel industry as other global apparel firms have begun to ramp up their use of dry-dyeing technology. For example, Nike has spearheaded a partnership with Dutch firm DryCoo. In 2012, Nike provided the Kenyan marathon team with a uniform made from recycled bottles and dyed using its water-free dyeing processes. Levi Strauss too has released a range of Water<Less jeans which use drastically less water in the manufacturing process. Firms in the apparel sector are traditionally very competitive, but these actions show a move towards dramatic water efficiencies interwoven with business and competitive factors.

Water stewardship as defined by WWF (www.panda.org/ws) is the other critical part of building resilience for both business and freshwater habitats.

"This technology is absolutely disruptive. Now is a time to think differently about the dyeing of textiles as we've been using water for such a long time. This is a perfect case study to show that we don't need water. It will be an answer to a lot of environmental issues."

"I wouldn't differentiate green innovation from any other sort of innovation. The starting point is to ensure that the technology has positive impact. Make sure the technology actually delivers. Business relationships are important: they should be open and honest. Then finally, try to incorporate it into normal business practices as quickly as possible."

Philipp Meister, manager sustainable materials & innovation, Adidas

CHINA'S ASTONISHING SUSTAINABLE BUILDINGS ARE READY FOR INTERNATIONAL IMITATION

INNOVATOR(S)	Broad Sustainable Building (BSB)
DESCRIPTION	<p>Rapid urbanisation in China is opening up opportunities for firms to innovate by developing buildings with less impact, on radically shorter timescales.</p> <p>Broad Sustainable Building (BSB), a Chinese real-estate firm, constructed its prefabricated T30 Hotel in Hunan in just 15 days. T30 uses significantly less steel than conventional buildings, consumes less energy and reduces the impacts from lengthy construction site projects. BSB also claims that its prefabrication model lowers costs to just one third of a traditional construction project – in part because through bulk purchasing materials.</p> <p>In the west, prefab construction is mostly limited to residential homes, and construction times are still longer – on the scale of one to two months for a residential building in the US as opposed to the days-scale of BSB's buildings. But companies like IKEA, with its Live Smart ('BoKlok') apartments, have started to enter the prefab construction market – albeit still on a residential scale. These homes provide low-cost alternatives that appeal to rural families that cannot afford to live in expensive cities.</p>
WHAT ARE THE ENVIRONMENTAL BENEFITS?	<p>The environmental impacts of the construction sector are significant. Quick construction lowers the impacts of lengthy construction sites while prefabrication lowers on-site waste. Additional impacts on the local community arise from the transport of materials, water, cement and removal of waste from the site.</p> <p>There is also the potential to reduce whole lifecycle impacts. BSB reports that its T30 hotel building is five times more energy-efficient than conventional hotels, through thick insulation, multi-paned windows, external solar shading, heat recovery, LED lighting, elevators with power generation on the descending phase, and water-saving toilets.</p> <p>Finally, the prefabrication of components allows greater control but less flexibility over the materials used: the buildings use recyclable materials and can be specified to avoid specific substances as per the local market norms.</p>

WHY IS THIS GAME CHANGING?

Construction activities typically account for some 5% of western countries' GDP, and an even greater proportion in developing countries. In aggregate, emissions from buildings account for about a third of the world's global carbon emissions. So any scalable solution that significantly lowers construction impacts and the lifecycle of buildings is potentially game changing. But in order to gain market acceptance, it's critical that safety and building quality are not compromised by quick construction times, and that sufficient transparency and quality assurance can be established during the prefabrication stage.

According to the US Census Bureau, 9.8 months is the average time from start to completion of non-residential construction projects in the US. A new model that reduces this down to just two weeks has the potential to be very disruptive. Furthermore, environmentally-friendly materials bought in bulk drive the price down and standardised, repeatable construction plans radically cut down on labour costs.

WHAT ARE THE IMPLICATIONS FOR OTHER COMPANIES?

BSB is looking to transfer its technology to 100 franchisees nationally and internationally to take its method of creating prefabricated sustainable and efficient buildings to new countries. The franchise model is necessary as local partners are required so that logistics for any of the modules do not extend beyond 500km away – this would negate the benefits of the building's lower impact.

While the model will have to overcome significant perception barriers, it has the potential to gain faster traction in the industrial sector rather than in residential. This innovation also comes at a time when the industry is starting to embrace the idea of structures that can easily be assembled and disassembled as was seen for some of the London Olympic Games venues. The construction sector is very conservative, generally waiting for significant proof that any innovation really drives better returns, with the status quo otherwise dominating. But the potential for disruption is so large in this instance that western construction companies should keep close tabs on Asian firms like BSB that have perfected the model and are scaling it up.

"The real-estate market is hot in China so green buildings has been a real growth area. The technology is not really, really high tech, it's simple and easy to apply."

Yumin Yeh, sustainable development and strategic partnerships manager, US China Clean Tech Centre



© COURTESY OF VORTEX

"We made the conscious decision not to look at existing ATMs when we developed our product. We needed to think completely differently to come up with something to meet the needs of rural India."

Vijay Babu, CEO, Vortex Engineering

FRUGAL INNOVATION IN INDIA INSPIRES RADICALLY SUSTAINABLE PRODUCTS

INNOVATOR(S)	Vortex Engineering; GE
DESCRIPTION	<p>India's culture of <i>jugaad</i>, or 'frugal innovation', is a response to resource limitations. It sees individuals and businesses radically rethinking and redeveloping products, processes and business models to produce the same utility using fewer resources, usually at a lower cost.</p> <p>One example of a frugal innovator in India is Vortex Engineering, which makes a solar powered ATM, called Ecoteller, suitable for deployment in rural areas. The firm successfully leapfrogged existing solutions used by consumers in developed countries to produce a radically sustainable solution more suitable for the Indian market.</p> <p>Another example is Tata's 'Swach' which is a low-cost water purifier targeted at rural families without electricity or running water. Designers were able to design a \$20 filter (which is 50% cheaper than its nearest competitor) that combines rice husk ash waste with a filtering bulb containing a silver nanoparticles-based antibacterial compound that kills waterborne parasites and bacteria.</p> <p>The concept is no longer confined to India. GE has taken a leaf out of the frugal innovation book and designed an electrocardiograph (ECG) machine called the MAC 400, which costs \$800 as opposed to \$2,000 for a conventional ECG. It was designed to be handheld as opposed to a 15lb unit – and it was designed in just 18 months. This enables the cost of ECGs to be reduced for patients.</p>
WHAT ARE THE ENVIRONMENTAL BENEFITS?	Products, technologies and models based on the concept of frugal innovation use radically fewer resources, including both physical materials and energy. For example, Vortex's Ecoteller uses just 10% of the power of a traditional ATM and uses solar power, which means a significantly lower carbon footprint.
WHY IS THIS GAME CHANGING?	<p>As we come close to global natural capital constraints, firms that take a leaf out of the jugaad book will hold advantageous positions in their markets, shielded from the worst of resource price hikes.</p> <p>Another competitive strength from constantly questioning a product is the ability to deliver better customer outcomes, in much the same way that UK engineering group Dyson aims to do when redesigning simple products such as hand dryers.</p>
WHAT ARE THE IMPLICATIONS FOR OTHER COMPANIES?	Due to their low resource use, frugal innovations are typically low-cost innovations that provide the same outcome for users. Such a model has the potential to be seriously disruptive as firms strive to lower their costs and to pass cost savings onto consumers. As India's role in the global economy grows, multinational firms face inevitable and growing competition with India's frugal innovators.

CASH FOR CONSUMER RECYCLING SCHEME CREATES REPLICABLE ECONOMIC INCENTIVES

INNOVATOR(S)	Wongpanit
DESCRIPTION	<p>Wongpanit is a purchaser of recyclable waste from households, community groups, retailers and other businesses in Thailand. The firm creates an economic incentive by paying for recyclables and regularly updates its prices for each material. Wongpanit collects, pays for and recycles materials ranging from batteries, computers and used cooking oil. The bulk of the reclaimed materials are sent to recycling plants in Thailand, while a minority are exported to China and South Korea.</p> <p>Wongpanit has a franchise model, currently with 1,150 franchisees. Its annual revenues from its Thai business are 1 billion Thai Baht (£20 million). The Wongpanit company buys between 300 and 500 tons of recyclable waste per day.</p> <p>Wongpanit has exported this model by launching a US branch in Baltimore, Maryland called WPN Recycling in 2011. As well as cashing in on Baltimore's trade in scrap metal, WPN collects and recycles aluminium cans, cardboard and plastic among other materials.</p>
WHAT ARE THE ENVIRONMENTAL BENEFITS?	<p>Recycling encourages an open-loop economy, replacing the need for virgin materials. For example, used cooking oil is a more environmentally preferable source of biodiesel than virgin crops. It also reduces the waste and resulting pollution from used materials such as plastic bottles.</p>



The trash trade in Thailand is evolving with recyclable waste increasingly collected from homes instead of landfill.

WHY IS THIS GAME CHANGING?	Recycling is nothing new. But putting a value on waste has changed perceptions in Thailand, allowing people to see the value in recycling their waste rather than throwing it away. For example, in Thailand, household food waste, which can be processed to generate biogas and fertilisers, is worth \$26 in electricity, \$18 in heat, and fertiliser worth \$6 per tonne according to Wongpanit's estimates.
WHAT ARE THE IMPLICATIONS FOR OTHER COMPANIES?	<p>This economic view of recycling has long been cultivated in countries where scrap materials have value from a purely monetary – not environmental – perspective. Scholars of the ‘trash trade’ in developing countries note that recycling in the west is primarily driven by ethics and not by the economic value of the waste. However, models such as that of Wongpanit present a potential significant disruption to current models, which often require businesses to pay to have their recycling collected separately from their landfill waste, which itself attracts a landfill tax.</p> <p>The actual economics of paying for waste will vary by country, but Wongpanit's model has been shown to work in other sectors. US telecommunications firm Sprint works with eRecyclingCorps and has successfully collected and recycled 4.1 million handsets and saved over \$1 billion a year by refurbishing and reselling phones. Sprint has found that paying customer for old handsets works better than their previous approach of providing vouchers and money off bills.</p>

“Our US branch in Baltimore opened in 2011 as a small collector of metal scrap and bottles and it's been really successful! Normally people would have to pay to get rid of these materials. It also involves poorer people in the community and provides these people with extra money.”

Wimonrat Santadvatan, International Coordinator, Wongpanit

ENERGY STRESS CHALLENGES LEAD TO CLEAN TECH BUSINESS MODEL INNOVATION

INNOVATOR(S)	Suzlon Energy; Shree Cement
DESCRIPTION	<p>Suzlon Energy, a wind turbine supplier based in India, originated as a textile manufacturer. An unreliable and increasingly expensive power supply in India led the firm's chairman Tulsi Tanti to experiment with wind energy production. Having generated his own firm's energy use, Tanti found that wind energy proved a viable business, with better returns than textiles. Suzlon is now the world's fifth-largest supplier of wind turbines. The firm's turbines are used across India and exported globally, with contracts across Europe and the US.</p> <p>Another example of energy stress in India leading to a profitable and exportable business model is Shree Cement. Shree Cement in India launched a campaign to reduce its electricity use and produce it more efficiently. Now it has become a low-cost producer of electricity in the region, with profitable sales of surplus electricity augmenting its cement business.</p>
WHAT ARE THE ENVIRONMENTAL BENEFITS?	Business energy users shifting to greater renewable energy supplies and moving into renewable energy generation accelerate decarbonisation across the power sector.
WHY IS THIS GAME CHANGING?	The paradigm shift for energy-intensive companies to evolve their business models towards renewable energy generation is a game changer. And while the economic incentives for renewable energy implementation vary from country to country, Shree and Suzlon's situations are by no means unique. Continuity of supply is a major driver for energy investments in the US, while financial subsidy regimes in Germany provided an incredible accelerator to the market in Germany.
WHAT ARE THE IMPLICATIONS FOR OTHER COMPANIES?	Western companies are also increasingly concerned over energy security and volatile prices, and some have exploited new avenues. The Ritter Gruppe in Germany expanded into renewables from its initial business in chocolates, and Ikea is going further than renewable energy-powered stores and now offers customers their chance to install solar panels.

MICRO-MODELS CREATE INCLUSIVE GREEN ECONOMIES

INNOVATOR(S)	Grameen Shakti, Grameen America
DESCRIPTION	<p>The Grameen family of organisations was founded in the mid-1980s by Muhammad Yunus. They're based on the concept that mobilising bottom-of-the-pyramid talent through a microcredit scheme could engender solutions to the problems faced by these marginalised people. They enable borrowers to secure loans through trust within the community rather than collateral.</p> <p>The microcredit model was applied in Bangladesh to develop Grameen Shakti, which offers renewable energy-based solar home systems financed by small loans and instalment payments. These solar PV systems are highly cost-effective for rural areas. Grameen Shakti trains local community members and youths as technical engineers as it grows its rural coverage, achieving a network of 904 branch offices all over Bangladesh. It's now the largest off-grid energy programme in the world, delivering solar power to an estimated eight million people in Bangladesh.</p> <p>The Grameen Shakti model has not yet been replicated in western countries, but the Grameen family of companies has successfully entered the American market: Grameen America has replicated the successful Bangladeshi Grameen Bank model. Since its inception in 2008 Grameen America has made micro loans to 17,000 women living below the US poverty line. This provides a powerful proof of concept for microfinance-based models being taken from developing to developed countries.</p>
WHAT ARE THE ENVIRONMENTAL BENEFITS?	<p>Grameen Shakti has been the first in the world to install solar home systems in a million homes – and expects to reach two million homes by the end of 2016. Its solar PV systems rely on the long hours of sunlight in Bangladesh, and the system is an improvement on Bangladesh's fragile electricity grid. In addition, the lack of monthly bills and fuel costs, and low repair and maintenance costs, mean it suits the local economic conditions.</p>

WHY IS THIS GAME CHANGING?

Traditional arguments against installing solar PV systems are that they're too expensive to undertake in poor rural communities. The Grameen microfinance model has debunked this, and demonstrated that such renewable energy programmes can be implemented at scale, with microcredit the key enabler.

WHAT ARE THE IMPLICATIONS FOR OTHER COMPANIES?

While the markets for solar energy in the west vary country by country, and grid infrastructure is generally more stable, Grameen's microfinance model has shown game-changing applications by reaching one million homes that would otherwise have not been supported by traditional finance tools.

Even in the west, the current financial institutions generally severely limit lending to small businesses that can't provide collateral – hence it becomes very difficult for a large group of people to access capital. Grameen estimates that the global number of potential micro-borrowers is one billion, with a total loan demand of \$250 billion. Given that the larger players in the financial world are not currently geared to targeting this potential demand, the opportunity is there for others to leverage microcredit models.

CHINESE EXPERIENCE WITH ELECTRIC VEHICLES REAPS BENEFITS IN THE US MARKET

INNOVATOR(S)	BYD
DESCRIPTION	<p>BYD is a Chinese company that manufactures and sells solar, rechargeable batteries and electric vehicles. The firm aims to create an end-to-end 'zero carbon and zero emission eco-environmental system' and is currently the largest electric bus manufacturer globally. The first Chinese investment that Warren Buffet's Berkshire Hathaway company made was in BYD in 2008.</p> <p>Already a leader in the Chinese EV market, BYD has recently been awarded two contracts in California for the provision of electric buses. In the UK, BYD and Green Tomato Cars have signed a memorandum of understanding to create London's first fleet of all-electric minicabs.</p> <p>BYD's competitive edge comes from its investments in battery technology to increase the range of its buses, make them vehicle-to-grid ready, and improving the business case for EVs. Integrated solutions have enabled the firm to create innovative technologies at lower cost. And its experience in the solar and rechargeable batteries markets and technologies complements its EV business. In addition, the firm has designed its buses to allow easier access to disabled people, with a floor that drops below the axle.</p>
WHAT ARE THE ENVIRONMENTAL BENEFITS?	<p>By operating in the three markets of renewable energy, rechargeable batteries and electric transport, BYD is positioning itself to create end-to-end sustainable, zero-emission systems.</p>
WHY IS THIS GAME CHANGING?	<p>BYD's activities across these markets have enabled the company to innovate and gain an advantage against its peers in the US. BYD is currently focusing its efforts on public transport systems (including buses and taxis) owing to the ability of public transit companies and authorities to look at whole life costs and the significant environmental savings that can be made. Its ability to electrify and power transport with renewable energy at scale is a game changer.</p>
WHAT ARE THE IMPLICATIONS FOR OTHER COMPANIES?	<p>BYD demonstrates how other businesses could benefit from taking an integrated approach across various clean technologies to strengthen propositions for consumers and public transit customers.</p>



© COURTESY OF BYD

“The Chinese have always been known as copycats but here’s a company that’s innovating in a way that Detroit cannot keep up! The success is due to the innovations. It’s fantastic technology.”

“The greenest company in the world happens to be a Chinese company – no one would have thought it.”

“Warren Buffet doesn’t understand the technology but has that much confidence in the management team. He described the BYD CEO as a cross between Thomas Edison and Jack Welch! BYD was the first Chinese company he’s invested in and remains his largest Asian investment.”

“BYD is going to create a totally zero emissions ecosystem of products – renewables, storage batteries and electrified vehicles. Every piece of the puzzle has to be in place to make it work.”

“If you’re going to invest public money into anything to reduce emissions it has to be public transport! It’s the biggest and best bang for the buck, both environmentally and economically.”

“We’ve got these contracts because the technology and the model just don’t exist in the west. This breakthrough innovation will transform the market.”

Michael Austin, vice president, BYD

INNOVATIVE 'PAYMENT FOR ECOSYSTEM SERVICES' IN CHINA ACHIEVES RESTORATION AT SCALE

INNOVATOR(S)	China national and local government
DESCRIPTION	<p>China is leading the world on payment for ecosystem services (PES) – an economic model that puts a financial value on such services, to create an economic incentive among the economic actors that rely on them or affect them to protect them.</p> <p>Forest Trends identified that in 2011 there were 61 active water basin payment programmes in China providing ecosystem services valued at over \$7.5 billion. This accounts for 91% of the worldwide total of \$8.2 billion. One example is the programme around Fuzhou in China. Urbanisation and deforestation upstream of the city brought irregular and unsanitary river flows to Fuzhou. Fuzhou authorities now pays around \$800 million every year to other cities upstream to administer regional water management programmes, and to encourage farmers to reforest stripped hills and implement sustainable land-use practices.</p> <p>In the US, there are currently 68 active water basin payment initiatives with transactions in 2011 valued at \$360.5 million. In 2011, over \$171 million was channelled into innovative 'instream buybacks' within the US to purchase and retire water rights normally diverted for irrigation, drinking, or other consumptive use. This ensures that water is left in rivers, in an attempt to restore their natural flow regimes – to continue supporting domestic agricultural and environmental ecosystems.</p>
WHAT ARE THE ENVIRONMENTAL BENEFITS?	<p>Payment for ecosystem services creates economic incentives to preserve and restore ecosystems that provide inherent value, such as water basins and forests. Ecosystem Marketplace research found that nearly 116 million hectares had been managed for watershed services in China in 2011 – this is over 99% of the worldwide total of 117 million hectares.</p>



WHY IS THIS GAME CHANGING?

With the power of the Chinese national government behind it, payment for ecosystem services has reached unparalleled scale in China, providing a major proof point on the possibility of developing PES schemes at scale. These models are replicable and include significant lessons for the rest of the world, as evidenced by growing interest in the Americas and the un-ignorable value of resources in stressed areas. For example, the value of the crops produced in water-risk regions in the US is estimated to exceed \$105 billion.

WHAT ARE THE IMPLICATIONS FOR OTHER COMPANIES?

The dominant players in China's payment for ecosystem services programmes are government bodies, both local and national. The power of the Chinese national government backing these schemes has been integral to their success so far but there is significant potential for increased private sector involvement. The takeaway message for western firms is to engage local and national authorities more proactively and treat water management as a shared risk and opportunity. They can look to some of the Chinese PES schemes for inspiration on how to work cooperatively at the water basin level.

See wwf.org.panda/ws for a wider robust approach to water stewardship.

"China is paying a lot of money to improve environmental management and is leading the world on things like afforestation and payments for watershed services."

Michael Bennet, senior adviser, Forest Trends Beijing

WESTERN INNOVATIONS FLOW INTO ASIA





INSPIRING OPPORTUNITIES FOR WESTERN BUSINESSES IN ASIA

Finding business opportunities in Asian countries can be about much more than targeting a growing middle class with products and services already developed in the west. There are four major reasons why.

First, the rapid regional economic development provides opportunities to leapfrog technologies – *i.e.* break the technology pathway that was used in developed countries. Applying the concept of dematerialisation in Asia is exciting because of the potential opportunities to move straight to more resource-efficient approaches, processes and designs. For example, car-sharing models present a significant opportunity for western firms to apply the knowledge learned from European and North American markets to convince Asian consumers to bypass car ownership and move straight to car sharing. Start-ups such as 1hai, iCarsClub and Zoom are ramping up. If they're successful, they could pave the way for collaborative consumption models in Asia.

Second, the global economic set up in terms of trade structure and country specialisation makes countries such as Bangladesh pivotal in the textiles industry. This opens up opportunities to work at a scale on open-loop innovations that wouldn't be possible if western innovators just focused on developed markets. The Estonia-Bangladesh partnership between Aus Design and Beximco is an illustration of an open-loop opportunity to upcycle waste material along the textiles value chain into new garments.



The local economic and political set up allows the development of solutions and markets on a large scale that western companies are not used to.

Another consequence of the structure of the global economy is the extent and reach of multinational corporations' supply chains in Asia. This opens the door for supplier-led initiatives such as BT's or IKEA's net positive strategies which are rippling through their supplier bases in Asia, leading to a new wave of innovations. Also consider the supplier/customer collaboration opportunities as Teijin did when entering the Chinese market for recycling polyester fibres.

Third, there are regional issues that are fundamentally different from those found in emerging markets. The issue of pollution from open fires has led to solutions developed by Biolite originally targeted at campers, taken to new markets. Similarly, clean air solutions are booming on the back of unprecedented peaks of smog in major cities. This opens up new markets for western companies.

Finally, the local economic and political set up allows the development of solutions and markets on a large scale that western companies are not used to. This is critical in the development of the low-carbon and renewable solutions in response to the enormous challenges in its power sector: high volumes of greenhouse gas emissions and high particulate pollution are causing multiple costly knock-on impacts, pushing central governments to invest massively. China's spend of \$66 billion on renewables in 2012 made it the second-largest market after Europe, according to Bloomberg. The solar electricity generation market is being engaged by firms such as US-based Solaria, and local investments in electric vehicles has seen Tesla, Geely and General Motors enter the market.

CAR SHARING SET TO TAKE OFF GLOBALLY

INNOVATOR(S)	iCarsClub; Zoom
DESCRIPTION	<p>Zoom, set up in 2012, is the first company taking the car-sharing business model to India. Its model is similar to that of ZipCar in the west, in which a fleet of vehicles is owned by the company and rented hourly. Zoom was launched in Bangalore by two American entrepreneurs keen to replicate the success of ZipCar in a fresh market. At the end of July 2013, Zoom reports that it had a fleet of 42 cars and an average fleet utilisation of 65%. And by January 2014 they aim to have 150 vehicles at 15-20 locations.</p> <p>iCarsClub is Asia's first and largest peer-to-peer car sharing business. The model is more like WhipCar in the UK, rather than ZipCar, as it relies on consumers sharing their own vehicles. The Singapore firm was launched in December 2012 and so far over 5,000 car shares have been made. iCarsClub has set a target to attract 5,000 members with 1,000 cars in Singapore, and another 1,000 cars in China by the end of 2013.</p>
WHAT ARE THE ENVIRONMENTAL BENEFITS?	<p>At their heart these sharing schemes take cars off the road compared to a traditional individual consumption model, lowering emissions commensurately (iCarsClub estimate lowering greenhouse gas emissions by up to 64% per shared car).</p> <p>In fast-developing metropolises of Asia, major additional benefits come from helping to tackle overcrowding on the roads, which is why iCarsClub is gaining traction in Singapore.</p> <p>Finally these businesses generate a positive social impact by introducing lower-cost models to facilitate access to transport for the population.</p>

"It's challenging to convince people to share their belongings. You have to make the benefits for the owners really effective and persuasive. We know that sharing is beneficial to society and the environment but we have to market it as beneficial to the owner."

"We've learnt a lot from the US and their experiences. Having that experience also helps us to talk about the idea with people here. The whole idea is new here so we need proof points to convince people."

Jamie Wong, CEO, iCarsClub



ISTOCKPHOTO

Car-sharing can reduce congestion and pollution.

WHY IS THIS GAME CHANGING?

Car-sharing in general is a game-changing practice solely for its environmental benefits. While in most Asian countries, including China and India, the number of cars per 1,000 inhabitants is 10 times lower than in Europe and North America, their growth is staggering. Penetration of cars trebled in China between 2005 and 2012 according to World Bank development indicators, rising to over 120 million passenger cars in 2013. This brings considerable 'leapfrogging' potential if car sharing can achieve mainstream. Bringing the model to scale is made easier because consumer-owned car models, such as that of iCarsClub, can become very attractive to enterprising adopters who can make up to \$12,000 extra income by sharing their car's idle time. This echoes the success of consumers profiting handsomely from AirBnB and HomeAway by leasing extra properties on a short-term basis.

WHAT ARE THE IMPLICATIONS FOR OTHER COMPANIES?

Opportunities to export proven car-sharing models exist across a number of Asian countries. The tensions inherent between fast development, access to transport, and pollution control support the long-term development of these markets.

Companies entering the market should look to the local incentives and disincentives of car ownership to determine appropriate these models are. For example, in Singapore, the state has already implemented a number of indirect incentives – including an expensive certificate of entitlement system that makes car ownership significantly more expensive, to the tune of almost \$65,000.

One cultural hurdle to jump, though, when considering deploying a car-sharing method in the east, is Asian perspectives on commodities and sharing: in the west collaborative consumption models have succeeded as consumers see real return on investment from sharing possessions rather than buying new. But researchers and consultants, like those at Transportation Sustainability Research Centre at the University of California at Berkeley, note that car ownership is a social statement of wealth, and that Asian consumers could be sceptical about sharing cars for fear of implying that they can't afford their own. Simultaneously, the same researchers note that a nudge from the US and European experiences with the model could help propel it forward as younger, more flexible generations look to emulate the western consumer.

OPPORTUNITIES HEAT UP FOR THE CIRCULAR ECONOMY IN CHINA

INNOVATOR(S)	Teijin Fibers
DESCRIPTION	<p>Japanese multinational Teijin launched its textile polyester recycling process Eco Circle in 2002. The process makes it possible to recycle polyester products, including fibres, plastic bottles and films, into new fibres of the same quality. They've generated estimated sales of \$121 million annually, using over 20,000 tons of recycled polyester fibre.</p> <p>There's been early adoption in the west, but it wasn't until late 2012 that Teijin Fibers opened its first polyester recycling plant in China. The plant will recycle fibres from local garment factories and has announced partnerships with two local companies already: Shandong Asahi Green Source Hi-Tech Farm and Shandong Asahi Green Source Milk Products.</p>
WHAT ARE THE ENVIRONMENTAL BENEFITS?	<p>The apparel manufacturing process generates significant environmental impact that can be minimised or avoided through the innovations of Teijin Fibers. Of the total global polyester production, up to 70% is used in the textiles industry. Polyester production includes a number of petroleum-based processes that are energy-intensive and rely on finite, non-renewable national resources. With energy prices such as crude oil rising, there's an economic imperative for recycling polyester as well as the environmental benefits of avoiding petroleum consumption.</p> <p>In addition, fibre recycling cuts down on the significant issue of waste in the apparel sector, with over 653,740 tons of clothes disposed of annually.</p>

WHY IS THIS GAME CHANGING?

As part of Eco Circle, Teijin is working with over 150 apparel and sportswear manufacturers worldwide to develop and manufacture products made from recyclable materials, as well as to collect and recycle these products at the end of their useful lives. Manufacturers include Patagonia, which has collaborated with Teijin for over 15 years.

China is central to the apparel industry and the market for polyester: it accounts for 65% of the global production of polyester for textiles, making it the world's most important polyester market. It's also the largest importer of PET at 1.7 million tonnes in 2011, which accounts for more than half the Asian demand according to China customs.

WHAT ARE THE IMPLICATIONS FOR OTHER COMPANIES?

This example highlights the potential for open-loop models in China. But the scale of the opportunity at both ends of the value chain marks this type of innovation as noteworthy of study by western companies looking for disruption opportunities.

Other companies should observe the evolution of Teijin's strategy to understand how to penetrate the market while minimising risks. Developing the original concept for the innovation in its home country, followed by getting major apparel manufacturers such as Patagonia and Adidas (and their customers) on board have established a solid platform with stable customer demand. It was then able to penetrate the largest market for polyester fibres. To de-risk market entry they partnered with local companies in order to ensure a steady supply of raw plastic materials.



Japanese multinational Teijin opened its first polyester recycling plant in China in 2012.

UPCYCLING MEETS MASS PRODUCTION TO CREATE NEW RESOURCE OPPORTUNITIES

INNOVATOR(S)	Beximco; Aus Design; Trash to Trend
DESCRIPTION	<p>‘Upcycling’, the process of creating a new product from waste materials, is a response to the high water, energy and waste impacts in the textiles industry. Reet Aus is an Estonia-based fashion designer working with the largest apparel company in Bangladesh, Beximco, to radically reduce the environmental impact of textiles used in the fast fashion sector, by closing the textiles loop at mass scale. A new collection of garments launched in July 2013 uses waste created during the standard production process, including overproduced fabric, overproduced garments, cutting leftovers, fabric roll ends and other sources of production waste.</p> <p>Aus has also founded Trash to Trend, a software platform that creates a contact point between mass producers and designers to share material information and good design ideas as well as to find a marketplace to meet customers.</p>
WHAT ARE THE ENVIRONMENTAL BENEFITS?	<p>Each garment in the 2013 collection carries a label with a unique calculation of the environmental impact of the piece. Across the collection, each garment saves on average 4,500 litres of water, a 78% reduction compared to comparable pieces made from virgin materials, and creates 2kg (or 86%) less CO₂ emissions. This is from the avoided disposal of waste fabric through incineration and landfill and the fact that materials are not reprocessed, simply redesigned.</p>

“We have demonstrated a huge environmental impact reduction due to using secondary materials without reprocessing them. On average each upcycled product saves 4,500 litres of water and creates 2kg less CO₂. It shows how dramatically the industry can reduce resource input if reorganising the way of thinking. Although we know realistically it’s a huge dream, our aim is to help finding the clever solutions to make upcycling a regular part of the industry.”

Reet Aus, founder, Aus Design and Trash to Trend

WHY IS THIS GAME CHANGING?

The mass production of upcycled garments is a step beyond one-off designs made with reused fabric, with more game-changing potential. The collection is relatively small in scale at the moment but Aus estimates that from an original production line of 30,000 tops another 4,200 'upcycled' items could be produced from the production waste – a 14% uplift in production made possible with minimal additional inputs.

Beximco is working towards incorporating upcycling as a regular part of its production cycles. The firm produces 56 million garments per year, creating thousands of tonnes of waste – which represents a huge potential for repurposing waste.

Further game-changing potential could be realised if and when the waste coming from the whole of the apparel supply chain could be repurposed. Going one step further, this concept could be expanded to post-consumer waste textiles and involve more partner companies, to create circular textile fabric loops.

WHAT ARE THE IMPLICATIONS FOR OTHER COMPANIES?

The partnership between Aus and Beximco, a mass producer in Bangladesh, demonstrates the opportunities for small companies and designers to approach and influence large companies in developing markets with new ideas.

There are two specific lessons for other companies in the sector. First, by partnering with companies in Bangladesh, Aus is maximising her potential for scaling up her upcycling concepts. With a large majority of the workforce involved in the \$19 billion-a-year textile industry – the textile industry accounted for 45% of all industrial employment in the country in 2012– Bangladesh will become the largest ready-made garments manufacturer by 2016. Second, by establishing relationships in this industry at the bottom of the supply chain, entrepreneurs marketing 'greener' solutions can access companies across the world in the apparel supply chain.

"The key to scaling up sustainable fashion is to look for ways of creating cooperation between small and clever initiatives with the dominant market players. To have a successful cooperation in Bangladesh, the first priority is to be good friends with your partners, and only then it's possible to overcome the thousand difficulties related to such radical innovation."

Reet Aus, founder, Aus Design and Trash to Trend

CHINA'S INVESTMENT IN RENEWABLES SPARKS WESTERN INTEREST

INNOVATOR(S)	Solaria
DESCRIPTION	<p>Owing to its pollution concerns, China is expanding its plans for renewable energy, including solar. Its five-year plan announces the installation of 1,000MW of renewable energy by 2015, and 3,000 MW of concentrated solar power plants by 2020.</p> <p>While most of China's solar power infrastructure is domestically-owned, western firms have stepped up to the plate to offer solutions in this growing market. Solaria Corporation is a Californian company that's established operations in China to meet demand for high efficiency, large-scale solar projects. Solaria has found success in partnership with China's largest solar power plant investor and operator, CECEP Solar Technology; and two major utilities, GD Solar and Huanghe Hydropower. They recently announced new 10MW to 50MW utility-scale projects.</p> <p>Despite China's struggles with a bloated solar market, Solaria has been able to achieve success – reporting that it's achieving margins equivalent to similar projects in the US – because its technology fits well into the existing supply chain in China. It deploys solar systems that work with existing infrastructure and doesn't manufacture the materials itself. Rather, it's able to buy up and use the silicon materials China has an oversupply of.</p>
WHAT ARE THE ENVIRONMENTAL BENEFITS?	<p>Aside from helping enable a fossil-fuel independent economy, the rise of renewable power is important in Asia given its air pollution issues, stemming from a development policy that prioritised economic growth above all else. Renewables will largely be replacing coal-fired power plants, which are – along with vehicle exhaust – the main reason why particulate air pollution is such a significant issue in China.</p>



Solaria Corporation is a Californian company that's established operations in China to meet demand for high efficiency, large-scale solar projects.

WHY IS THIS GAME CHANGING?

The potential to invest in China's renewable market sector is a game changer simply because of China's huge energy appetite, coupled with the government's increasing concerns about pollution. This trend is reflected in the numbers for its demand for renewables. For example, photovoltaic (PV) demand from the Asia Pacific region will exceed 16GW – which is 40% of global PV demand this year.

WHAT ARE THE IMPLICATIONS FOR OTHER COMPANIES?

China has announced plans to scale back on its use of coal. Such plans are opening up opportunities for western firms to export renewable energy solutions to meet its increasing demands. Not every segment of the energy value chain is attractive in China. For example, domestic manufacturing of solar panel materials will still dominate in a bloated market, with authorities having put a moratorium on new solar factories built in China in order to stabilise the market. But the market may become more attractive given recent news where Lord Stern hinted that a carbon market could appear in China before 2020.

In order to be successful and tap into this potentially growing market, firms should look closely at how Solaria has achieved success: its links to government-owned entities through its existing projects with utilities will help mobilise business growth and win influence in a crowded market.

CONVENIENT OFF-GRID SOLUTIONS ARE SOLVING ENERGY AND POLLUTION CHALLENGES

INNOVATOR(S)	BioLite Stove
DESCRIPTION	<p>BioLite's clean cookstove was initially conceived and designed to enable campers in the US to cook without petrol or batteries, which are inefficient and polluting. This CampStove burns biomass such as twigs and leaves, and includes a thermoelectric chip which powers a fan, increasing the efficiency of the fire and reducing smoke. In addition, the electricity generated from the waste heat can be used to charge devices via a USB port.</p> <p>The company identified the large potential of the technology to provide a more sustainable cooking option in rural areas of emerging countries across Africa and Asia. It tweaked its product to produce the HomeStove specifically for this purpose. HomeStove is now being rolled out as part of large-scale pilot programmes across countries including India, Uganda and Ghana.</p>
WHAT ARE THE ENVIRONMENTAL BENEFITS?	<p>BioLite's HomeStove reduces smoke emissions by over 90% compared with a traditional three-stone fire used in rural areas, almost eliminating black carbon, with substantial health benefits for indoor users. The stoves need 50% less biomass, meaning time and cash savings too. Surplus heat created can be used for electricity, meaning less waste and increased access to electricity for population in off-grid locations.</p>

"Through a model of paired innovation, we're designing the technology in parallel for both developed and for developing countries. Innovation is coming from both directions. The things we learn in the field diffuse across into both products."

"The camp stoves we sell in developed markets are neat gadgets and they get lots of attention. This gives us a near-term revenue stream that can fund our work in developing markets, making it a commercially viable and scalable business model that can really have positive impact."

Ethan Kay, managing director of emerging markets, BioLite

WHY IS THIS GAME CHANGING?

BioLite's initial idea to create a more sustainable and convenient method of cooking while camping was a good solution for a niche market, but the firm's adaptation of its innovation for emerging markets is where the innovation becomes game-changing.

Being an 'off-grid' solution means BioLite is perfectly suited to bringing a clean and green revolution to rural and emerging markets. BioLite estimates that three billion people worldwide cook on open fires, including over 100 million people in both China and India. Open cook fires release one billion tonnes of CO₂ into the atmosphere every year.

WHAT ARE THE IMPLICATIONS FOR OTHER COMPANIES?

BioLite's story highlights how innovative companies in Europe and other parts of the west can repurpose their innovations to meet challenges in new markets.

BioLite suggests that companies thinking about entering emerging markets, particularly those selling to rural communities, take a long-term view of the market and invest in research on their new market. Scaling up the provision of clean cook stoves has faced cultural, infrastructure and policy challenges, demonstrating how crucial it is for companies to understand the emerging markets they enter. For BioLite, the gradual and considered expansion into emerging markets is being funded by sales of the CampStove in developed markets. This provides a potentially replicable model for others to follow.

"BioLite has been profitable from day one which gives us a tremendous cushion. This allows us breathing room to incubate the emerging markets business at an appropriate rate."

"It was a surprise to the founders of the stove that there are three billion people in the developing world that cook on open, smoky fires, leading to four million deaths a year and more black carbon than cars and trucks in the world combined. This opened up a whole new and more important market that they could target in parallel with the original camping market."

"It's cool to make neat product for backpackers but there's a much more important market that we can design a solution for in parallel."

Ethan Kay, managing director of emerging markets, BioLite



Clean cookstoves can replace inefficient, polluting ones.

CHINA'S COMMITMENT TO EVs OPENS DOORS FOR INNOVATION

INNOVATOR(S)	Tesla; Detroit Electric Co & Geely; General Motors
DESCRIPTION	<p>In 2012, the Chinese government announced a \$16 billion investment plan to reach 500,000 battery-powered electric vehicles and plug-in hybrids by 2015, and five million by 2020. As a result, the last few years have seen a number of innovative automakers from Europe and America expanding into China to seize the new opportunities.</p> <p>Silicon Valley-based electric vehicle manufacturer Tesla announced in January 2013 its plans to open its first store in China, in Beijing. The firm plans an 8,000-square-foot facility, three times larger than its typical US stores.</p> <p>Another US-based automotive firm, Detroit Electric company, intends to partner with China's automotive giant Geely to co-develop more electric passenger vehicles, specifically a pure electric version of Geely's Emgrand EC7 car. All vehicles that emerge from the strategic partnership will be sold in China.</p> <p>General Electric is also eyeing up the opportunities and has signed a memorandum of understanding with the Sino-Singapore Eco-City Investment and Development Company to explore commercial opportunities in the Tianjin Eco-City in northern China.</p>
WHAT ARE THE ENVIRONMENTAL BENEFITS?	<p>The environmental impacts of vehicles are well-documented, with the World Resources Institute estimating that 900 million tonnes of CO₂ are emitted by motor vehicles each year. In addition, they contribute to air pollution in cities: it's estimated that 19% of particulate matter comes from vehicle exhausts.</p> <p>Electric cars contribute to the solution, provided their lifecycle impacts including those from the electricity generation are well understood, and are below those of their fossil fuel counterparts.</p>

WHY IS THIS GAME CHANGING?

In 2010, the number of automobiles globally in use increased to over one billion – and China has the world's second-largest car population, with 78 million vehicles, only topped by the US. China is predicted to have the largest global market for cars by 2020, with 22 million cars sold per year.

As the middle class grows and as electric vehicles become more accessible to non-luxury consumers, the EV industry is poised to make huge waves. In 2011, General Motors alone sold 2.5 million vehicles in China. Meanwhile, India is the world's sixth-largest car market and is expected to take third place behind China and the US by the end of the decade, with annual sales growth of 12-14% from 2014 to 2020. If electric vehicles can make inroads into these growing markets, then there's potential for major disruption.

WHAT ARE THE IMPLICATIONS FOR OTHER COMPANIES?

For automotive manufacturers seeking to grow in Europe and the US, China presents an additional market with significant policy support for EVs and rising levels of disposable income. At the same time, the local governments are putting curbs on the number of conventional cars on their streets. The pollution issues are substantial enough that Beijing, Shanghai, Guangzhou and Guiyang have all introduced measures such as ordering government cars off the roads and subjecting residents to a ruling limiting the use of cars to alternate days between 7am and 7pm.

It's likely that the group of future leaders in the EV world will come from those players being successful in the Chinese and other emerging markets, making the most of significant economies of scale.

"In terms of the potential of electric vehicles, China gets it more than the US right now. They're investing public sector money because it's economically positive, as well as for environmental reasons."

Michael Austin, vice president, BYD

POCKETS OF STRATEGIC ‘NET POSITIVE’ INNOVATION POP UP IN ASIA

INNOVATOR(S)	Bayer MaterialScience; BT; Huawei; IKEA
DESCRIPTION	<p>Aiming for a restorative or net positive environmental impact has been a recent trend in the sustainability strategies of European firms. Now the trend is beginning to show promising signs of life in Asia – and firms based in the west are leading the charge through their work with supply chains and local operations.</p> <p>BT is working with its suppliers to reduce their impacts as part of its Net Good initiative, meaning the ripple effect of its sustainability strategy is being felt worldwide. As part of its Better Future Supplier Forum, BT funds assessments for suppliers and provides consulting support. BT supplier SGW Global took advantage of this support and designed products with carbon footprints reduced by over 30% compared to previous designs.</p> <p>IKEA’s ‘Climate Positive Opportunities for Suppliers’ project with WWF provided factsheets to its suppliers both in Europe and in Asia to help them identify best practices in their specific areas for net positive measures. For example, one textile supplier in Bangladesh that participated in IKEA’s programme reduced its energy consumption by 29% and cut its CO₂ emissions by 25% by identifying and implementing efficiency measures – saving €1.1 million and 15,600 tonnes of CO₂.</p>
WHAT ARE THE ENVIRONMENTAL BENEFITS?	<p>‘Net positive’ strategies bring with them positive environmental impacts – whether it’s in terms of energy, carbon, water or resources such as timber. German chemicals firm Bayer MaterialScience has constructed one of the world’s first net positive energy buildings in India. The building generates 72,023 kWh of energy through solar PV and consumers 63,910 kWh per year, leaving a net positive of over 8,000 kWh.</p>
WHY IS THIS GAME CHANGING?	<p>With large multinationals exporting their sustainability values and net positive strategies into their supply chains, these firms’ top-down demands have a positive ripple effect. This is a significant step up from supplier scorecards that evaluate their suppliers’ sustainability policies but often lack teeth.</p>
WHAT ARE THE IMPLICATIONS FOR OTHER COMPANIES?	<p>When going down this road, western companies should be thinking in terms of the opportunities to add value that can be generated at each step of the value chain, within the context of a net positive sustainability strategy. Companies need to be open to the widely different benefits that can be generated: in the examples given above, IKEA’s suppliers are able to reduce costs and BT suppliers strengthened their customer relationship by redesigning their products; Bayer was able to break new ground in the design and operation of its buildings.</p>



'Net positive' strategies bring with them positive environmental impacts.

HUGE MARKET OPPORTUNITY FOR RESTORATIVE, CLEAN-AIR SOLUTIONS IN CHINA

INNOVATOR(S)	Philips; IQ Air; Blueair
DESCRIPTION	<p>In January 2013, smog levels in China reached unprecedented 'hazardous' levels. Official measures of PM2.5 (particulate pollution) rose to a high of 993 micrograms per cubic metre in Beijing, 40 times the level set by the World Health Organisation, which is no more than 25. Pollution was so bad that the government warned people to stay indoors. The negative health and environmental impacts of air pollution have created growing demand in China for clean air solutions.</p> <p>Netherlands-headquartered consumer electronics firm Philips leads the market in air purification systems. The firm, which has a 40% share of the Chinese air purification market, reported a rise in Chinese sales of 29% to €2.71 billion in the past year. Other European firms seizing this opportunity include Swiss company IQ Air and Swedish firm Blueair, which intends to further increase investment in its mainland China operations following a 300% year-on-year increase in sales.</p>
WHAT ARE THE ENVIRONMENTAL BENEFITS?	<p>China has an undeniable problem with particulate pollution. Smog conditions are a frequent occurrence in major cities, leading to an increase of respiratory diseases in major cities and growing concern from its populace in Beijing and Shanghai in particular. Clean air solutions capture particulates from the air and trap them in any of several types of filtration substrates – some can remove up to 80% of air particulates in large warehouses in one day's use.</p>
WHY IS THIS GAME CHANGING?	<p>The scale of the air pollution issues, coupled with the fact that there will be 170 million people moving into urban areas between now and 2022 in China, make tackling air pollution a game changer not only from an environmental perspective, but also from a human health perspective.</p>
WHAT ARE THE IMPLICATIONS FOR OTHER COMPANIES?	<p>The Chinese national government is investing \$283 billion to tackle air pollution over the next five years. A portion of this investment will go towards products that can make China's air safer. For instance, the Chinese air purifier market is expected grow annually at a rate of 34% until 2018, largely stemming from industrial air purifiers, but also from consumer demand for low-cost residential air purifiers. The speed of the market growth provides opportunities for new entrants to this market, despite the presence of incumbents.</p>



"The poor air scandal in Beijing has started to focus minds and the government and enterprises are starting to put a lot of money into better environmental management."

Michael Bennet, senior adviser, Forest Trends Beijing

LESSONS

This report highlights some of the green innovations that are flowing across the world, to and from Asia and developed economies in the west, with the potential

to scale up at the global level. For established businesses in Europe and other parts of the west, these trends have implications for their growth and progress where long-term sustainability factors are becoming increasingly important.

On one hand, with domestic innovation in Asian countries comes the risk of disruption in western markets: Asian companies are already competing in the developed markets based on much more than just low-cost manufactured goods.

On the other hand, opportunities exist for western businesses to introduce new products and processes that tackle resource constraints and pollution in Asia.

Lessons for western businesses from disruptive Asian innovations

- **Dramatic resource efficiencies are possible** – if you think outside the box. In fast-growing Asian economies, there's a growing need for innovation that appeals to a society hungry for faster, more advanced products and processes – but that innovation needs to account for resource limitations and environmental pressures. As such, entrepreneurs have responded by taking into account the concept of *jugaad*: adapting by creating new solutions to existing problems using far fewer resources. Dematerialising innovations – like the at-scale deployment of prefab buildings in China, or the dry-dyeing technology of Yeh Group – will migrate to disrupt western economies outside their originating countries. Western companies can respond with like-for-like thinking such as GE's lighter, lower-cost ECG machines.
- **The bottom of the pyramid provides lessons for business and environmental opportunities.** A recent EY study of global entrepreneurial cultures found entrepreneurship is particularly strong among climbing classes in rapid-growth markets like India – where positive images of entrepreneurs in media and education, social pressures, and encouragement of collaborative problem-solving are strong. Western firms should take a leaf out of this book and encourage innovation



Innovation needs to account for resource limitations and environmental pressures.

from the bottom of the pyramid, as this groundswell is ripe with potential. Microfinance models such as Grameen have tapped into the entrepreneurial spirits of resourceful, bottom-of-the-pyramid individuals who have been able to engender success out of constrained conditions. Grameen says it's the accountability among their entrepreneur base that enables it to achieve its 99% repayment rate. This concept was initially questioned, but has proven successful in the west with consistent growth of their US branches at Grameen America and climbing numbers of loans given out. The application of this model to renewable energy technology installation in Bangladesh offers new microfinance opportunities.

- **Embrace collectivism and partnerships to fast-track innovation.** The concept of what psychologists call 'collectivism' among individuals facing common problems is very strong in Asia and percolates throughout local cultures. For example, in Asian business etiquette, experts stress that group efforts are rewarded and no individuals are typically singled out – while individual successes are less likely to be rewarded. Lessons can be learned here: collaboration within a business, between businesses and with the consumer make ripe ground for quick innovation and the crowdsourcing of ideas. Partnerships among businesses and tapping into local networks have been key to the successes of Reet Aus, enabling the growth of this trash-to-trend business. Yeh Group cites its partnerships with global apparel labels as key to the success of the eventual proliferation of its dry-dye technology. Similarly, Teijin's entry into the Chinese polyester market with recycling solutions was de-risked by local partnerships.



There is no doubting the speed of the regional economic development nor the arrival of a new middle class with enormous purchasing power and appetite for material goods.

- **Allow for agility in your business model and flexibility in your product portfolio.** Success stories like Suzlon Energy and Shree Cement, which started off with completely different business models, found that their own unique solutions to environmental problems opened up completely new commercial opportunities. While both of these firms ended up selling energy, the potential exists to sell other services – as Germany's Ritter Gruppe has done by moving into renewable installation. This is consistent with the global move from products to services in the sustainable economy. BYD is also an excellent example of a multi-pronged business model enabling success across renewable energy, rechargeable batteries and electric transport markets, thus positioning itself not only to target city-wide renewable transit projects, but also more broadly to create end-to-end sustainable, zero-emission systems.

Lessons for western firms attempting to launch sustainable businesses in Asia

- **Look for opportunities arising from the tension between fast development and the environmental issues that come with it.** There's no doubting the speed of the regional economic development nor the arrival of a new middle class with enormous purchasing power and appetite for material goods. According to the World Economic Forum, 70% of the global middle class will reside in developing countries by 2030. But the environmental cost associated with these economic advances presents very real constraints on purchases, such as the curbs on using vehicles. At its heart, this tension is what underlies the restorative and clean tech opportunities. The BSB processes for reducing the impacts of buildings both in their construction and lifecycle stages are a typical response to the dual economic and environmental challenge.



Major driver for China's auto markets is the psychological thrill of declaring and projecting success by buying a car. This clashes with models of dematerialisation.

- Pay close attention to the regulatory landscape which creates markets on an unprecedented scale.** China in particular has created a favourable landscape for the development of its solar energy and electric vehicles market. The scale of the investments and hence opportunities is astounding, as evidenced by China's commitment to put half a million EVs on the road by 2020, attracting US firms such as GE and Solaria on the solar side. Other examples of regulatory initiatives include the Chinese national government's investment of \$283 billion to tackle air pollution over the next five years, which will be critical for firms selling restorative solutions, such as Philips and BlueAir, but also for potential new entrants. Similarly, the centralised power system has enabled the creation of the world's largest payment for ecosystem services schemes.
- Be prepared to cross cultural hurdles around resource thinking.** Throughout human history, acquisition of material goods has been an indicator of wealth and a status symbol. In erstwhile developing economies like China's, a culture of ownership still correlates with status. JD Power and Associates, which is an auto industry group that monitors consumer trends, says that a major driver for China's auto markets is the psychological thrill of declaring and projecting success by buying a car. This clashes with models where dematerialisation is the key to making sustainability advances. The reality is that physical and regulatory constraints that come as a response to the pollution challenges are forcing a cultural shift. Marketers will also take note when positioning clean tech alternatives such as the EVs of Tesla as the more desirable product over their fossil-fuel counterparts.



\$110 billion

The collaborative consumption is potentially a \$110 billion market

- **Leverage ‘social accountability’ for success in the sharing economy.** The collaborative consumption market is worth a potential \$110 billion. Coupled with the rise of the middle class’s purchasing power in the developing economy, there are opportunities for collaborative consumption models to really take off in these economies – but cultural hurdles, mostly around trust of strangers, need to be crossed. For example, Jamie Wang of iCarsClub says that mutual trust within Asian communities is not as high as in western countries. For iCarsClub, the worry could exist that their car users would not take care of their cars. But Wang argues that in Singapore and Japan, where education levels are high and western success is emulated, they have seen car-sharing success. One solution, originally touted by founders of the sharing company, is to leverage customers’ social accountability to those within their peer group through the internet – all transactions, comments and interactions would be made public online and form a ‘social currency’. In Bangladesh, the overwhelming success of Grameen Bank is proof of this concept that social accountability works: it was originally pioneered as an idea that entrepreneurs, though strangers to one another, if held accountable to one another would almost always pay back loans without collateral.
- **If you can’t do it yourself, get your partners to do it.** Entering a new market is seen by boardrooms as a potentially risky activity. Different regulations, customs and influence networks are best tackled with the help of local partners. But the case studies shown here underline the additional benefits of working with partners both inside and outside your current supply chain. For Bayer, IKEA and BT it’s a way to enable their net positive strategies either through local net positive actions, or from suppliers redesigning products to meet those goals. In the textiles sector, Reet Aus’s work with Beximco has allowed the upcycling innovations to be applied on a scale that wouldn’t otherwise have been possible.



The Grameen Bank has pioneered a new approach to support entrepreneurs.

LOOKING AHEAD

Businesses based in Europe and other parts of the west would do well to learn from how Asian firms are forging ahead with frugal innovation, working with entrepreneurs, embracing collectivism and moving clean technologies along. These advances are critical in running successful and resilient businesses in the face of international environmental challenges and a fast-changing global economic landscape.

Dry-dyeing textiles, prefab construction, solar-powered ATMs and other innovations that dramatically reduce material and energy use are on the rise in Asia and can undercut western firms unless they respond with similar entrepreneurial and frugal approaches.

Lessons can be taken from the waste reclamation that provides additional income for households and businesses in Thailand, to boost the ‘trash trade’ and circular economy in Europe and elsewhere. The textile manufacturer and cement producer in India that moved into renewable energy generation will add to the thinking of many businesses concerned about their own volatile energy bills.

BYD’s technical expertise across renewable energy, rechargeable batteries and electric transport in China, the US and the UK is inspirational for any business moving into more comprehensive mobility solutions.

More rounded freshwater solutions require closer working between public and private sectors, and the Chinese lead the way in payment for environmental services (PES) schemes. These are an important part of the mix and provide experiences that other companies in other markets can draw from.

For any company expanding into Asia, business growth that fits with efforts to tackle the social and environmental challenges will boost their appeal to local business and government partners. Western businesses can build on local interests in frugal product innovation and bring new complementary business model innovations, such as car-sharing, which helps to leapfrog car ownership and supports dematerialisation, reduced congestion and pollution cuts in mobility. Other approaches around collaborative consumption that are increasingly being tested out in the west could accelerate the dematerialisation of eastern systems.

The growing 'trash trade' in parts of Asia can be supported by other aspects of the circular economy brought by those western firms involved in the redesign of products for perpetual recycling, upcycling or the increasing set-up of business ecosystems to increase waste-resource cycles.

Asian renewable energy projects require technologies that fit with local equipment and infrastructures and need support around project management and performance management. Companies such as US-based Solaria bring this to the table. Philips is another business that capitalises on clean-up commitments in China through its air-purification technologies to reduce pollution in warehouses and other urban spaces.

Restorative or net positive strategies are increasingly embraced by a number of European companies. These are having an impact down their supply chains, including those based in Asia. Such strategies are already encouraging restorative measures by suppliers in the east.

Problem-solving across developed and emerging markets is becoming lucrative and is strengthening companies' international licence to operate. My thanks to all who were interviewed in this Green game-changers report and for providing valuable insights into innovative global trade.

Dax Lovegrove is head of business sustainability and innovation, WWF-UK

Innovation in numbers

100%
RECYCLED



48%

48% of Asia Pacific firms with revenues over \$250 million will increase their overall spend on sustainability 1-9%. (Verdantix Global Sustainability Leaders Survey 2012)

\$8.2 BILLION

Annual global investments in watershed services reached nearly \$8.2 billion in 2011, and China is leading the world with the lion's share of this transaction value (Forest Trends Beijing, Interview 2013)

10% OF GDP

Costs of environmental degradation in China approached 10% of GDP over the past decade; 6.5% of which is from air pollution. (World Bank "China 2030," 2013)

\$12,000 EXTRA

Car sharers in Singapore can earn up to \$12,000 extra income by sharing their car's idle time (iCarsClub, Interview 2013)

\$66 BILLION

China spent \$66 billion on renewables in 2012 (Bloomberg New Energy Finance, 2013)



Why we are here

To stop the degradation of the planet's natural environment and to build a future in which humans live in harmony with nature.

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