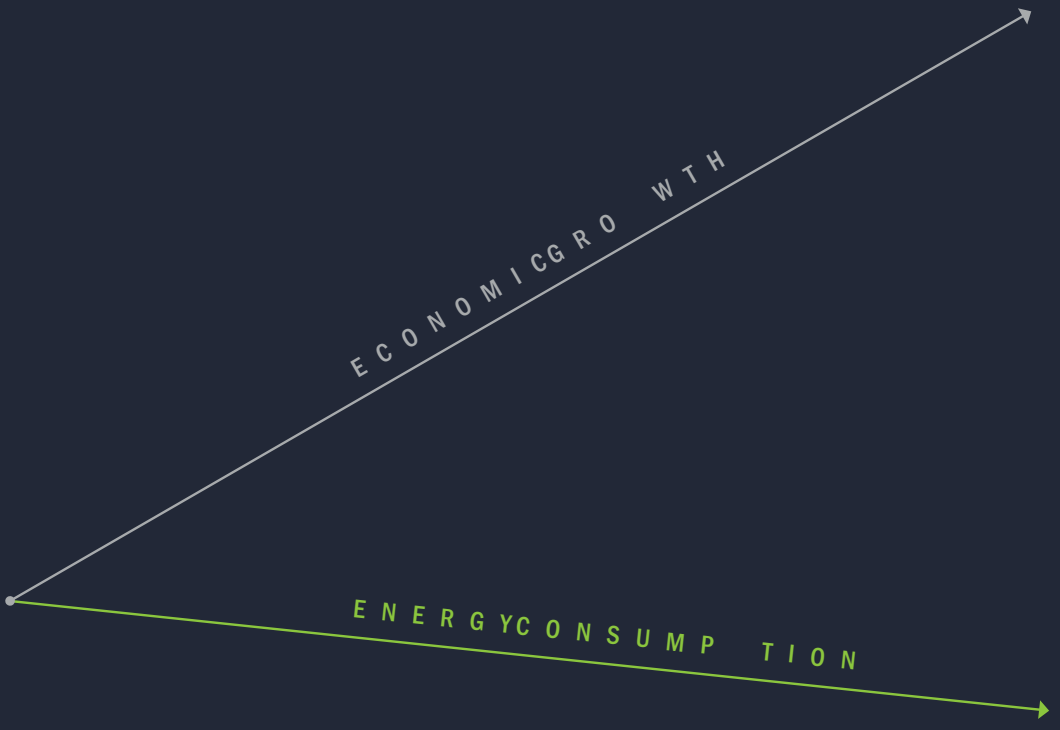
Less Energy — More Growth

Prosperity through efficiency

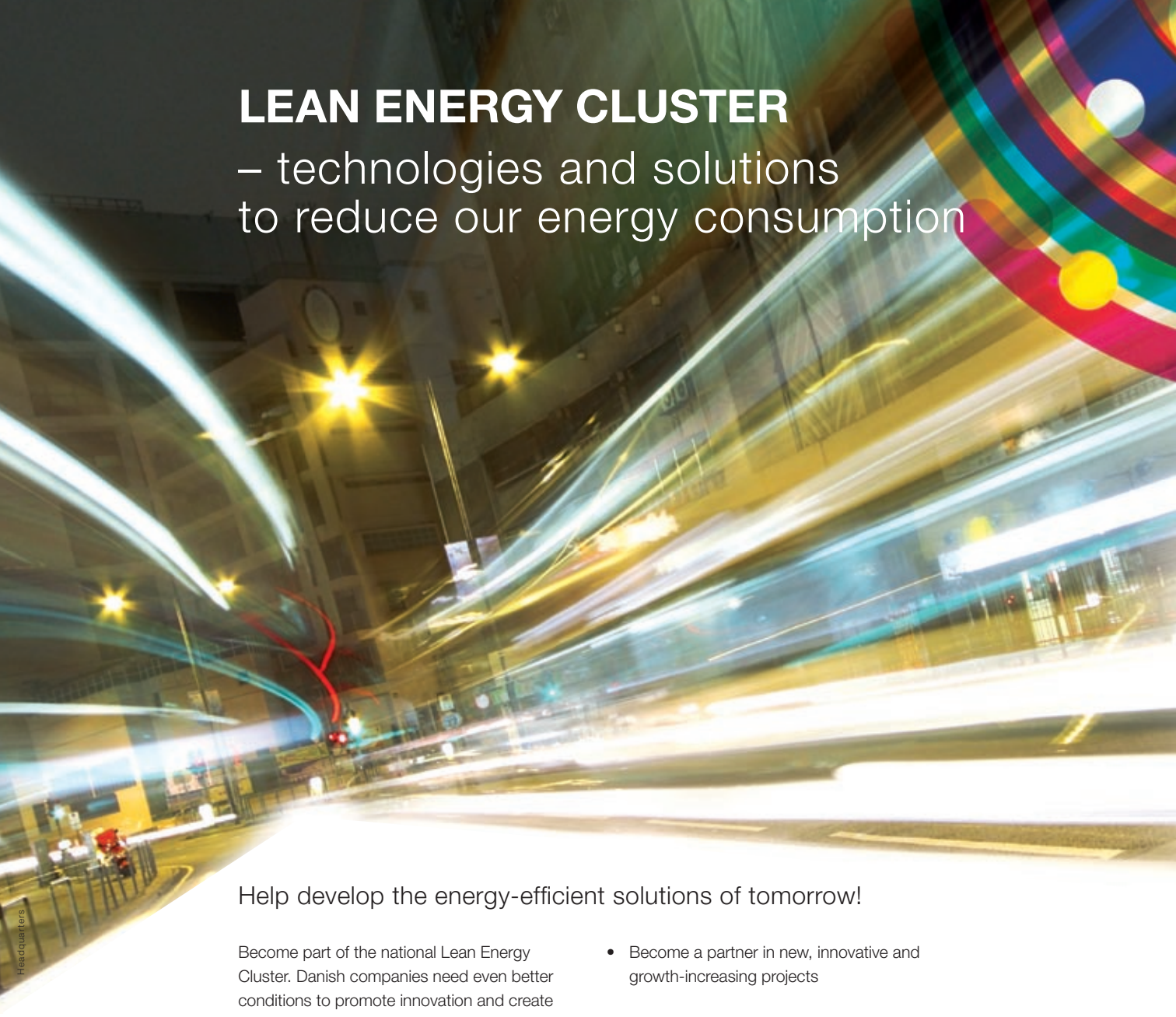


LEAN ENERGY CLUSTER

Mondaymorning

LEAN ENERGY CLUSTER

– technologies and solutions to reduce our energy consumption



Help develop the energy-efficient solutions of tomorrow!

Become part of the national Lean Energy Cluster. Danish companies need even better conditions to promote innovation and create new markets, jobs and economic progress.

That is why we have created the Lean Energy Cluster. The Cluster consists of companies, public players and science institutions. Together, they create the framework for the development and creation of energy-efficient technologies.

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- Obtain increased visibility for your company and your products
- Gain access to our network, sparring op portunities and new cooperative possibilities
- Learn about the latest educational offers and research results

If you wish to learn more about the Lean Energy Cluster and possible membership, please contact us at info@leanenergy.dk or call Communications Manager Rebekka Bøgelund, mobile: +45 20 487 487.

Read more about the Lean Energy Cluster at **www.leanenergy.dk**

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Less is more

Denmark has successfully decoupled economic growth from energy consumption. Demanding more from less has made Denmark one of the most energy-efficient countries in the world.

Without an increase in the consumption of energy Denmark has created jobs and a strong green industry.

More than 1,200 cleantech companies currently operate in Denmark – one-fifth within energy efficiency – contributing approximately 10 pct. to the total exports of the country.

The global market is increasingly calling for solutions within energy efficiency. Whereas the economy of the past century was fueled by cheap and abundant coal, oil and natural gas, scarcity will shape the 21st century.

In this century, we will not have the luxury of time. Tsunamis of people are approaching the urban shores, as 80 pct. of the population in developed countries will live in cities in 2020. Entirely new – and energy-efficient – cities need to be built.

Single technologies will not suffice in this challenge – only collective solutions will.

That is why Monday Morning, Lean Energy Cluster and their partners have come together to present this report.

It describes the growth potential that comes from demanding more from less; why companies should form clusters, share knowledge and create a complete and exportable package of solutions; why energy efficiency is the shortest – and cheapest – way to cut emissions and reduce the demand for fossil fuels, and still holds a lot of potential in Denmark; why the future winners in the global business community will be those who adapt to a new energy-efficient reality; and what drive investments in energy efficiency.

We will also stress that solutions are ready and available today. Throughout this report, you will be introduced to these Solutions of Today – existing solutions that will save energy and grow the economy. Solutions that make it possible to get more from less.

Enjoy the read.

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BE › THINK › INNOVATE ›

The biggest energy change we can make right now

is the one nobody knows about

Pumps provide one of the single biggest savings opportunities in industry. Find out how the rigth motor technology can reduce their power consumption by up to 60% at grundfos.com/energy

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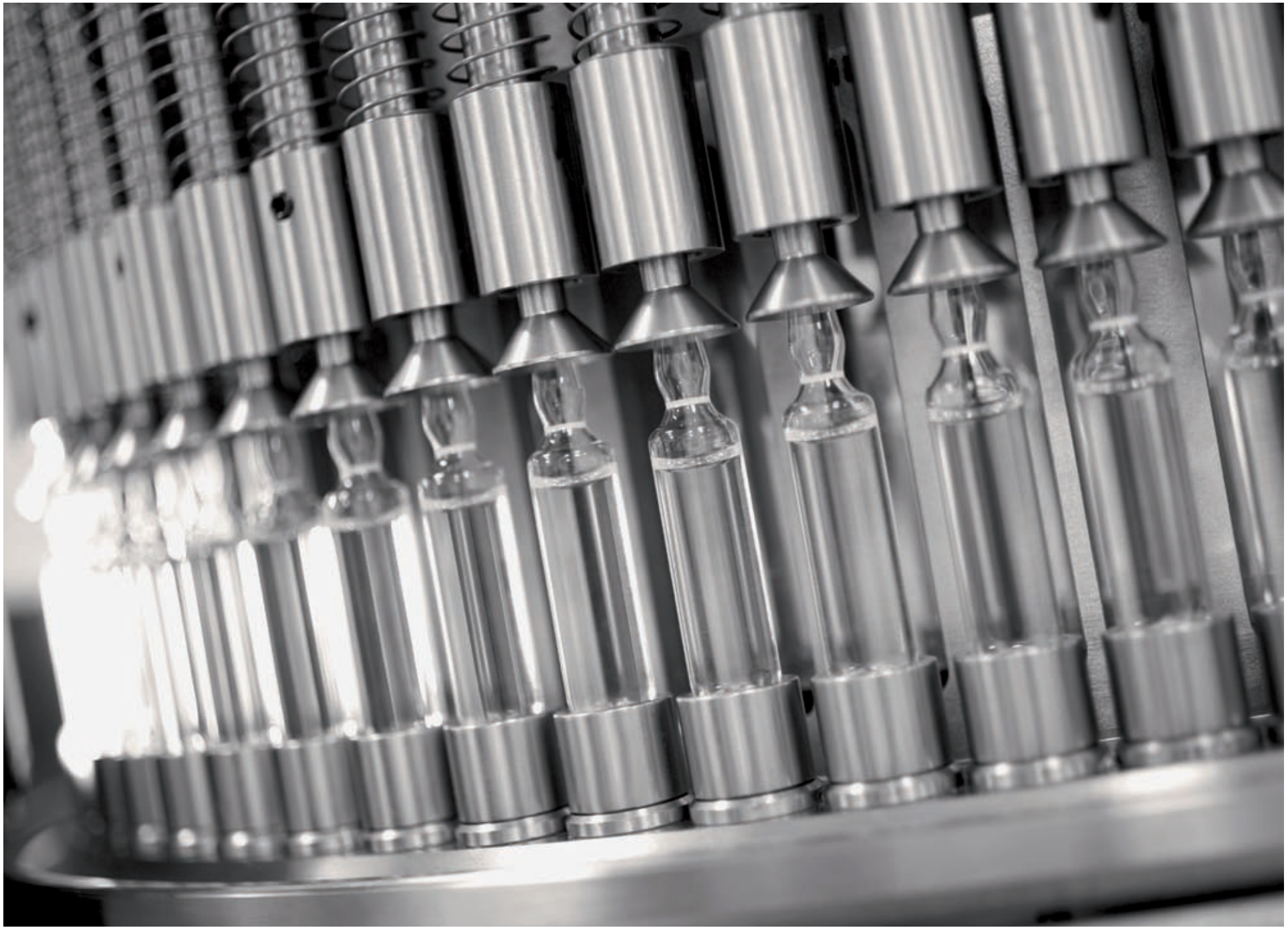

Less energy – more growth

Denmark is one of the most energy-efficient countries in the world. Through an ambitious strategy, Denmark has achieved steady economic growth without an increase in energy consumption. Benefits include job creation and a strong green sector.

Denmark's energy consumption has not grown for 30 years, despite economic growth of around 70 pct. Over one-fifth of the electricity Danes use today comes from renewable sources.

Combine the two and it means that Denmark's CO2 emissions are falling.

Since the great energy crises of the 1970s, only a few countries have achieved what Denmark has: increasing the efficiency of industries and cutting energy consumption in households. The country has managed to decouple economic growth from energy consumption (See Figure 1 on next page).

From an international perspective, Denmark's experience provides important lessons on how to decrease an economy's dependence on fossil fuels. When the first oil crises hit, many countries were dependent on foreign oil. Denmark was one of them. With energy production based almost entirely on imports, the effect of the crises was devastating and brought the issues of energy security, energy independence and energy efficiency to the top of the political agenda.

Several policies were employed. The North Sea was explored for oil resources, support for alternative energy sources was increased and investments in infrastructure and efficiency were made.

The policies pursued by successive Danish governments were consistent over a long period. The lesson for any country seeking to reduce its dependence on fossil fuels: It is crucial to secure a stable coalition to support policy change, one that thinks long term and invests accordingly.

Through policies mandating energy efficiency in buildings, taxing delivered energy, and subsidizing energy efficiency measures, Denmark had the same gross energy consumption in 2010 as in 1980.

Energy-conscious growth story

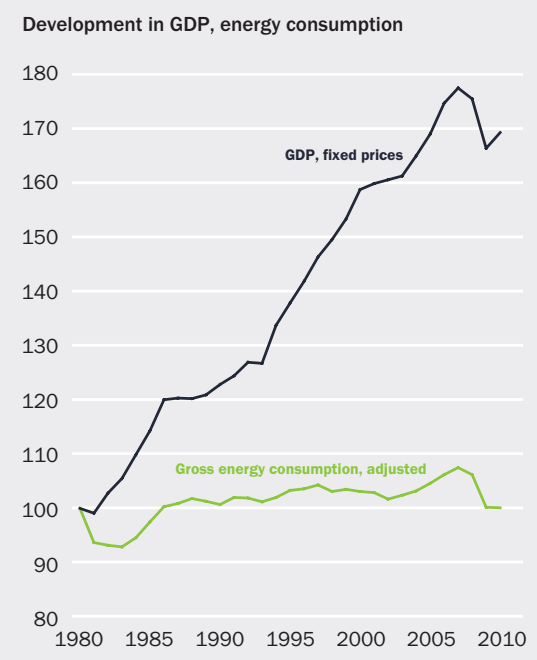

Figure 1: Denmark has cracked the code for sustainable growth.

MM **Source:** Danish Energy Agency

Meanwhile, the energy mix over the past thirty years has changed considerably. Adding renewables and natural gas to the grid instead of oil and coal has slashed carbon emissions.

GREEN GROWTH: This is not only a story of environmental achievements, however. It is also a story of how a mix of tough environmental and energy taxes; an abiding political vision to make Denmark energy self-sufficient; and close cooperation between public authorities and scientific institutions, the business community and the wider population has created green growth.

Investments in energy efficiency should be seen in a broader perspective.

It is not just about reducing energy consumption and carbon emissions. It is also about creating jobs and business opportunities: Green growth across the entire economy – not just in the cleantech sector.

Whereas the economy of the past century was fueled by cheap and abundant coal, oil and natural gas, scarcity will shape the 21st century. A growing global population will accelerate the drawdown of diminishing resources (See Figure 2).

The search for cheap and reliable alternative sources to satisfy our energy demand has been under way for decades. However, the cheapest energy remains energy never used. Lowering demand through energy efficiency still holds huge potential.

Over the next 25 years, world energy consumption is expected to increase by one-third. This will place strain on fossil energy resources – increasing prices and uncertainty. Already, the price of oil has been turbulent and increasingly expensive over the past decade (See Figure 3).

As countries' growth potential depends on access to energy, this will accelerate the global race for resources. Furthermore, the increasing prices on fuel will redefine world trade as we know it. Producing and transporting goods in an energy efficient manner.

SOMETHING IS ROOTING IN THE STATE OF DENMARK: The evidence from Denmark supports the case that increased use of renewable energy and energy efficiency should be seen in a broader perspective, one that highlights the potential of green jobs.

According to a recent study, "Cleantech – the Golden Egg of Danish Economy" by Brøndum and Fliess, more than 1,200 cleantech companies currently operate in Denmark – a fifth of these within the energy efficiency sector.

In its most recent data report, the Danish Energy Agency, which tracks exports in this sector, reported that Danish companies exported 52.2 billion DKK worth of energy technology in 2010, or 9.5 pct. of total Danish exports – a European high (See Figure 6 on page 11).

Danish energy technology exports have fallen, however, as a result of fierce international competition and the global economic crisis. From 2009 to 2010, Danish exports of energy technology fell by 10.3 pct., while the European average increased by 12 pct. However, looking at the past decade, Denmark still outperforms other European countries with an

World Population

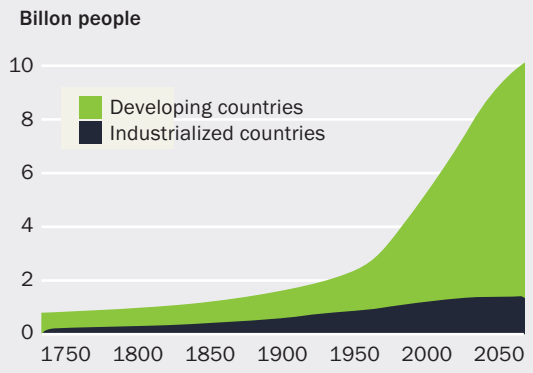

Figure 2

MM **Source:** World Energy Outlook 2010.

Rising oil prices

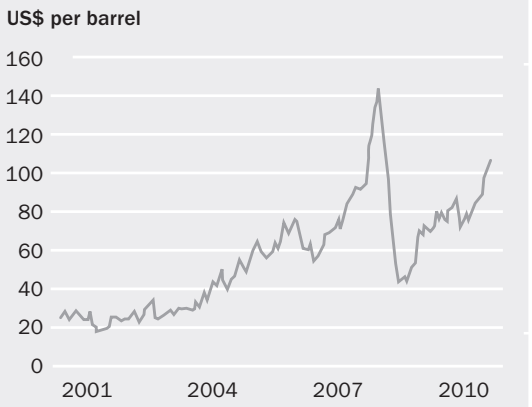

Figure 3

MM **Source:** Bloomberg.

Energy technology exports

Figure 4: Development in energy technology exports, indexed.

MM **Source:** Danish Energy Agency.

Turnover and employees

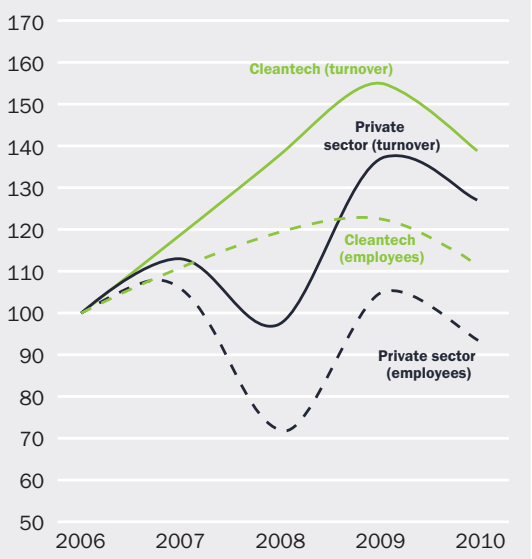

Figure 5: Development in turnover and number of employees in the cleantech field compared to the Danish private sector as a whole, indexed.

MM **Source:** Cleantech - The Golden Egg of the Danish Economy.

97.7 pct. increase in exports compared to 61.7 pct. (See Figure 4).

Also, while the global economic crisis did impact the cleantech sector in Denmark, it still outperforms the Danish private sector overall with regard to turnover and number of jobs, according to the study by Brøndum and Fliess, and has done so the past five years (See Figure 5).

The cleantech sector has clearly rooted itself as an integral and important part of the Danish economy and exports.

HOMEMADE JOBS: In the current economic situation, investment in energy efficiency offers governments a much-needed tool to avoid economic stagnation.

Countries preoccupied with job creation are looking at green jobs as an environmentally and economically sustainable solution – as some green jobs cannot be exported.

Investments in energy efficiency measures redirects money otherwise spent on energy costs, reduces emissions and uncertainty, and creates jobs – via the short-term employment of labor otherwise idle during recession and the long-term recycling of the cost savings from energy efficiency improvements.

We have already seen energy efficiency programs deployed as an important part of stimulus packages in Europe and the United States. In the 2009 U.S. stimulus bill, 5 pct. of the $787 billion allocation was targeted to the renewable energy industry; the two largest portions of that $41.4 billion were put into energy efficiency and smart grid technology. The investment in energy efficiency, especially, has immense positive and immediate economic implications.

Programs such as building retrofitting and weatherization are labor intensive and require on-site work that does not compete with cheaper overseas labor. Efficiency programs can create net employment that would otherwise sit idle during economic downturn.

Energy efficiency advocates have for years highlighted the economic benefits of these programs. One of the most comprehensive studies supporting the case is a study of job creation in California by Dr. David Roland- Holst. The study, which reviewed a 34-year period, suggests that the increase in disposa-

Export

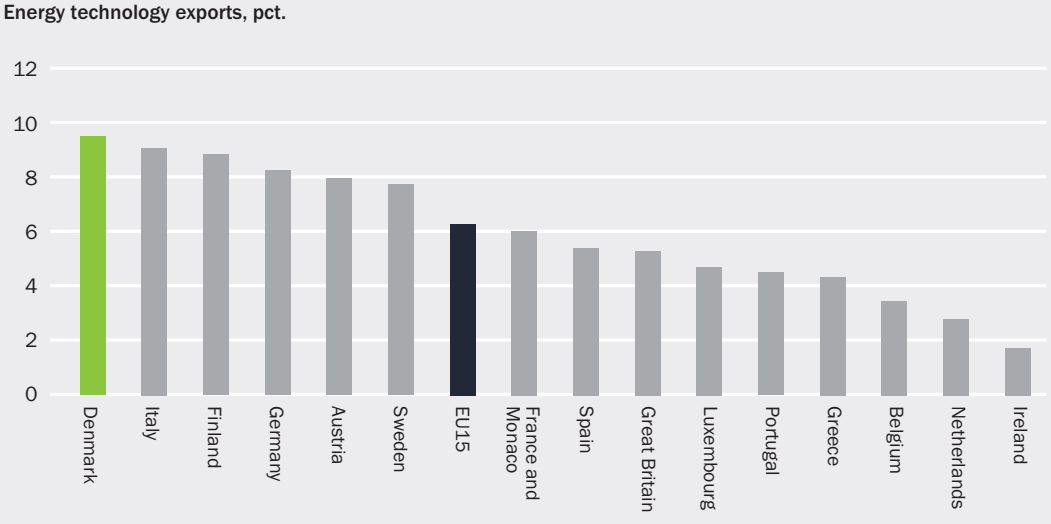

Figure 6: Energy technology exports share of total exports.

MM **Source:** Danish Energy Agency.

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Solar Inverters

Short description of solution:

Solar cell inverters convert direct current from each section of the solar cell facility to alternating current, which is distributed into the buildings power network. The inverters automatically optimise the output according to the quantity of power produced by the solar cells. If not enough solar power is produced, the inverters shut down automatically.

Energy saving potential:

The solution has been implemented in the newly built Crowne Plaza Copenhagen Towers, where energy-efficient technology has cut energy consumption by 53% when compared with conventional hotels. Annual CO2 savings are estimated to reach 1,373 tons.

Economic potential:

The solution is very suitable for similar buildings to be constructed all over the world.

The product is already exported to China, South East Asia and Europe, and in all regions Danfoss see increasing demands.

Solution provided by:

Danfoss

ble household income stemming from energy savings can be responsible for the creation of many jobs. Dr. Roland-Holst's findings show that about 1.5 million induced FTE (Full time employee) jobs with a total payroll of $45 billion were created due to the energy efficiency savings of $56 billion from 1972-2006.

However, these findings have met with skepticism by critics. Will green jobs just replace those lost in declining brown industries? Is a Keynesian stimulus the most effective way of creating long-term jobs? Others note that new demand generated by reallocated savings from energy efficiency might itself drive up energy demand and minimize any emissions reductions.

IT'S THE DEFINITION, STUPID: Environmentalist, companies and politicians therefore frequently fight

over the size of the green economy. While advocates view green jobs as having massive potential, critics contend that the green jobs argument, and its link to energy efficiency, rests on uncertain ground, making aggressive policy hard to justify.

One reason for this dispute is that a universal definition of "green jobs" is yet to be decided on. Getting to an agreement may prove difficult.

Installing wind turbines or solar panels are, of course, green collar jobs. But what about bus drivers or bicycle manufacturers or repairmen? Bus drivers and bike manufacturers enable people to leave gas-guzzling cars at home, arriving at work in an energy efficient way. However, bus drivers are seldom classified as green jobs. A lot of jobs fall in that category of "unsung green heroes."

In addition, neither green job studies nor their critiques typically include avoided environmental costs or other potential benefits (such as less imported fossil fuel and reduced health care costs) that would favor increased energy efficiency. Investments in energy efficiency provide protection from political and economic risks associated with relying on a limited suite of energy technologies and fuels often controlled by unstable regimes.

Another benefit: Ensuring increased efficiency in the transportation sector would not only reduce carbon emissions but also congestion and deaths in urban areas from local air pollution. The City of Copenhagen has examined the effects of travelling by bike or car. Looking at the total cost of air pollution, accidents, congestion, noise and wear and tear on infrastructure when travelling by bike and car – bikes came out on top. For every kilometer traveled by bike instead of a car, the city saves DKK 0.45. Economic benefits such as these are often overlooked when discussing energy efficiency investments and programs.

LESS ENERGY – MORE GROWTH: Studies - such as "Green Jobs and The Clean Energy Economy" - suggest that countries and companies taking strong early action to save energy stand to benefit most, due to the increasing certainty of a market price on carbon and tightening of emission limits over time.

Evidence comes not just from Denmark. Several countries have built strong industries by encouraging renewable energy and energy efficiency.

Germany has offered a 20-year "feed-in" tariff since 1990 and subsidized rooftop and utility-scale photovoltaic (PV) installations since 1991. In addition, to encourage adoption, from 1995-2004, the government provided loans for PV installation. The policies made Germany the world's top market for solar installations.

During the first oil crises in the 1970s, Japan was completely dependent on imported energy. Today, solar- powered electricity in Japan is cost-competitive with electricity produced from coal. The solar-industry operates without subsidy, and Japanese manufacturers account for a substantial share of the global PV market.

In Denmark, renewable energy and energy efficiency investment have been strong drivers for economic development and employment while insulating the economy from the volatility that stems from overreliance on a few energy technologies. It's a path of environmental – and economic – sustainability.

Sources:

Berkeley Roundtable on the International Economy: Denmark – Country case analysis, 2011.

Brøndum & Fliess, Cleantech – with the Customer in Focus – The Golden Egg of Danish Economy, 2011.

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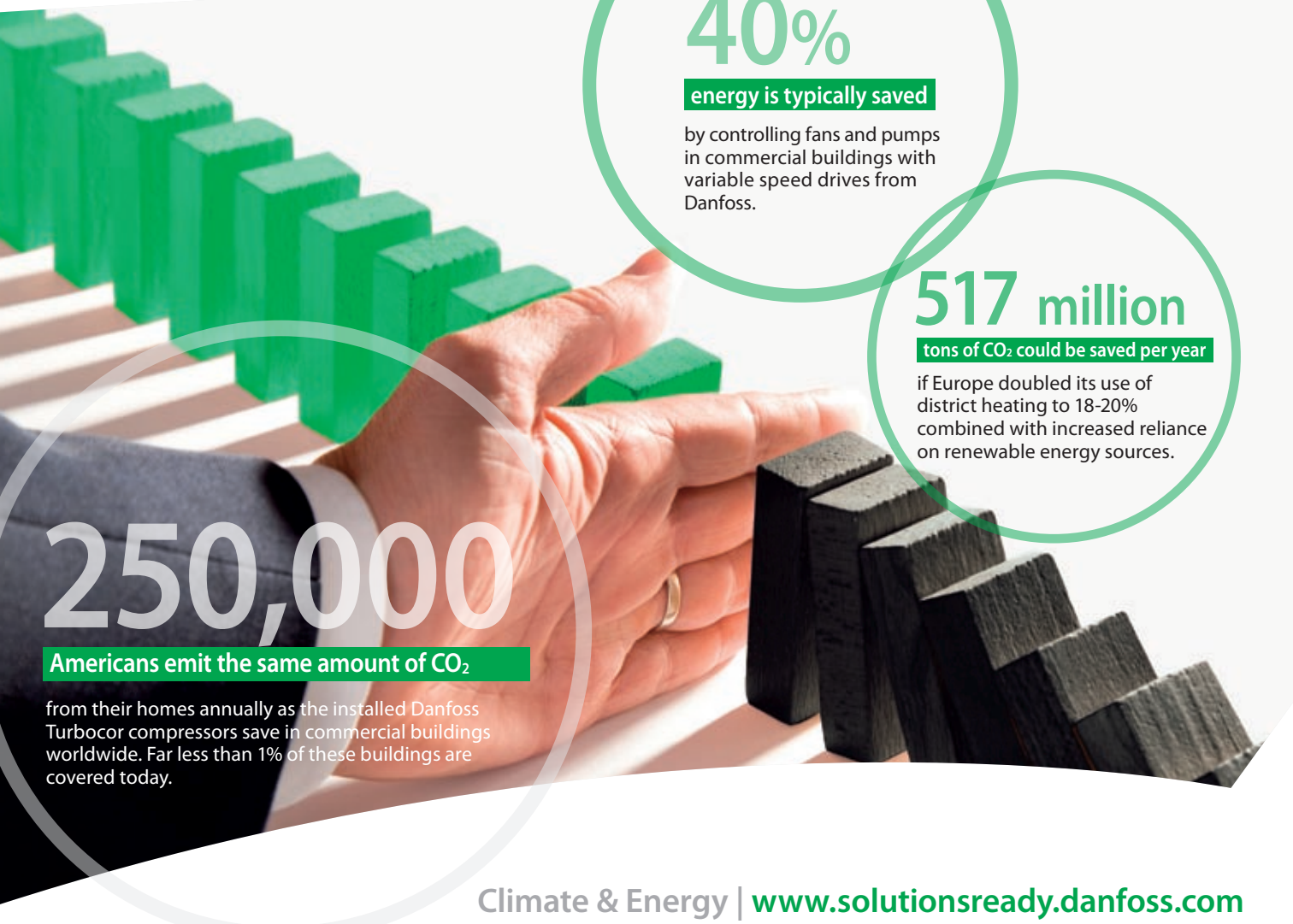
Daniel M. Kammen, Founding Director, Renewable and Appropriate Energy Laboratory University of California, Berkeley & Ditlev Engel, Chief Executive Officer, Vestas Wind Systems A/S: Green Jobs and the Clean Energy Economy, 2009.

Danish Energy Agency.

MAKING MODERN LIVING POSSIBLE

Save energy and CO_2 today
The solutions are ready!

Danfoss is a global leader within energy-efficient solutions that help save energy and combat climate change. Our key competencies are the cooling of food, air conditioning, the control of electric motors and the heating of buildings – as well as solutions for renewable energy such as solar power and heat pumps. We have built up our competencies within these areas over the past 78 years.



40%

energy is typically saved

by controlling fans and pumps in commercial buildings with variable speed drives from Danfoss.

517 million

tons of CO_2 could be saved per year

if Europe doubled its use of district heating to 18-20% combined with increased reliance on renewable energy sources.

250,000

Americans emit the same amount of CO_2

from their homes annually as the installed Danfoss Turbocor compressors save in commercial buildings worldwide. Far less than 1% of these buildings are covered today.

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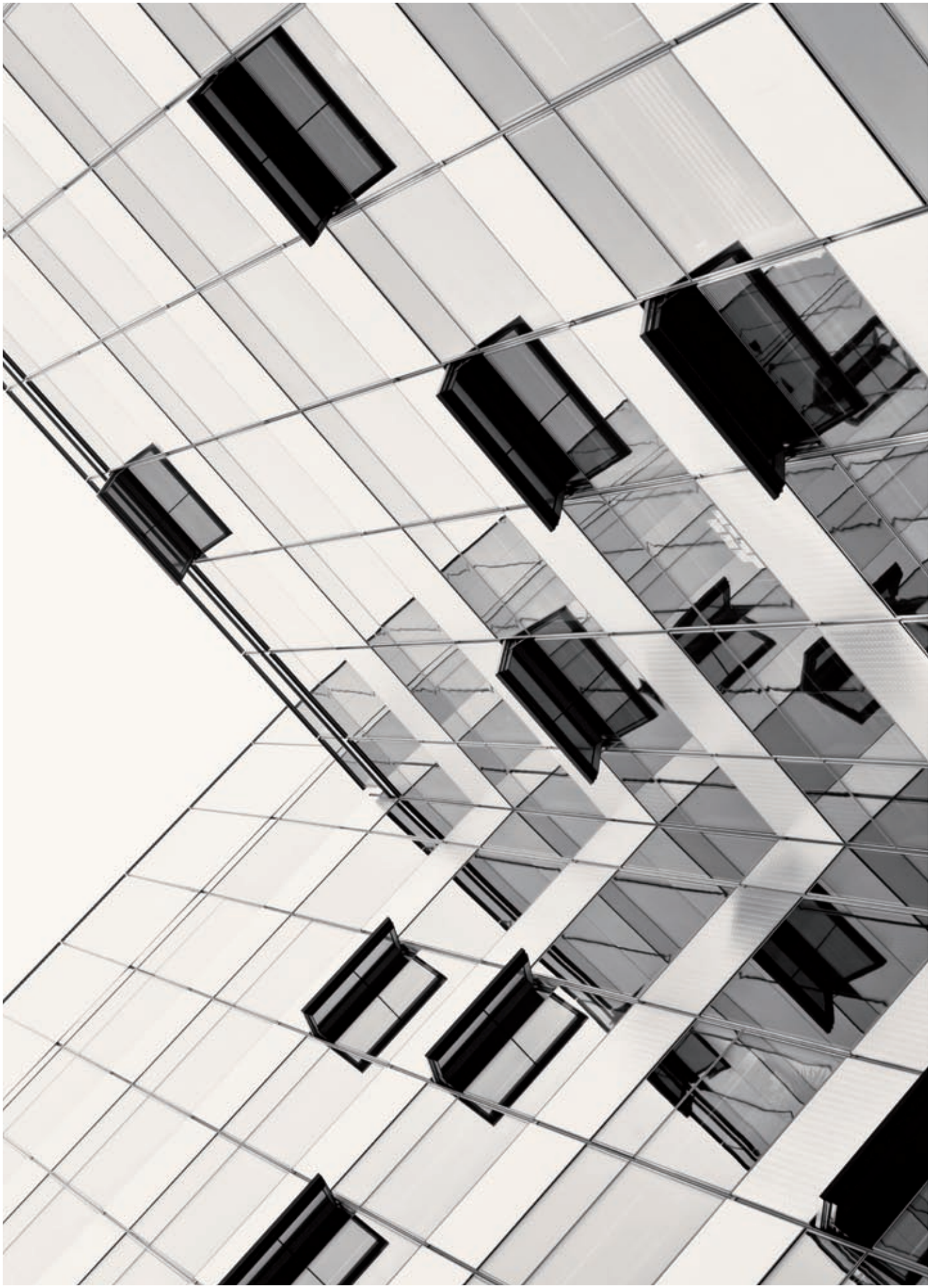

Danish technology makes your operations "Lean"

Productivity is essential to compete in global markets. That's common knowledge to Danish companies. Energy crises, skyrocketing taxes and record-high wages have turned Danes into productivity experts. In southern Denmark, these competencies become solutions that make operations lean, speed up processes and save companies money.

When California long-haul trucker Santiago Rosales rolls up to Three Harbors, an off-dock depot in Oakland, to pick up cargo that often has to be refrigerated to its end destination, he crosses his fingers that it will be stored in a "Star Cool" container.

He does so for two reasons. Refrigeration containers, or "reefers," are often quite noisy, making it difficult to communicate and sleep at night on long-distance travels. The Star Cool container is the quietest reefer in the industry. But most important: It saves him money.

As an independent trucker, Rosales pays upfront for the diesel used by his truck. A costly affair, considering retail prices for diesel in the US increased from just above $2 a gallon in 2007 to nearly $5 a gallon in late 2011. A lot of diesel is burned to run the generators that keep a reefer and its cargo at set point.

Rosales has found that he can save up to $2.28 per gallon of diesel consumed by carrying a Star Cool container. A survey of truckers who frequent Three Harbors revealed that those carrying a Star Cool container saved a minimum of 20 pct. compared to other reefer units (See Figure 1). That not only saves the truckers money and ensures a good night's sleep. It also makes their operations leaner, lowering their diesel consumption and allowing them to drive longer distances without stopping for fuel.

The secret behind Santiago Rosales', and the other California long-haul truckers', dramatic savings is combining innovative technologies from the members of the Lean Energy Cluster, based in southern Denmark. While the Star Cool container itself is trademarked and marketed by world-leading container manufacturer Maersk Container Industry (MCI), it contains critical components from several other cluster members. That includes high-efficiency permanent magnet motors from Grundfos, one of the

02. Solutions of today

Star Cool

Short description of solution: The Star Cool (also known as a reefer unit in the transport industry) is designed to perform the lowest Total Cost of Ownership.

Energy saving potential: Tests performed by the users have documented that in comparison with other reefer units, the Star Cool uses up to 50% less energy.

Economic potential: With fuel prices rocketing and no ceiling in sight combined with an accelerated conversion from conventional reefer bulk vessels to container vessels, MCI see a huge export potential in the Star Cool unit. Because of the low power consumption, shipping lines are now able to power the Star Cool units in pairs where traditional reefer units are powered by single individual power cords. MCI believes that energy efficiency will increasingly dictate competitiveness in the future and have therefore made it their core strategy to provide the most energy efficient products in the market.

Solution provided by: Maersk Container Industry

world's largest pump manufacturers; motor controls from Danfoss, one of the world's leading manufacturers of high-efficiency electronic and mechanical components; and intelligent climate controls from one of Denmark's fastest-growing electronic companies, Lodam Electronics.

Together, these technologies offer a unique solution, setting new industry standards for low noise, durability and energy savings, while helping customers and users achieve leaner operations – a win-win for members of the Lean Energy Cluster and their customers. As Søren Leth Johannsen, MCI's Chief Commercial Officer, says: "The spillover effect for both is a competitive advantage in the market, and a technological edge to your competitors."

ADVOCATES FOR A DANISH "GREEN LEAN" CULTURE: According to Søren Leth Johannsen, the "cluster effect" confers a tremendous advantage on companies in southern Denmark. "It gives access to world-leading energy-efficient technology, and it's a forum for the exchanging of experiences," he says. "That's especially expressed in the cooperation around our Star Cool technology."

Like other members of Lean Energy Cluster, MCI believes that energy efficiency will increasingly dictate competitiveness in the future. MCI's core strategy is to provide the most energy-efficient products on the market. "All through the value-chain, from R&D to sourcing and production, we are focusing on creating the lowest -possible carbon footprint. In operations, it's documented that our solutions are causing the lowest carbon emissions in the industry," Johannsen says.

The story is similar for other members of Lean Energy Cluster, making them advocates for a widespread Danish "green lean" culture.

Danish companies, over many years, have been forced into thinking about productivity and the environment. The energy crises of the late 1970s and early 1980s led to high energy taxes and tough environmental legislation in Denmark. At the same time, increasing global competition, record-high living costs, and high income taxes and wages made it difficult to run a company in Denmark, especially a manufacturing plant.

The industry's reaction, though, was to ramp up productivity and green innovation. Today, Denmark is one of the most competitive and energy-efficient nations in the world. A green and lean public sector and industry have together managed to grow the Danish economy 70 pct. over the last 30 years, without increasing the nation's energy consumption (See article "Less Energy, More Growth").

In that context, the Lean Energy Cluster in southern Denmark is spearheading the Danish "green lean" culture – blending the demand for increased productivity with the need for energy efficiency. The cluster's solutions meet the fast-growing global need for energy efficiency and acknowledgement of the rising challenges of resource scarcity and energy security.

"Our vision is to develop solutions that use as

Containers and fuel consumption

Cooling Unit OEM	Generator Set Type	Miles *Average*	Hours *Average*	Diesel Gallons Used *Average*	Miles/ Gallons	Gallons/Hour
Star Cool (SF)	Dual frequency	1,614	49	31	52.28	0.63
Star Cool (SC)	Single frequency	1,418	47	40	35.24	0.86
Other brand	Dual frequency	1,362	38	40	33.93	1.05
Other brand	Single frequency	1,372	40	51	26.70	1.29

Figure 1: Data provided by truckers show a 22 pct. savings when using a Star Cool refrigeration unit via a single-frequency generator set when compared to other cooling units powered by a dual-frequency generator set.

MM **Source:** Integrated Reefer News, 2011.

little energy as possible to secure a modern welfare society, without compromising the comfort of living," says Peter Gedbjerg, CEO, Lean Energy Cluster.

TAKING YOUR OWN MEDICINE: Members of the southern Danish cluster aren't just preaching and marketing being lean and energy efficient through their products. It's something they are living. Most of them being early adopters – and interpreters – of Japanese automaker Toyota's groundbreaking business philosophy, Lean. "Basically Lean is about minimizing waste in all aspects of a company's processes, and that's a pivotal cultural element defining most of the companies behind Lean Energy Cluster," Peter Gedbjerg says.

Thus far, Lean has been used primarily as a tool to boost productivity by minimizing waste and increasing product quality on the factory floor. But interpretations in the direction of "Green Lean," which encourages enterprises to trim their resource consumption in general and thereby optimize their carbon productivity, have, in just a few years, become a competitive parameter used to save costs, attract investors and secure access to new markets. It is here that members of the Danish Lean Energy Cluster are global leaders.

"There is a clear movement in the industry from marketing energy-efficient solutions into branding the companies themselves as energy-efficient entities, being lean in everything they do," says Per Michael Johansen, Professor and Dean of the Faculty of Engineering, University of Southern Denmark.

Per Michael Johansen, a university partner and Lean Energy Cluster Board Member, considers this a new megatrend, driven by rising societal demands for responsibility. In response, the southern Danish companies are selling energy-efficient solutions and making themselves showcases for energy efficiency by literally taking their own medicine – and exercising "green lean."

Danfoss makes a good case for this trend. In 2009, the company launched an ambitious climate strategy called "3x25," committing Danfoss to cut its carbon emissions by 25 pct. and to source 25 pct. of its energy from renewable sources by 2025. "We will achieve these goals by taking our own medicine," says Kim Christensen, head of Danfoss Heating Solutions and Board Member of Lean Energy Cluster. "It's about being energy efficient in everything we do," he says.

Put into practice, it is Danfoss Solutions – Danfoss' in-house ESCO, or energy service company – that shall realize the energy savings. Danfoss Solutions delivers energy cost savings on a "no cure, no pay" basis, guaranteeing that the energy efficiency projects installed are paid for through the savings generated. For Danfoss, the task, as established in its climate strategy, is to reduce the company's energy bill by 35 million DKK annually by, among other things, installing Danfoss' own energy-saving technology, such as frequency converters, in the company's plants.

Another tool is to focus Danfoss' comprehensive internal and external lean programs on energy efficiency. In the "Danfoss culture," lean is advocated by shop-floor workers and executives alike. It's used to continuously improve the company's productivity – one reason, according to Kim Christensen, that Danfoss can maintain manufacturing facilities in a high-cost nation like Denmark. "It also helps us to minimize waste of all kind, including energy and other resources. And these effects we will investigate more thoroughly in the future," he says.

Danfoss also plans to help its suppliers become leaner and greener as well. "We already assist suppliers setting up lean manufacturing processes. But when we are through designing processes to make our own plants lean on energy, we will assist our suppliers doing likewise," says Kim Christensen. "In the end, we believe this will create still more value for our customers."

TOTAL COST OF OWNERSHIP: Even a relatively small company in the southern Danish energy cluster like Lodam Electronics, with 60 employees, has a clear vision of creating more value for its customers, and becoming more energy-efficient and sustainable itself. "As a an electronic company, our 'production' isn't particularly energy intensive. But we focus on our internal sustainability by securing new buildings that live up to the highest energy standards, and by investing in sustainable energy such as geothermal heat," CEO Henning Kristensen says.

According to Kristensen, the guiding principle for Lodam, both for the company's sustainability agenda and the solutions it provides to customers, is

INTELLIGENT ENERGY CONSUMPTION REQUIRES INTELLIGENT HOLISTIC THINKING

How do we use the energy more intelligently? A crucial step is, according to Dean Per Michael Johansen, to ensure cohesiveness and holistic thinking across the many players and activities in the field of energy. It is about the research, future and progress of energy.

Energy Centre of Southern Denmark (Syddansk Energicenter)
In 2010, the Faculty of Engineering, University of Southern Denmark received 9.5 and 6.5 million Danish kroner from Syd Energi and Danfoss Foundation, respectively, for setting up the Energy Centre of Southern Denmark. Through research and development projects the centre will cooperate broadly with industry to speed up the development of intelligent management of our energy consumption.

Nationally rooted with a global outlook
According to Per Michael Johansen the objective is to create a nationally rooted centre with a global outlook: 'Denmark is a strong player in the development of sustainable energy technology.
With the centre as the common base we are able to invite all the energy companies to cooperate interdisciplinarily. This will generate results that will be noticeable to the citizens and, at the same, time improve our competitiveness in knowledge-intensive energy products globally. At present we are working on, for example, energy saving technologies for green houses and the development of fuel cells – all in the cross field between in-depth research and the application oriented return-on-investment approach of industry'.

New study programme in energy
A professor in energy efficient mechatronic components will be employed, who will be based locally at the Mads Clausen Institute at Alsion in Sønderborg. The professor will, together with a number of researchers and PhD students, be manning the centre, but also students will be a large part of the centre's activities: In September 2011, 30 new students started on the new engineering programme in Energy Technology. That the students will benefit from the centre's knowledge and network ensures that they, once graduated, will have significant experience with projects and close contact with industry.

Contact: Per Michael Johansen
pmj@tek.sdu.dk / 2778 7302

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to focus on total cost of ownership. "It's about being willing to pay a little bit more upfront for solutions that will save you money later on the energy bill," he says.

This can be a challenge, as the customer who specifies the solution in some cases isn't the same person or company that pays the energy bill. For instance, the primary customers for Lodam's intelligent controls are companies producing refrigeration and HVAC (heating, ventilation and air conditioning) systems. But the ones paying the energy bill are end-users of the systems – building owners, supermarkets or shipping companies.

"The task for us is to convince our customers that their customers are better off with a slightly more expensive but more energy-efficient solution," Kristensen says. A task that's getting easier to communicate as a spillover effect of the growing consciousness about resource scarcity and rising energy costs. "We are clearly beginning to see a major change in the industry towards total cost of ownership," he says.

The Star Cool container is living proof of that. Here, MCI is the customer for intelligent controls from Lodam; high-efficiency motors from Grundfos; and energy-efficient frequency converters from Danfoss. But it's MCI's customers – the shipping companies and independent long-haul truckers like Santiago Rosales – that are saving money through lower energy bills.

Keeping world PRODUCE FRESH

What´s the carbon foot print of your banana?

Well, if your banana was transported in a box from Maersk Container Industry (MCI), you are already a step ahead. Because our business model is simple. We simply want to build the world's most durable and energy efficient containers.

So far we deliver:

A ship sailing with 1000 of our Star Cool Integrated "reefer" containers will emit about 2 percent less CO2 than any similar cargo. (Source: World Cargo News, June 2011 issue)

But we don't rest on our laurels. To stay at the top, we must continue to innovate cool containers – literally.

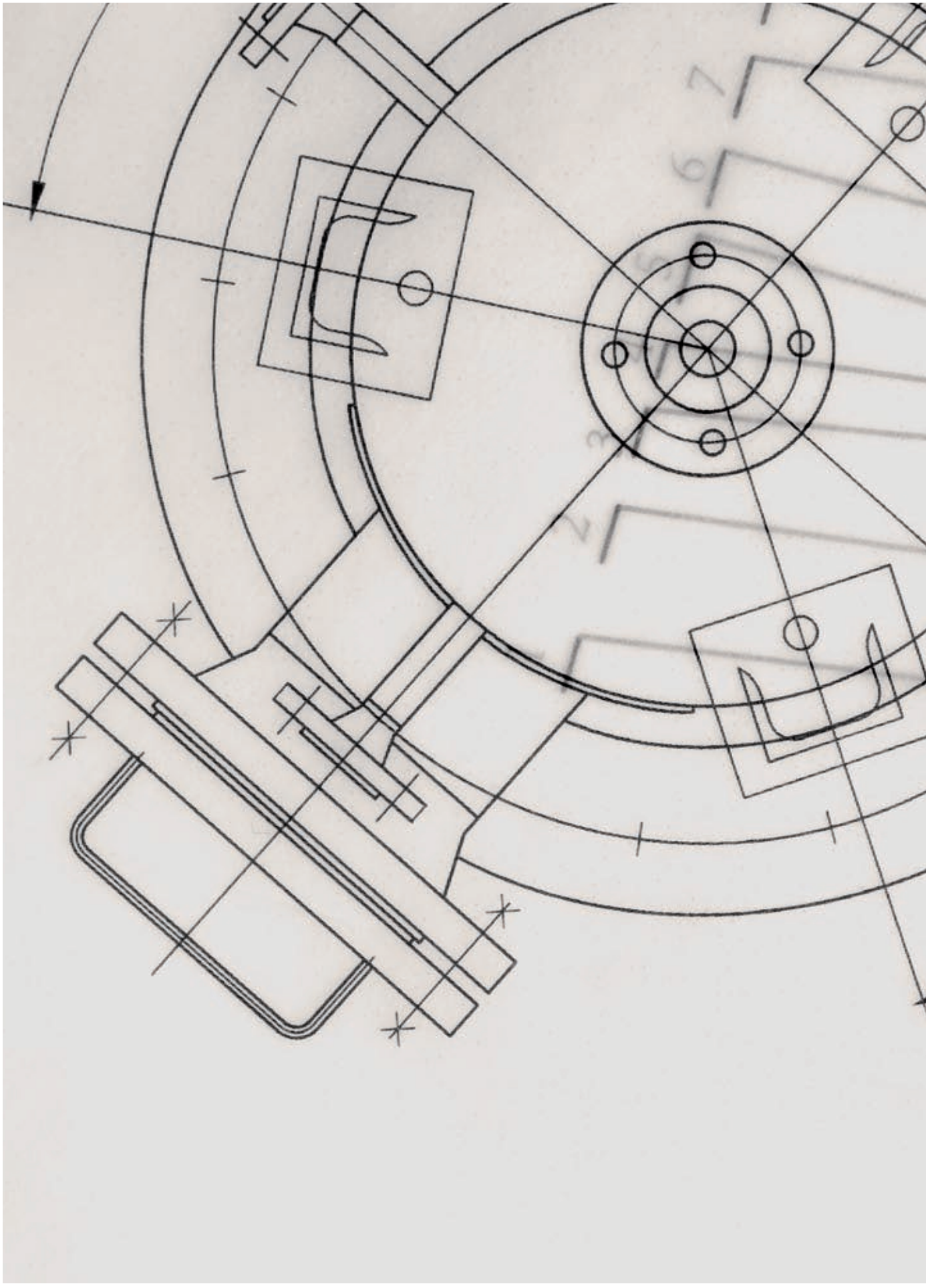
Our team of engineers and developers have their worldclass "playground" at Tinglev, Denmark. Here, good ideas are taken from inception to implementation. Here, experts design the containers that will brave global weather and wind tomorrow. You can see MCI´s containers around the world – and the bananas in your supermarket.

Maersk Container Industry – innovating to keep world trade fresh

In 2007 our factory in Qingdao, China, used 313 kg CO2 per USD 1000 turnover. In 2010, the equivalent number had decreased to 136 kg CO2. This was largely due to innovation and replacement of previous HCFC foam insulation with a new product, SuPoTec®, which does not emit green house gasses.
(Source: World Cargo News, June 2011 issue)

After switching the container interior from steel to plastic, each of MCI's Star Cool reefers weighs about 200 kg less than before, which equates to a saving of some 22 litres of vessel bunker fuel per year. This in turn equates to 70 kg less CO2 emitted each year.
(Source: World Cargo News, June 2011 issue)

MAERSK
CONTAINER INDUSTRY



Energy Savings – the cheap shortcut to a fossil-free society

Energy savings are crucial if we are to reduce our use of fossil fuels. The potential for energy savings is especially high in the public sector and buildings and represents an export market for energy efficiency technologies. Studies show that investments in energy savings are much more cost efficient than other energy investments.

Energy savings are an obvious shortcut to take on the path to a fossil fuel-free society. That is the concurrent message from the business community, politicians, EU and the public sector. Even though Denmark is one of the most energy-efficient countries in the world, there is still room for improvement. Reports show that there is a huge untapped potential to bring down our energy consumption.

In September 2010, the Danish Commission on Climate Change Policy published Green Energy – the Road to a Danish Energy System without Fossil Fuels. The comprehensive report outlined 40 concrete recommendations for how Denmark can become independent of fossil fuels by 2050. The commission stated that there were "no reasons" not to carry out all profitable energy savings.

"Even with the technologies known today, great opportunities exist to reduce energy consump-

DANISH COMMISSION ON CLIMATE CHANGE POLICY

In September 2010, the Danish Commission on Climate Change Policy published Green Energy – the Road to a Danish Energy System without Fossil Fuels. The report outlined 40 concrete recommendations for how Denmark can become independent of fossil fuels by 2050. The commission stressed that the green transition will require a total conversion of the Danish energy system away from oil, coal and natural gas to a green energy system with wind turbines and bioenergy as the most important elements. The commission was created by the Danish government in March 2008 as the first of its kind worldwide, and comprised ten scientists, each possessing special knowledge in the fields of climate, agriculture, transportation and economics.

tion through improvements in energy efficiency and, in many cases, there is money to be saved in making these improvements.

For example, there are already considerable opportunities for efficiency improvements in connection with heating buildings, use of electrical appliances, and in energy consumption for industrial processes," stated the commission.

The fact that energy savings are a tangible and easy place to start if we are to realize a fossil-free future is supported by Frida Frost, Chairman, Danish Society of Engineers (IDA). "Energy savings are the lowest hanging fruits. It gives immediate profit in terms of CO2 reduction and savings for the ones who are realizing the energy saving. Last but not least, it limits the need for investments in new production capacity," she says. Frost refers to a report from IDA estimating that total energy consumption in the Danish business and industry sector can be reduced by 25 pct. in 2015.

MORE INCENTIVES, PLEASE! Denmark's high energy prices and strict regulation already make energy savings a profitable solution. Even so, there is a distinct need for clear incentives if the potential energy savings are to be fulfilled.

Experience shows that neither homeowners or companies nor the public sector will carry out all of the profitable savings in the present environment, despite the good business case. Consequently, the Danish Commission on Climate Change Policy suggested the establishment of an energy certification for craftsmen to develop further competences in energy renovation and improve the visibility of opportunities. Furthermore, the commission pitched a proposal to introduce obligatory energy-saving targets for all buildings in Denmark.

Monday Morning decided to test the recommendations from the commission that are likely to be turned into policies and law by surveying the 100 most important stakeholders in the climate and energy business in Denmark about the commission's roadmap.

The survey results showed unambiguous support for an all-encompassing, long-term and ambitious climate strategy: taxes and tariffs, subsidies, public green procurement, wind energy, smart grids, biomass, strategic research and planning, and a full-scale focus on energy efficiency.

For a sustainable planet

Innovative Energy Control down to the smallest detail

At Lodam we create electronics for energy saving control solutions, while never losing sight of the big picture. This means better comfort and control for you. By focusing on the smallest details and combining this with our world-class knowledge, we deliver optimized comfort and energy efficient solutions for refrigeration, air-conditioning and heat pumps.

For a sustainable planet, it's vital to optimize energy efficiency, not only in our homes and workplaces, but also in food storage and transport. Lodam's innovative energy control solutions have contributed up to 50% savings in food transport by sea, and up to 35% energy savings within convenience store cold counters.

Lodam

MEMBER OF THE BITZER GROUP

Efficient energy control for better living.

A European potential

Denmark is not the only country that favors energy savings. The EU Commission targets a total of 20 pct. energy saving in 2020. The plan from EU goes hand in hand with the European vision for 2050 of a resource-efficient and low-carbon economy, increased energy independence and security of supply.

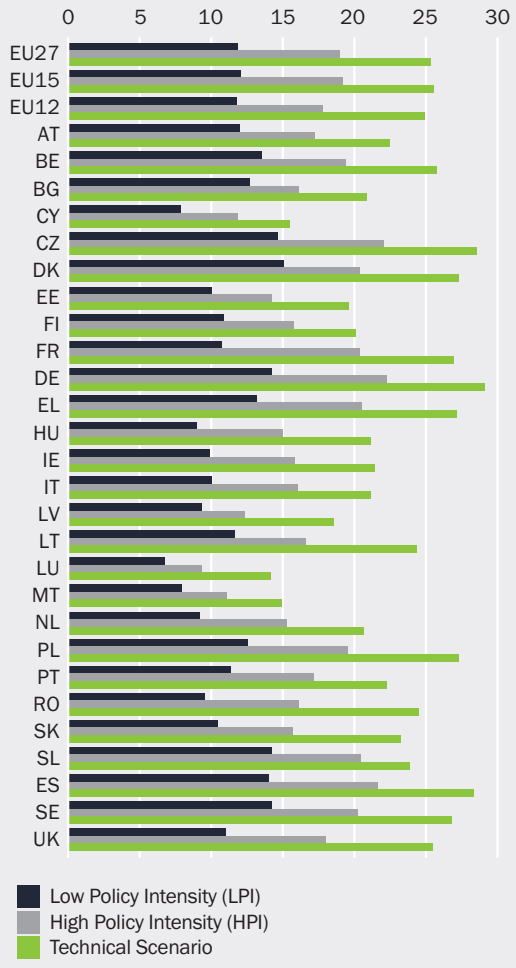


Figure 1: The current efforts and future business-as-usual policies of the EU member states broadly fall under the Low Policy Intensity (LPI) scenario. The High Policy Intensity (HPI) scenario describes the additional technology diffusion of best energy-saving technologies (BAT) to the maximum extent possible, from an economic viewpoint. The Technical Scenario considers a full technology diffusion of BAT to the maximum technical extent possible.

MM **Source:** EU Energy Efficiency Plan 2011.

According to the survey, respondents supported all of the energy efficiency recommendations for the proposal concerning obligatory energy saving in all Danish buildings.

ENERGY EFFICIENCY – REDEFINING GLOBAL TRADE: Carrying out energy savings is not just a question of implementing the right incentives for companies – it also depends on behavioral change by companies and their consumers. At Maersk Container Industry (MCI), which is known for building some of the world's most durable and energy-efficient containers, energy savings are closely connected to behavioral change.

"People who buy bananas or other tropical fruits cannot be expected to know whether their fruit was transported to the supermarket using the least amount of energy possible. We hope consumers will have such knowledge in the future," says Morten Nylykke, General Manager, Maersk Container Industry.

Nylykke emphasizes that the energy efficiency has been an important competitive and operational advantage for MCI. "In recent years, fuel prices has rocketed, with no ceiling in sight. Energy efficiency has become a parameter for competitiveness in the transportation industry. At MCI, we have welcomed this challenge and have made it our core business strategy to provide the most energy-efficient containers on the market. By focusing all our resources into developing more sustainable solutions, we are redefining global trade," he says.

THE PUBLIC SECTOR IS THE PLACE TO START: The Monday Morning survey of energy stakeholders reinforced the importance of another commission recommendation, this one highlighting the opportunity to tap energy savings in the public sector.

Calculations from the Department of Civil Engineering at DTU (The Technical University in Denmark) and Rockwool show that the energy-savings potential of public buildings in Denmark is as high as 75 pct., compared to a 2006 baseline, largely because many buildings are in a wretched state.

The public is ready to take action. "It is evident that the public sector is leading the way. It would send an important signal that we put our own house

ZERO company

Vi går forrest i visionen om at gøre Sønderborg CO2-neutral i 2029

Intelligent lysstyring – til gavn for mennesker og miljø

Spar masser af penge med lysstyring inde og ude

Etableret tilbage i 1958 er vi i dag Skandinaviens førende udbyder af produkter og løsninger, som skaber optimal lyskomfort for brugerne, samtidig med at el-forbruget til belysning reduceres betragteligt. Vi kalder det intelligent lysstyring – til gavn for mennesker og miljø!

Udendørs lysstyring giver tryghed og komfort

Skumringsrelæer, bevægelsessensorer og dæmpere giver mange fordele både for private husholdninger, men også for virksomheder og organisationer. Du kan etablere elegant og lækkert lys omkring boligen eller virksomheden, samtidig med at du skaber god komfort, tryghed og modvirker tyveri. Og så er der ikke mindst en ganske pæn energibesparelse at hente i forhold til at lade udendørsbelysningen brænde uafbrudt.

Massive besparelser kan hentes indendørs

Især indendørs er der for virksomheder og organisationer ofte meget store besparelser at hente ved at installere intelligent lysstyring. Ved en forholdsvis simpel on/off-styring via tilstedeværelsessensorer i f.eks. kontorer eller klasseværelser, kan du opnå ca. 35 % i besparelse på el-forbruget til belysningen. Og ved at udnytte det indfaldne dagslys i rummet og lave en såkaldte zoneopdelt dagslysstyring kan du let og hurtigt spare helt op til 80 % på el-regningen.

Du kan læse meget mere om vores palette af intelligente produkter til inden- og udendørs lysstyring på **www.servodan.dk**. Eller kontankt din nærmeste el-installatør for at høre mere om vores mange kvalitetsprodukter.

Servodan er ZEROcompany

Vi har siden 2008 været ZEROcompany og således bidraget aktivt til at fremme energieffektive løsninger i tæt samarbejde med ProjectZERO. Efter mere end 50 års virke har vi således hjulpet brugerne af vores produkter med at spare over 1.000.000 ton CO_2. Vores mission er, at dette tal bliver meget større. Til gavn for brugerne og for os – men ikke mindst til gavn for vores klode.

SERVODAN | niko

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Et lillebitte udpluk...

41-233
Udendørs bevægelsessensor med dæmp, ur og skumringsrelæ – alt i én.

41-231/AN
Udendørs bevægelsessensor i antracit eller hvid.

41-400
Indendørs tilstedeværelsessensor, som næsten ikke ses – kun Ø90 mm.

41-300/302/320/350/351
Danmarks stærkeste serie af tilstedeværelsessensorer til dæmp eller on/off og med et detekteringsområde på hele 140 m^2.

in order, and that we're willing to develop a market and start job creation," says Jørgen Abildgaard, Climate Director, City of Copenhagen.

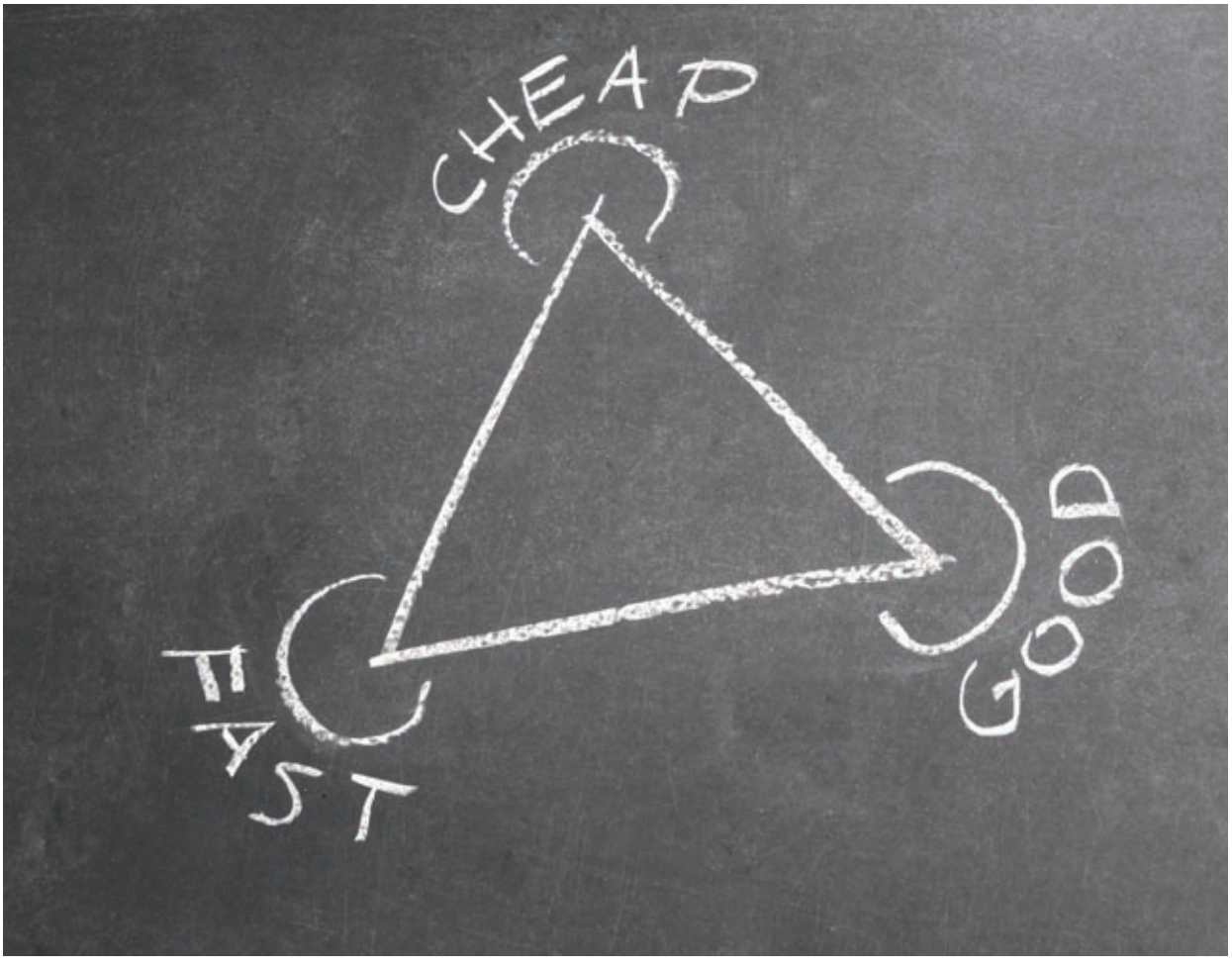
That a domestic market for energy savings exists seems clear based on these statements, but, according to some of the main operators on the energy efficiency market, we don't have to stop there.

Peter Gedbjerg, CEO, Lean Energy Cluster, notes there is a potential export market for Danish energy-saving technology. "Even after having harvested the low-hanging fruits, the potential savings by developing innovative new solutions in cooperation between industry and the public sector are huge and might even have a technology export potential," he says.

SMARTER ENERGY AWARENESS IN BUILDINGS: Buildings are energy gluttons. Forty percent of Denmark's total energy is consumed by buildings. This presents a promising market for energy-saving companies.

The total cost of the energy consumed by buildings in Denmark is 45 billion DKK annually. Calculations from IDA show that total energy consumption could be reduced dramatically in 2020 if 75 pct. of poorly insulated walls, roofs, floors and windows were replaced or retrofitted. Starting the renovation today would yield a total savings of 18 PJ (petajoules) in 2015 and 37 PJ in 2020.

In southern Denmark, 256,000 state-of-the-art smart meters were installed by SE to help consumers reduce the energy consumption of their homes. "As the first energy company in Denmark, we installed meters in every household and company, which has given our customers the opportunity to follow their consumption night and day. We can see that the



How do you meet climate challenges in your municipality?

The keyword is energy management because…

- **energy management will create momentum and innovation in your work with climate issues;**
- **energy management will enable you to prioritize your investments in relation to savings;**
- **energy management will give you a strategic management tool to improve energy efficiency – and therefore an ongoing overview of your energy and climate efforts;**
- **energy management will achieve a minimum of 10% in energy savings. Past experience from Danish municipalities and businesses has proved this.**

We can help you organize your climate efforts and make sure that they are visible. We will also ensure that the climate efforts are deeply embedded in your organization. In this way, you will achieve lasting energy improvements.

For further details, please contact
Senior Consultant Mads Bo Andersen at
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Get practical tools – and learn more about energy management based on ISO 50001, the international standard for energy management, by attending our course on 19 – 20 March 2012.
For more information, see www.ds.dk/kurser/energi.

DS
DANSK STANDARD

VLT drives

Short description of solution: The drives save energy, and make hundreds of motors run more efficiently and last longer.

Energy saving potential: Energy savings of 5-15%.
The solution has been implemented by the Arla Food Ingredients Group factory in Videbæk, Denmark, which uses around 50 million kWh of electricity per year. Therefore just a 10% saving in energy costs is of huge importance.

Economic potential: The solutions within industrial automation are very suitable not only for dairies but for most mass producing industries all over the world.

Solution provided by: Danfoss

many customers, who are now aware of their detailed consumption, reduce it. We are convinced that this trend can increase massively if we can create a dynamic pricing-model for electricity, so that the prices are low or even negative when for example the wind power surpasses the demand and high at peak-hours as 6 pm when we all are making dinner," says SE CEO Niels Duedahl.

EVEN CHEAPER THAN WIND TURBINES: Despite common agreement that energy efficiency is an affordable and preferred shortcut in the green transition, its potential has often been overshadowed by other components in the green Danish success story such as the wind turbine industry.

A study published in 2011 might help to change this imbalance. Conducted by Norenergi, a Danish energy consultancy, and the Danish Construction Association, the study reveals that in the short term it is cheaper to invest in energy savings than wind turbines. The study found that the cheapest electricity savings can be fulfilled with an investment of 0.1 DKK/kWh. By comparison, the study said, a similar kWh produced by the new wind farm next to the Danish island Anholt would require an investment of 0.7 DKK/kWh (See Figure 2). Energy savings, the report found, can prevent the need for new energy capacity equivalent to 15 new wind farms at Anholt. Implementing just the profitable energy savings in industrial building could save Denmark 5 to 9 billion DKK each year.

Energy savings are one of the shortest ways to a fossil fuel-free society, but more incentives and behavioral changes are needed if we are about to unleash its potential.

Energy savings cheaper than wind

Costs: production/saving of one kWh

Initiative	Price per saving/ production per kWh
Electricity savings in the industry sector before 2020	0.10 – 0.40 DKK
Heating savings in buildings before 2020 (15 percent most profitable savings)	0.25 – 0.35 DKK
Heating savings in buildings before 2020 (35 percent most profitable savings)	0.35 – 0.60 DKK
Current off-shore wind turbines	0.56 DKK
Anholt off shore Windmill Farm in 2014	0.71 DKK

Figure 2: In the short run it is much cheaper to save one kWh based on fossil fuels than building a new renewable production capacity in order to produce "new" kilowatt hours.

MM **Source:** Norenergi for Tekniq and The Danish Construction Association: The Economics for Wind, Solar and Energy Savings, 2011.

United, we export

The global market is calling for energy-efficient solutions. The solutions, however, are not individual technologies but systems. Companies, knowledge institutions and the public sector are clustering to create exportable packages of solutions. They lack international partners, though, and are in need of additional human resources.

Clusters are forces to be reckoned with in the Danish energy landscape. Companies, universities and institutions are increasingly becoming aware of the benefits of sharing knowledge and developing new solutions together.

One reason for this is that the global market is asking for collective solutions. Single technologies are not sufficient to meet the massive challenge of building entirely new – and energy-efficient – cities.

Already, more than half of the world's population resides in cities; UNEP estimates that between 2011 and 2020 the population in cities will increase by 715 million. The result: In 2020, 80 pct. of the population in developed countries and 51 pct. in developing countries will live in cities.

Some of these cities are yet to be built, and countries such as India and China are scrambling to find the resources to put together new cities.

In the Middle East, too, leaders are looking for the best technology to build entirely new cities. Christopher Sorensen, Deputy Director for Innovation at Masdar, Abu Dhabi, recently visited Denmark to discover what solutions can be transferred to the ambitious project in the desert. He is not interested in individual technologies.

"It is wonderful that Denmark has great individual technologies within water for instance. But when we are building an entirely new city, we cannot

Heavy duty Hybrid Vehicles – garbage truck

Short description of solution:

Traditional garbage trucks use the diesel engine to lift and compress the garbage. The engine is noisy and inefficient for this purpose as it is designed for something else – making it run on full power.

Energy saving potential:

Accessories on the hybrid garbage truck are powered by electrical systems.

Economic potential:

Each truck saves 5000 litres of diesel per year – the equivalent of 15 ton of CO2. Simultaneously, less particle pollution and less noise allows for a healthier working and city environment.

Large potential in cities all over the world due to increasing awareness of particle pollution and noise reduction in cities.

Solution provided by:

Lean Energy Cluster

deal with single technologies. We need collective solutions –systems that are already working. We do not have the time to put the pieces of the puzzle together ourselves," he says.

Ranbir Saran Das, Managing Director of Fairwood Group, agrees. Saran Das is involved in the development of the Delhi Mumbai Industrial Corridor, a 300-kilometre long development zone linking India's largest cities, to prepare for what he describes as "the tsunami of people" entering the middle class in India.

"The smartest thing for companies to do is to get organized in clusters and come to us with complete package solutions that are ready to plug and play," Ranbir Saran Das says "We do not have the luxury of time."

DANISH SOLUTIONS TO GLOBAL CHALLENGES: In southern Denmark, companies and institutions are working together to help people like Ranbir Saran Das and Christopher Sorensen.

Close to the German border, many companies have strong competencies within energy efficiency, giants such as Danfoss and Maersk Container Industry. Danfoss operates in 22 countries, employs 24,000 people, and boasts a product line spanning from high efficient residential and district heating systems over refrigeration and air-conditioning components and systems to solar energy and industrial automation. Energy efficiency is at the core of all the products; Danfoss, therefore, participates in the Lean Energy Cluster. Similarly, Maersk Container Industry, with production in China, maintains its central R&D department in Denmark, close to some of the world's leading businesses and research institutions within refrigeration technology and energy efficiency – all participants in the Lean Energy Cluster.

The companies united themselves in a cluster to gain additional strength and opportunities. Lean Energy Cluster facilitates business development within energy efficiency – bridging the gap between companies and knowledge institutions in this field.

"We gather stakeholders who see a business interest in developing, producing and selling innovative solutions based on energy efficiency technologies," Lean Energy Cluster CEO Peter Gedbjerg says.

The cluster identifies and nurtures technologies, solutions and opportunities that can be turned into sales for members, matching the right partners for projects and ensuring that all agreements have been secured before projects are launched.

A concrete innovation project has been fostered by the cluster: Heavy-duty vehicles where accessories are powered by electrical systems (See Solutions of Today: Heavy duty Hybrid Vehicles – garbage truck on opposite page).

The project comprises eleven partners, each contributing in their unique way. The companies are rooted in the same region of Denmark, but all have a nationwide or global market.

"When they participate in this project it is because they have been chosen because of their leadership internationally within their little area of expertise. The work in the cluster allows us to work with the best in the field," says Peter Gedbjerg.

Participating companies develop knowhow to be commercialized in the future; for each, the potential gain is far greater than what they contribute to the project as all participants are market leaders within their area of expertise.

"The partners have joined forces because they are leading in different fields and gain from the project. The hybrid garbage truck is based on the regions competencies within mechatronics, energy systems, material science and logistics.

Together, we create a product far better than what any company could create on its own. " says Rasmus Banke, CEO of Banke Accessory Drives. The company is newly established and a direct result of the project.

The hybrid is a concrete example of how it is possible to transform single technologies into new innovative products. Businesses depend on the right business environment: stakeholders willing to take a risk and share. Clustering is about connecting stakeholders and opening doors.

Another example of how connecting technologies can produce new innovative solutions is the refrigerated container. Danfoss, Lodam, BITZER and other companies are supplying parts that Maersk Container Industry assembles in a complete and unique package. Fifty-thousand have now been sold (See Solutions of Today: Star Cool - page 18).

Formal collaboration in the shape of clusters is essential if companies want to maintain enough of the production to allow for innovation. The Lean

WHAT WILL ENERGY EFFICIENCY LOOK LIKE IN 2020?

Sustainia is a vision for a sustainable future communicated in a way people can understand and relate to. A clear demonstration of how we could live already in 2020 if we boldly implemented the technologies and solutions needed and already available.

The book “Guide to Sustainia” describes the full vision of Sustainia and explains in a clear and simple manner how your city, home, energy system and transportation could look like in 2020: How could you get around, how could we make our buildings more environmentally friendly, how would a desirable and sustainable city look like and how can we make all key elements in our society more energy efficient.

Sustainia is developed by Monday Morning in collaboration with a range of global multinational companies and experts. United Nations has invited Sustainia to play a key role in the Rio+20 in June 2012.

We look forward to showing you around in Sustainia and welcome your input for our further development.

For more information: www.sustainia.me

Mondaymorning

Energy Cluster aims to create growth for companies within energy efficiency by transforming knowledge and technology into new business endeavours and growth.

The cluster is facilitating several other innovation projects, among them an intelligent cooling and heating control in supermarkets (utilizing the thermal capacity in food to adjust the consumption of electricity in cooled and refrigerated supermarket counters) and a virtual green house (developing a new air-conditioning system that reduces energy consumption, and establishing a centre where greenhouse producers and technology suppliers can test their ideas). The next step is to introduce these solutions to global buyers.

The Lean Energy Cluster is just one cluster in Denmark uniting companies and institutions within the promising market for green solutions.

With 87 pct. of Denmark's combined turnover from wind energy, the Central Region of Jutland boasts a unique position in the global wind energy market. Fourteen-thousand wind employees work in the area, giving companies access to a high-skilled labour pool.

In Esbjerg, in far western Denmark, another cluster launched recently. Next Step City wants to unite companies and institutions focusing on intelligent energy.

Esbjerg boats itself as the offshore capital of Denmark and as an "Energy Metropolis". Already, every tenth job in the city is energy related - 9,000 jobs in the offshore industry alone - and the number of workplaces is expected to increase in the coming years.

And in the Danish capital, the Copenhagen Cleantech Cluster is organizing the Danish cleantech sector. Under the project – funded in part by the EU – the cluster is obligated to fulfill a number of objectives, including establishing 8-10 public-private partnerships.

Bornholm, Lolland, Samsoe and Northern Jutland, to name a few, are home to different forms of

clusters devoted to cleantech in Denmark. Companies are increasingly understanding the value of getting organized, sharing knowledge and developing new solutions together.

THINK GLOBAL: The emergence of clusters in Denmark is promising, yet they often fail to understand the importance of a global outlook and outreach. They are inexperienced in the discipline of international collaboration.

The recent "Nordic-German-Polish Cluster Excellence Project" by Nordic Innovation is the most comprehensive study benchmarking European clusters.

It finds that Germany – besides being a world champion in export – also succeeds in developing clusters that work across borders.

Dr. Gerd Meier zu Köcker, Director of Kompetenznetze Deutschland, explains that the German clusters are typically 4 to 5 years older than their Danish counterparts, and more experienced at collaborating internationally.

According to Gerd Meier zu Köcker, the strong international clusters are one reason for Germany's fast recovery from the economic crisis and its increasing exports. "The cluster facilitates visibility, access to markets and international knowhow," he says.

Dr. Meier, familiar with the Danish clusters through collaboration with the Danish knowledge center Reg X, notes that world-class clusters exist in Germany and Denmark within the energy sector. "But the majority of Danish clusters are lacking behind by 5 years compared to the Germans. And since the German clusters have matured more, they have a series of benefits yet to come for the Danish ones," he says. Besides greater visibility and stronger international networks, he points to a more flexible collaboration between business, academia and the public sector.

"The cooperation between the engineering programs and industry generates synergies, and hence growth, through several mechanisms." says Ib Christensen, Associate Professor at the Mads Clausen Institute at University of Southern Denmark. "Obviously, the ability for the companies to recruit new candidates that are already established in the local community. But also the feedback from industry to the students via their projects contributes to the synergic development between engineering educations and industry."

The university is a partner in the Lean Energy Cluster and is currently developing courses in efficient energy handling.

"There is no doubt, that the collaboration between clusters and university will initiate further growth."

WHAT ECONOMIC CRISES?: Looking at the growth rates for companies participating in the innovation projects, there is evidence that clustering might be a recipe for success.

This goes for giants such as Danfoss and small- and medium-sized businesses such as Lodam.

Danfoss´ turnover have grown from around 19 billion DKK in 2006 to almost 32 billion DKK in 2010. An increase of 68 pct. The turnover for 2011 and 2012 is expected to be 34 and 37 billion DKK, respectively.

An even more impressive development can be seen at Lodam, a company focusing entirely on energy efficient electronic controllers. Between 2006 and 2010, the gross profit grew from 15.5 million DKK to 40 million DKK.

Increasing profit from under five million DKK to ten million DKK. In the same period, the company has doubled the number of employees.

"We have has been appointed as one of the fastest growing gazelle companies in Denmark by the Danish business magazine, Borsen, four times over the past five years. And our business and number of employees are expected to grow in the future" says CEO at Lodam, Kristian Strand.

The cluster is also gradually strengthening its competencies within technology development. The BITZER group, the world's largest independent manufacturer of refrigerant compressors, chose to place their development of electronics at Lodam, which is part of the cluster.

Lean Energy Cluster also believes the way forward is clustering, and exporting solutions and new technology together.

"Denmark is in many ways in the forefront of developing and implementing new, innovative solutions within energy efficiency. The latest World Energy Outlook clearly states the potential for energy efficiency globally. Working as part of the cluster enables small- and medium-sized industries to enter the world market. Among our member industries and partners, we see two-digit growth rates despite

Building of greater value

DGNB, LEED and BREEAM enable you to build or retrofit in an intelligent way that ensures attractive buildings with high comfort and ensures the long term value of your building using Life Cycle Cost assessments. We are ready to assist you when designing, building and retrofitting your building using the principles of these sustainable certification systems.

A comfortable and healthy indoor climate enhances productivity in office buildings and increases learning ability amongst youngsters in schools and universities. When your building meets the standards of DGNB, LEED or BREEAM you get much more than a healthy indoor climate. Your building will be sustainable and of greater value, making it easier to let or sell.

Read more on mth.com

MTHøjgaard

Controlled Atmosphere
(CA System)

Short description of solution: Modifies the atmosphere inside containers, hereby significantly improving shelf life for refrigerated goods.

Energy saving potential: By controlling the levels of oxygen and carbon dioxide inside the container it significantly prolongs the ripening process of transported fruit and vegetables. The energy saving potential of this technology is huge, as shipments have traditionally been performed with aging conventional reefer bulk vessels with ineffective fuel consumption. The conversion over to CA containers allows for more precise and steady planning in the logistic chain to the benefit of the growers and consumers.

Economic potential: The technology is particular interesting as it opens new trade routes that were previously unavailable due to the delivery time. It therefore opens new markets for producers of agriculture products, both big and small, that were previously unavailable to them.

Solution provided by: Maersk Container Industry

the difficult circumstances that we experience," says Peter Gedbjerg from Lean Energy Cluster.

In fact, the core challenge for these companies is not the economic crisis, but attracting talent. Highly skilled employees are scarce, and some companies are looking to relocate elsewhere in Denmark or outside its borders. Even though the region has the second-highest concentration of engineers in the country, more are needed.

If Denmark fails to supply sufficient human resources to the companies that have demonstrated such great growth potential, the future prosperity of the nation is at stake.

Developing talent is not something which should be left to any individual company. It should be a national priority to supply talent where it is needed.

If the Danish clusters can overcome these two challenges – learning to collaborate across borders and attracting the necessary talent – then united they will export to global buyers such as Ranbir Saran Das and Christopher Sorensen.

Sources:

UNEP. 2011. Green Economy: Cities investing in energy and resource efficiency.

Nordic Innovation: Nordic-German-Polish Cluster Excellence Project.

Drivers of energy efficiency in buildings

A recent study from the Institute for Building Efficiency identified the top three global drivers for energy efficiency – cost savings, incentives and public image. These are said to be the forces that will unleash the $1 trillion potential of energy efficiency.

With energy prices on the rise worldwide, investment trends demonstrate that decision-makers are increasingly interested in figuring out how to reduce energy costs. These concerns have stimulated heavy investment in energy efficiency measures. The Institute for Building Efficiency recently completed the largest-ever survey on corporate energy efficiency. The study, which polled 4,000 managers and executives on six continents, found that across continents energy efficiency investments are largely driven by cost savings, incentives and public image.

SAVINGS – A GLOBAL CONCERN: China addresses energy efficiency in its latest Five Year Plan, aiming to reduce energy consumption per unit of economic output by 16-17 pct. by the end of 2015. The "Energy Efficiency Indicator" study also shows that 84 pct. of Chinese and 88 pct. of Indian managers and executives believe energy management is "extremely" or "very" important to them. In Brazil, 73 pct. of respondents deemed energy efficiency as the top strategy for reducing their organization's carbon footprint. In 2006, the EU launched a plan to reduce the annual consumption of primary energy by 20 pct. by 2020, and energy efficiency is at the core of this plan. When the plan was released, the EU Commission stated: "Energy efficiency is one of the most cost effective ways to enhance security of energy supply, and to reduce emissions of greenhouse gases and other pollutants. In many ways, energy efficiency can be seen as Europe's biggest energy resource."

Despite the high ambition, a recent calculation by the Commission revealed that the EU will only reach half of its target. With oil projected to reach $175 a barrel in 2016, the EU has renewed its attention to energy efficiency, launching the "Energy Roadmap 2050," which says: "We need to reduce

06. Solutions of today

Condensing unit controller

Short description of solution: Optimizes the operation of refrigeration plants resulting in lowest possible power consumption at actual loads and ambient temperature.

Energy saving potential: Up to 35% energy savings. Proven in trials with two identical convenience stores in Thailand – one with ordinary condensing unit and one with BITZER Ecostar condensing unit with Lodam controller integrated.

Economic potential: Increasing global focus on energy efficient solutions means that smaller supermarkets, shops and service stations are modernizing/retrofitting their refrigeration plants to environmental sound solutions. Further new EcoDesign directives are implemented in many countries, stating maximum allowed annual power consumption at a given annual cooling load, the so-called EESER value. The solutions assists global manufacturers of Air Cooled Condensing units to comply to these increasing requirements to energy efficient solutions.
The product is already exported to China, South East Asia and Europe, and in all regions demands are increasing.

Solution provided by: Lodam

energy consumption by 2050 by a minimum of 32 pct. to maximum of 41 pct. compared to the peak in 2005/2006." Reducing energy consumption will demand renewed investments in the EU, but the roadmap analysis finds it will not be cheaper to cut these investments: "If we continue with current policies, we may not have to invest as heavily in infrastructure as in the decarbonisation scenarios (high efficiency, high renewable, delayed CCS, low nuclear and diversified supply technologies), but we the face higher fossil fuel costs as natural gas and petrol prices are estimated to rise due to an increase in worldwide demand. By contrast, in the case of the decarbonisation scenarios higher upfront investment is needed but less fossil fuel."

DOING THE MATH: The "Energy Efficiency Indicator" study looks at the key challenges to achieving energy efficiency, including investment. The challenges are identified as "lack of technical expertise to evaluate opportunities, technical challenges such as difficulty assessing whether projects' promised savings will be achieved, and financial barriers including projects' inability to meet internal 'hurdle rates' and lack of capital to invest in project." According to the study, however, companies that allocate resources to analyze their energy use are afterwards more likely to invest in energy efficiency measures.

INCENTIVES FOR ENERGY EFFICIENCY: The "Energy Efficiency Indicator" indentifies incentives such as government grants and utility rebates as the second most important driver for energy efficiency projects. The study finds that 48 pct. of European respondents say it is "extremely likely" or "very likely" that national governments will mandate energy efficiency and/or carbon reduction within the next two years. Despite the demand for energy efficiency, the biggest challenge for companies remains the difficulty of securing the necessary capital to fund projects. Government incentives can help overcome some of the hurdles.

Any new energy efficiency technology takes time to scale up, reinforcing the need for long-term incentives to promote investments by companies in new technologies. In 2009, McKinsey wrote in "Unlocking Energy Efficiency in the US Economy" that "even the fastest moving technologies of the past century that achieved widespread adoption, such as cellular telephones, microwaves, or radio, took 10-15 years to achieve similar rates of scale-up. Without an increase in national commitment, it will remain challenging to unlock the full potential of energy efficiency."

Regional and national strategies to unlock the potential will help scale up energy efficiency. McKinsey suggests in the US case that "enhanced performance contracting or loan guarantees are relatively untested but could facilitate the end-user funding. Alternatively, the entire national upfront investment of $520 billion (not including program costs) could be recovered by through a system-benefit charge on energy on the order of $ 0.0059 cents per kWh of electricity and $ 1.12 per of MMBTU (1,000,000 British Thermal Units) of other fuels over 10 years."

PUBLIC IMAGE: In 2011, public image was one of the top drivers for energy efficiency. The Institute for Building Efficiency explains why: "One leading symbol of branding and public image is the pursuit of green buildings, and interest in such buildings doubled from 2010: Four in 10 respondents in 2011 indicated that they had a certified green building. Respondents reported growing interest in green building certification and approaches and, for the first time, certification efforts were more prevalent in existing than in new building." After a few years of climate fatigue, climate change mitigation, energy security and resource scarcity are again top public concerns. A 2011 Nielsen survey found that 69 pct. of the 25,000 respondents in 51 countries are "very" or "quite" concerned about climate change. These concerns push consumers to demand that companies do something about it.

The Carbon Disclosure Project's (CDP) Carbon Action Plan is an example of an initiative that encourages companies to measure and disclose to CDP their greenhouse gas emissions, water management and climate change strategies. Investors asked CDP to start the Carbon Action Plan so they could more easily assess their investments. According to CDP, "increasingly investors recognise that climate change is having material impacts on businesses and these impacts are likely to grow. A recent report from Mercer suggests that climate change can contribute

to up to 10 pct. of total portfolio risk. Some sectors such as mining, transportation and electric utilities are particularly exposed and investors want to see companies acting to reduce these risks by cutting emissions."

THE POTENTIAL OF ENERGY EFFICIENCY: In 2008, global management firm McKinsey wrote that if $170 billion a year were invested in energy efficiency from 2008 until 2020, it could halve the growth in energy demand globally. This investment would not only cut energy demand, it would also greatly benefit the emissions rates, helping to hold the global mean temperature rise below 2 degrees Celsius. McKinsey indentifies lighting efficiency, heating and cooling systems, and technologies within vehicle and factory machinery as the change makers in energy efficiency, and believes that "concerted action could reduce global energy consumption in 2020 by 135 quadrillion British thermal units (QBTU) a year, the equivalent of roughly 64 million barrels of petroleum a day." McKinsey estimates that in the US alone energy savings could, if executed holistically and at large scale, "yield gross energy savings worth of more than $1.2 trillion, well above the $520 billion needed through 2020 for upfront investment in efficiency measures (not including program costs)".

The enormous potential of energy efficiency appears evident, but a "comprehensive and innovative approach" will be required on all levels to unleash its full potential. Until then, all measures and steps will be studied because there is no doubt, from Brasilia to Bangalore, all eyes are on energy efficiency.

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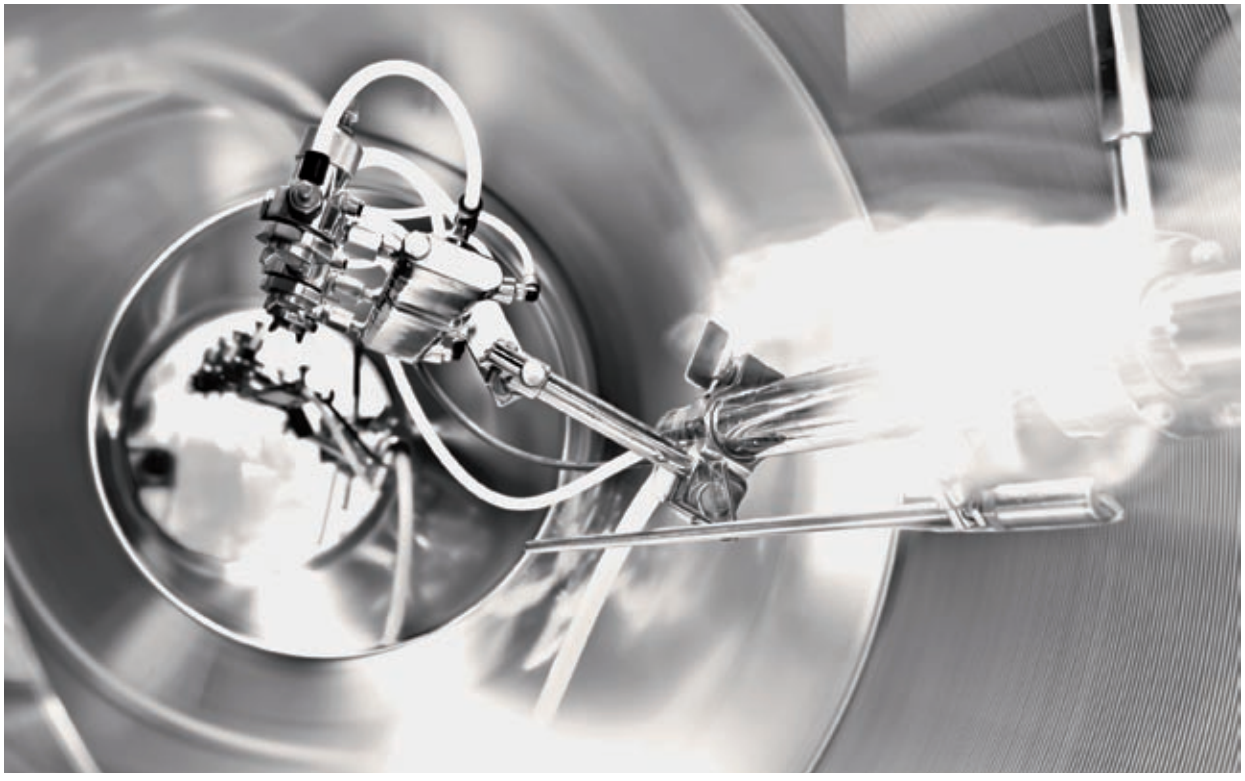

Skiing in 2050?

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CATALYSING YOUR BUSINESS

Global business leaders are ready for green action

There is consensus among global business leaders that sustainability, energy efficiency and green growth will have a strong impact on how companies think and act in the future. The future winners will be the companies that adapt to a new green growth reality, and adopt this new mindset, faster and more completely than their competitors. To secure the transition to a green economy, political leaders must hand over more responsibility to the business community and focus on private-public partnerships, advises Yvo de Boer, former Executive Secretary of the UNFCCC.

Global companies are in the middle of major business reorganization towards a green society. There is consensus that the growth of tomorrow is embedded in a future green economy.

Business executives already engaged in making their operations greener often cite efficiency gains as a main reason for their efforts. As regulations will force them to change in the long run, first-movers should enjoy a big advantage. Ranbir Saran Das, Managing Director, Fairwood Group of Companies, in India, is one first-mover who has seen the advantage of turning his business green.

Ranbir Saran Das is a trendsetting entrepreneur within Asian city development. His company backed a 90-billion DKK investment in an enormous finance and IT district in Gujarat, one of the fastest-growing federal states in India.

Fairwood Group is also involved in the Delhi Mumbai Industrial Corridor, a 300-kilometre development zone linking the biggest towns in India.

Ranbir Saran Das stresses that green growth is not just about following existing norms and benchmarks, but about setting them and taking the road not taken.

In the above-mentioned projects, a main objective is to integrate the best possible green solutions, delivered by leading companies in Europe, the Unites States and Asia. In Gujarat, there is a distinct awareness that all new building projects be sustainable. Consequently, renewable energy, advanced public transport systems, energy efficiency and district cooling are integrated into the city development process.

Ranbir Saran Das believes that green initiatives should be the focus of economic activities of any company that is serious about the environment. "Things are changing fast in India at the moment," he says. "But we have to make the right intelligent decision. It is all about choosing the right technologies

SE Big Blue

Short description of solution:	Helping industrial customers improve their basic operations by optimizing their use of energy.
Energy saving potential:	Energy savings potential will depend on the individual industry and application in question, but SE Big Blue often realizes two digit percentages of energy savings for customers.
Economic potential:	The growth potential is assessed to be very high in an industry in the early growth stage – growth is expected to increase very fast over the coming years and will accelerate with rising fuel prices, increased global energy consumption and supply uncertainty.
Solution provided by:	SE

now; otherwise you're stuck with the wrong decisions in the next 50 years."

A NEW BUSINESS REALITY: It is not only in developing countries that business leaders are embracing the green growth agenda.

At DNV, one of the world's leading risk management specialists, they recognize that the upward march of energy prices, increasing environmental awareness and energy security issues has spurred investments in energy efficiency.

"There is a strong consensus among senior executives that sustainability will have a material impact on how companies think and act in the future. Indeed, sustainability will drive innovation and is a real opportunity for the serious companies. Market sources are predicting that sustainability investments and related business is expected to grow significant in the years ahead," emphasizes Bjorn K. Haugland, COO, DNV Sustainability and Innovation division.

The expected growth in green business might be caused by a new business reality, one understood by global business leaders for a few years. In a 2009 interview with Monday Morning, Gil Friend, Founder, President and CEO of Natural Logic Inc. and eco-consultant for numerous Fortune 500 companies, offered an explanation for the fast-growing sustainable business initiatives.

"The big difference between today's movement and the eco-movement of the '60s and '70s is that we are no longer talking about sacrifice. This is not about lowering standards of living or corporate profitability. This is a new industrial revolution that makes winners of us all. The corporate winners will be the ones who adapt to a new reality and adopt a new mindset faster and more thoroughly than the competitors. Being sustainable will be a competitive necessity," said Friend.

This new business mindset also presents opportunities for companies that assist other companies with sustainability initiatives. One example is SE Big Blue, a new energy-saving initiative from SE, one of the biggest energy companies in Denmark. "At SE, we have put together some of Denmark's best energy experts to form SE Big Blue, which is a business unit dedicated to unlock customers' business potential by means of energy savings – to the benefit of the bottom line and a greener profile," says CEO Niels Duedahl. SE Big Blue provides solutions to customers across Denmark with a vision to be the partner of choice for major companies, municipalities and public-sector bodies on their journey to a greener and more energy-efficient world. See solutions of today on opposite page.

PRIVATE CAPITAL IS KEY: Even with private companies engaged in a greener economy, global political institutions must involve the business community even more.

This is the recommendation of former UNFCCC Executive Secretary Yvo de Boer. Of the world's 100 largest economies, half are corporations, whose executives have more power than most presidents and prime ministers. In order to secure the transition to a green economy, which is necessary to avoid runaway climate change, political leaders must give the business community a more central role, says de Boer, now Special Global Advisor on Sustainability and Climate Change at KPMG.

"The effects of climate change are environmental issues. But the solutions are economic issues. One of the things that have struck me for many years is that climate negotiations for a long time have been dominated by people from the Ministries of Environment worldwide, while the challenge really is to create an intelligent economic agenda," de Boer says.

He points to the fact that the international community, according to the International Energy Agency (IEA), faces investments as massive as $20,000 billion in the next 20 years. It is expected that the necessary funds will come from private, not public, investors.

CALL FOR PRIVATE-PUBLIC PARTNERSHIPS: In addition to private capital, Yvo de Boer calls for broader private-public partnerships. He emphasizes the importance of companies and governments, at the local and national levels, working together, especially in the development of cities around the world, where emissions from buildings, transport, lighting and heating have a big impact on the climate.

"Take the example of energy efficiency in buildings. The problem is that the costs linked to energy renovation often falls on the owner whilst the advantage of the energy renovation often falls on the

tenant in the form of a lower energy bill. That is why it is often hard to go through with energy renovation. Here you need national governments stepping in and creating legislation that makes it possible to implement the renovations," he concludes.

For many years, Denmark has been a pioneer in private-public partnerships. One project has set an especially ambitious example – ProjectZero, in Sønderborg. Launched in 2007, ProjectZero strives to solve the climate challenge and create new green jobs by mobilizing all of the area's resources in pursuit of a clear goal: CO2-neutral growth and sustainable urban development. The partnership includes partners such as Sønderborg Municipality, Danfoss, SE, Nordea Bank Foundation and DONG Energy. The partners, and the entire region, are engaged in the vision of creating a CO2-neutral growth area before 2029 – creating new climate-business solutions, measurable CO2 reductions, new green jobs and a talented generation of young people.

"In just four years, the area's CO2 emissions will be 25 pct. lower than two years ago. This goal will be achieved by significantly more efficient use of energy and an increasing energy supply from the area's own renewable energy sources," says Peter Rathje, Managing Director, ProjectZero.

He stresses that the number of green jobs is growing in southern Denmark due to local demand, and because projects such as ProjectZero bolster exports and raise awareness of the participating companies in many countries, including China. Peter Rathje believes that the Sønderborg area and ProjectZero can serve as a role model for the rest of the world. Not by pointing accusing fingers, but simply with a fundamental belief that we can use energy much more efficiently than we do today. "This belief applies to storeowners, farmers and business leaders alike," he concludes.

Great savings to be made from heat recycling

Cronborg, from Holstebro in Denmark, provides heat pump solutions that save both money and CO2 emissions.

The recycling of heat can have a direct impact on a company's bottom line in form of smaller energy bills while at the same time reducing CO2 emissions.

Cronborg is a sales company specialising in heat recycling. We sell heat pumps and custom systems that recycle surplus heat from refrigeration and production for room heating and heated utility water - even at high temperatures. Swimming centres and server rooms, for instance, have seen great savings from modern heat pump technology. By recycling waste heat the expenses for heating can be halved and CO2 emissions reduced significantly.

Cronborg's custom heat pump technology solutions can be found in a large number of Danish companies and institutions. Here are a few examples:

Silkeborg municipality has installed a solution from Cronborg that recycles surplus heat from the municipality's server room, which is then used for heating elsewhere in the municipal administration.

Annual savings:
£6,651 (DKK 58,753). Annual CO2 savings: 31 tonnes.

Hobro Dairy recycles the waste heat generated by the milk cooling process.

Annual savings:
Approximately £40,750 (DKK 360,000). At the same time the solution has reduced the dairy's annual CO2 emissions by 60 percent.

Holstebro Swimming Centre recycles waste heat from the air and uses it for water heating.

Annual savings:
£29,606 (DKK 261,521). In addition to this, a significant reduction in CO2 emissions.

Faerch Plast in Holstebro installed a heat pump from Cronborg in connection with a boiler in the company's warehouse. The pump makes up for the majority of the heating demand placed on the existing gas boiler.

Annual savings:
£23,286 (DKK 205,700), as well as a significant reduction in CO2 emissions.

Last year, Cronborg's pump solutions resulted in a total reduction of the impact of CO2 emissions on the environment of 2,136 tonnes.

Read more on www.cronborg.dk

Advertiser's guide

Smart Metering for a Greener Living

The infrastructure of energy supply becomes increasingly complex, not least due to more sustainable but unpredictable energy sources.

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Worldwide utilities opt for smart metering solutions in order to gain energy savings and a more efficient customer service. Building a communication network that integrates intelligent meters for energy and water provides a detailed picture of the consumption pattern.

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Smart meters play an important role in the Smart Grid as powerful data hubs collecting data from heat, water and gas meters, communicating with other networked smart meters, receiving information from the central system and sending information to inhouse-displays and other Smart Home-devices.

Kamstrup A/S serves energy companies and utilities with metering solutions for electricity, heat, cooling water and natural gas. Our solutions include Smart Grid applications, Smart Metering systems, energy meters and water meters. Headquartered in Skanderborg, Denmark, Kamstrup carries a highly skilled workforce of researchers and developers and a fully-automated production plant.

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