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Interview with Michael Blichmann, general manager of Bosch Energy and Building Solutions: **“If energy isn’t used, there’s no need to supply it in the first place”**

November 27, 2014
PI 8594 UBE Res/af

- ▶ Savings of 20 percent possible for nearly every building
- ▶ “Carbon footprint” as sales argument
- ▶ Opportunities offered by connectivity

Can the waste heat produced in manufacturing be used to generate electricity or to heat buildings? Is a proprietary cogeneration plant a good alternative supplier of power and heat? Bosch believes a 20 percent energy saving can be achieved in nearly every building.

Stuttgart – The energy specialists of the Bosch subsidiary Bosch Energy and Building Solutions GmbH (BEBS) estimate that they can reduce the energy consumption of any building by at least 20 percent. BEBS offers this service to the facility managers of large buildings such as hospitals, office complexes, and medium-sized enterprises. These activities focus on improving the way various supply systems are connected, with a view to optimizing energy use, cost savings, and resource conservation. With the IPCC report having been presented at the UN climate change conference, Michael Blichmann, who heads up the Bosch energy services subsidiary, explains why this has an increasingly important role to play.

Mr. Blichmann, what are your customers looking for?

Whatever their field of business, our customers are facing increasingly fierce competition. Their response is to comb through all their costs for potential savings. Those with large buildings in particular find energy is becoming a more important factor. Just think about cooling in data processing centers or electricity and process heat in a manufacturing plant. In hospitals, energy is second only to personnel costs as an expense. As a result, our customers expect to noticeably

streamline energy use and hence reduce costs. At the same time, the topic of energy efficiency is gaining in importance for many people against the backdrop of climate change.

Can you put a number on the savings potential?

We generally work on the assumption that energy consumption for any existing building can be trimmed by at least 20 percent.

Why weren't such steps taken long ago?

Not only have dramatic rises in energy costs escalated the urgency of the situation, but also technical solutions are available today that didn't exist a few years ago. Thanks to these technological advances, we can unlock new potential for greater energy efficiency in our customers' operations. At the same time, power supply systems are becoming more and more complex. That's why companies, especially medium-sized companies, are looking to entrust this aspect of their business to a specialist service provider – leaving them free to devote their time and resources to what they do best.

What has changed in this sector to make things so complex?

Decentralized power generation, for one, has made things more complex on the supply side. Keeping tabs on the big picture and getting the best out of what's on offer is no easy task. Take, for instance, intelligent networks – better known as smart grids. The ranks of devices and systems connected with one another via the internet are swelling. In our business, the internet of things and services is a growing phenomenon. In the coming years, these networks will give rise to many more solutions and services geared to increasing energy efficiency. Dynamic electricity rates are just one example of this.

What kind of rates are those?

They depend on total demand. Electricity is very expensive during peak hours, but it becomes more affordable at night. This is the energy industry's way of attempting to flatten out the spikes in demand. We can take advantage of these rates today because we are able to precisely meter and control current the electricity, heating, and cooling requirements in a building at any given time. At times when electricity prices are high, certain equipment can be switched off and then put back into full operation when rates drop at night. This calls for legislators to act as well – such rates are legally permissible but they are still not being offered everywhere. A considerable amount of potential is squandered here.

Hospitals and plants with complicated manufacturing processes require a constant supply of electricity. Shutting equipment down is hardly an option.

How can you help them?

Even in those facilities, there are systems and machinery that are not in constant use. With the appropriate control measures in place, these facilities can also reap the rewards of switching equipment off. In the case of facilities that require a constant supply of electricity, acquiring a dedicated power plant, for example, should be seriously considered – especially as the plant can be precisely tailored to the customer's needs.

But these customers have to invest heavily before they can eventually see any savings...

Not necessarily. We also offer to operate a decentralized power plant for our customers and charge them only for the heat or electricity they actually use. A careful case-by-case assessment is made to determine what is required, what up-front costs this will incur, and what makes the most sense for the customer. This clearly shows just how important customized power supply services are going to be. In a few years' time, an individually tailored service will probably even be the make-or-break factor in selecting an energy supplier.

But isn't operating power-generating facilities really the big utilities' core business? What can Bosch offer customers that they can't?

Word is spreading that Bosch has a broad expertise base. We can turn to our colleagues at Bosch Thermotechnology to draw on their decades of experience in operating combined heat and power plants, for example, or reach out to the Bosch Security Systems team to help with optimizing networks and control systems at complex sites. At Bosch Rexroth, we have a ready source of knowledge on streamlining manufacturing plants and facilities. Consequently, our customers see Bosch in a completely different light from a company that specializes solely in selling energy.

What exactly is your approach?

Our experts start by analyzing the status quo on site. From there, they can calculate the potential gains in efficiency and determine the appropriate methods for achieving them. A central aspect of this is working out how energy can be used as effectively as possible. After all, if energy isn't used, there's no need to supply it in the first place. For instance, we investigate whether heat released during a manufacturing process can be used to generate electricity or heat other areas of the building. As I've already mentioned, it often pays for large sites to run their own combined heat and power plant.

How big is the market you are active in?

It's a rapidly expanding market. In Germany alone, the market volume for energy-related services will grow from 2.5 billion euros today to almost four times that in a decade. We expect that markets in other major industrial countries, such as those here in Europe, will follow a similar trajectory.

In the domestic construction sector, we have passive houses and even houses that produce more energy than they use. Are factories that are self-sufficient in their energy needs conceivable?

Absolutely. There are an increasing number of sites and companies that have made their production CO₂-free or are powered entirely by renewable energy. Both large and small companies have already set this as their goal, for example for power or heat, or because it allows a particular product to be marketed as having a small "carbon footprint." By systematically using every available option for saving and regenerating energy, this already works quite well.

What is the energy efficiency situation in German companies?

Some manufacturers have already been able to achieve a remarkable level of efficiency, particularly in production. But there is still considerable potential to be harnessed in ancillary processes such as heating, cooling, compression, and ventilation. Many of these processes have seen very little invested in them over the past few years.

Is energy primarily being used or wasted in the industry?

Wasting would mean that manufacturers are deliberately using energy in an inefficient manner, which is definitely not the case. In order to make a business sustainable, however, it's important to deliberately decide to address the topic of energy efficiency, to cement it as a corporate objective, and to put it into practice step by step.

What are the typical approaches in order to see results quickly?

There are often optimizations that can be made where air-conditioning and ventilation are concerned. The same is true for the regulation and control of air compression and heating as well as for heat transport. These are all areas in which investments in the improvement of energy efficiency would pay off quickly.

And which measures are designed to rather pay off over the long term?

This is where the really big potential lies, with efficiency gains in the two-digit percentage range. Examples including using waste heat or cogeneration systems, or

switching from one fuel source to another, such as from oil to biomass. Following our analysis, the Rothaus brewery switched over from oil to wood chips, and it now saves an enormous amount of money. And it's still good for the environment.

How is your export business? What markets are experiencing dynamic growth?

Bosch Energy and Building Solutions is a provider of services and systems solutions which can't just be simply exported. Interesting markets are the large European economies, the BRIC states, North America, as well as Japan and Korea. In all those places, we're seeing the trend toward increasing energy efficiency on the consumer side – sometimes fueled by environmental concerns, other times because of the desire to reduce costs and increase competitiveness.

Why does it pay off for companies or communities to generate their own electricity? And how eco-friendly is it?

It's difficult to make a general statement here. In principle, there can be a number of objectives behind someone generating their own heat and electricity. Above all, having a cogeneration plant pays off where usage is high enough that a low fuel price leads to an overall savings on electricity costs. Other objectives can be to reduce CO₂ emissions or achieve energy self-sufficiency.

What will be the big drivers of energy efficiency technology in the future?

The intelligent networking of buildings, property, and decentralized facilities in order to make energy flows and use transparent, comprehensible, and controllable – not just for electricity but also for heating, cooling, and ventilation. This transparency is the key to doing business in a truly sustainable way.

Internet:

Bosch Energy and Building Solutions homepage:

<http://bit.ly/1hBdaxp>

Press photo:

1-RB-20469 (portrait of Michael Blichmann)

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Giant industrial steam boilers and tiny semiconductor sensors **Savings on really big and really small items**

November 27, 2014
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- ▶ Tailored boiler systems
- ▶ Micro-gyroscope with world's lowest energy consumption

Stuttgart/Reutlingen – In the opinion of the Intergovernmental Panel on Climate Change (IPCC), one of the ways to limit our atmosphere's rise in temperature is by improving energy efficiency – in other words, achieving the same output while using less energy. Bosch research engineers are pursuing this goal for both the largest and the smallest of the company's products: industrial steam boilers that weigh tons and tiny semiconductor sensors.

Giant industrial steam boilers

Steam boilers are Bosch's biggest and heaviest energy-supply products. They are over 12 meters long and can weigh more than 130 tons in operation. Every hour, they are capable of delivering around 55 tons of steam – as is the case at Valenzi GmbH & Co. KG, a company based in Suderburg, Germany, that produces some 4,000 tons of mushrooms, 2,000 tons of fruit, and 700 tons of soup vegetables annually. The company employs two efficient Bosch steam boilers.

- Each produces five tons of steam per hour. First, the boiler feed water passes into the integrated waste heat recovery unit and is pre-heated using hot flue gas. This increases the boiler's energy efficiency by roughly 5 percent – with a proportionate drop in fuel consumption.
- The gas burners' electronic combined control system ensures optimum doses of fuel and combustion air. Compared to the mechanical control used by older combustion systems, this allows for more precise tuning, which further reduces fuel consumption. The burner output is smoothly adjusted to the actual steam requirement, and can be throttled back to approximately

17 percent of rated output. This greatly reduces the switching frequency of the burners, as well as reducing energy losses caused by upstream ventilation of the flue gas channels.

- The fan's engine speed is adjusted depending on burner output. In the partial-load range, this leads to significantly lower electrical power input.
- The boilers are equipped with a heat maintenance device: a heating coil is built into the boiler floor. This allows the boiler in operation to maintain the heat of the second boiler at a low pressure, which saves energy, avoids corrosion, and ensures rapid availability.
- A boiler system has a service life of between 20 and 40 years. Depending on the situation, it is typically possible to achieve efficiency gains of between 10 and 30 percent by replacing or modernizing older systems. At today's fuel prices, even the largest facilities will amortize quickly.
- Valenzi is expecting its investment in the new boiler system to deliver annual energy cost savings of some 40,000 euros. It will bring down CO₂ emissions by some 300 tons per year.

Tiny semiconductor sensors

Semiconductor sensors are Bosch's smallest products. These MEMS (micro-electromechanical systems) sensors act as sensory organs for smartphones and other electronic devices. Engineers create the most delicate of silicon structures for them. As the sensor casing measuring just a few millimeters moves, these structures shift a fraction of a thousandth of a millimeter. The finest movements measured are less than half the diameter of an atom. These minuscule movements change the sensors' electrical properties, which are then converted into a data stream that lets a smartphone "know" how it is oriented. Then the phone can rotate the image on its display accordingly. The dimensions that Bosch works to here are incredibly small; while a human hair has a diameter of 70 thousandths of a millimeter (70 micrometers), some sensor components measure only 1 micrometer – that is 70 times smaller than the diameter of a single human hair.

This is how Bosch subsidiary Bosch Sensortec (BST) produces the world's smallest and most energy-saving sensor unit, the BMI160. Inside its housing, which measures just 2.5 x 3.0 x 0.8 millimeters, this unit contains an accelerometer and a yaw-rate sensor (gyroscope), among others. The BMI160 measures the orientation of smartphones with great precision. Other applications include tablets, wearables, remote control units, game controllers, head-mounted displays, and smart glasses. The problem is that today's sensors draw too much electricity from mobile devices. But when the BMI160's accelerometer and gyroscope are in full operational mode, its typical electricity consumption is just 950 microamperes – that's less than half the standard in the market and is a world record.

“That means our chip can be running all day inside the smartphone and doesn't have to be turned off when not in use to conserve the device's battery,” says Torsten Ohms, who is responsible for developing this chip at Bosch Sensortec. One application sees a smartphone using the sensors to record all its user's activities throughout the day, so it can then report how much energy the user expended traveling to work, walking around the office, or going up and down stairs. “People who want to lose weight can for instance choose what to have for dinner based on how many calories they've burned that day,” Ohms says.

To save energy, one of the things he and his colleagues have done is refine the chip's silicon structures even further. It now converts movements into electricity even more efficiently than before, so it takes less energy to amplify the weak electrical signals. In addition, the sensor can store its own data, rather than constantly transmitting them to the smartphone's particularly energy-hungry main processor. “What's more, we switch off parts of the BMI160 when they're not needed,” Ohms explains. “If a smartphone is just lying motionless on the table for two hours, there's no need for the sensor to be calculating the yaw rate. So the gyroscope stays switched off – until the accelerometer detects motion, when it switches back on again.”

Internet:

Details on the boilers at Valenzi:

<http://bit.ly/1tVQ1JE>

Details on the BMI160 sensor:

<http://bit.ly/1I9IGCj>

Press photos:

1-TT-19706, 1-TT-19705, 1-TT-19704 (energy-saving steam boiler)

1-BST-20138-d, 1-BST-20137 (BMI160 sensor)

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Self-imposed commitment: cutting CO₂ emissions 20 percent by 2020

October 30, 2014

PI 8595 UBE Res/SL

How Bosch is reducing its carbon footprint

Waste heat from machining saves oil and gas

- ▶ Biomass boiler in Rodez
- ▶ Cogeneration plant in Schwieberdingen
- ▶ Sophisticated energy concept in Reutlingen
- ▶ Purchasing department considers how energy-efficient machinery is

Sometimes, saving energy can be very simple: switching off lights and machines that are not needed has improved energy use at the Bosch plant in Schweinfurt alone by some 5 percent. And waste heat can also be used.

Stuttgart – Bosch has taken on a self-imposed commitment to save CO₂. Relative to internally generated value added, emissions of this greenhouse gas are to be reduced by 20 percent by 2020. This company is already making good progress toward this target: in 2013, relative CO₂ emissions were 16 percent lower than in 2007, the reference year. This progress has been made in part by employing new, energy-efficient technology.

Examples 1 to 3: Woodchips and cogeneration plant

At the **Nuremberg** plant, for instance, making use of the waste heat from the electrical machining has in large part replaced the need for gas and oil for heating purposes – saving 1,800 tons of CO₂ emissions every year. One of the new technologies used at the Bosch plant in the southern French city of **Rodez** is an efficient woodchip-powered biomass boiler which reduces the plant's CO₂ emissions by 600 tons annually. In **Schwieberdingen** near Stuttgart, the use of a cogeneration plant (CHP) has enabled the location to save 1,600 metric tons of CO₂ each year.

Example 4: Use of waste heat in Reutlingen

Bosch has developed an especially sophisticated energy concept for its Reutlingen location south of Stuttgart. All the waste heat from production is exploited and water is recovered. In addition, the cooling-water and heating

systems are interlinked. This reduces consumption of fossil fuels. Other aspects of the energy concept include a combined heat and power (CHP) plant, heat pumps, flue-gas heat exchangers, a solar heating system, and a photovoltaic array. Together with efficient manufacturing processes and modern plant engineering, the concept helps Bosch save around **10,000 metric tons of CO₂ a year** at the Reutlingen location. Rather than by burning fossil fuels, 90 percent of the modern wafer fab's heat requirement is met by way of waste-heat utilization, a renewable form of energy.

Example 5: The “CO₂ networkers” from Schweinfurt

The Bosch Rexroth plant in **Schweinfurt**, Germany, has nearly achieved its goal of reducing CO₂ emissions by 20 percent by the end of the decade. “The project is focused primarily on the efficient use of energy in production. To achieve this, we use a special system,” says Leo Pototzky. As the project director for energy efficiency and CO₂ reduction, he is the driving force behind the project. He and his colleagues are not only installing the most efficient lighting and building insulation possible, but also looking at the energy consumption of all their machinery and plant.

And the necessary expertise is coming from within their own ranks. Bosch Rexroth makes drive and control technology for the mechanical engineering and process plant engineering industries. In other words, it knows precisely how individual components interact. The experts question whether all components in a system need to be used at all times or whether individual parts can be shut off. They may discover that a system can function perfectly well with a machine with a lower delivery rate or less powerful drive motors. This saves hardware, lowers energy consumption, and thus reduces greenhouse gas emissions. And not least, money can be saved.

Pototzky and his team have already analyzed more than 150 different types of machines and built up an enormous wealth of knowledge. They have become “CO₂ networkers,” making their extensive experience available to numerous plants within the Bosch Group. After they have taken stock of the situation, they ask a number of core questions. Which actions are appropriate? Which ones will have a lasting effect? And last but not least, which are also financially viable? After all, even a major target such as reducing CO₂ needs a realistic financial framework.

One good example of this is the **retrofitting of large grinders**. In Schweinfurt, these grinders are used to file down steel profile rails to one-hundredth of a millimeter. To counteract the resulting frictional heat, high-pressure jets spray coolant on the grinding disks and metal rail. For example, the jets have been

redesigned to make more efficient use of the coolant. This ultimately saves so much coolant that, despite higher production volumes, there is no need for a larger coolant tank and a substantially lower delivery rate is required. In addition, there is less splashing of the coolant, which used to create a fine mist in the grinding shop.

The workforce is also playing a part in making the project a success. Energy requirements in Schweinfurt can be reduced by **around 5 percent** by making sure lights and machines are switched off when not in use. In total, the measures have **reduced CO₂ emissions** at Schweinfurt **by nearly 2,500 metric tons per year**. This means Pototzky and his colleagues are 80 percent of the way toward achieving the goal they set.

Example 6: Energy-efficiency wiki

One of the ways information about especially successful concepts is made available is through a Bosch-wide energy-efficiency wiki. For each project and each idea that is put into practice, there is a fact sheet with the key data. Especially good examples are presented at coordinators' meetings. Later, Bosch's purchasing department ensures that any new machinery to be acquired satisfies the more exacting energy standards. "We are confident we can achieve our CO₂ target," says Dr. Ralph-Peter Mechnik, who coordinates the worldwide activities of the Bosch associates entrusted with improving energy efficiency.

Example 7: the "eta" model factory

Elsewhere as well, Bosch is working on the energy-saving factory of the future – for example, as an industrial and research partner on the "eta factory" project. The name refers to a publicly funded project of the Technical University of Darmstadt, named "Energy-efficient factory for interdisciplinary technology and application research." The objective of the project is to reduce energy consumption in industrial production. The project members believe that the energy-saving potential is as high as 40 percent. To demonstrate this, a model factory will be set up for research purposes on the university campus. All its systems, such as the building, technical infrastructure, and machinery and equipment, will be included in the plan and their energy requirements interconnected.

Example 8: painting shop saves 75 percent energy

At its plant in Mellansel, Sweden, Bosch Rexroth manufactures heavy-duty engines for ships, for mining, and for recycling plants. Engines that will subsequently come into contact with salt water are coated with several layers of corrosion-proofing. This is done in a painting shop on site. Now that this has been modernized, it uses **three-quarters less energy** than before. Among other

things, this is due to energy recovery using heat pumps. In addition, the paint shop now uses smaller drying booths where the old shop used a drying tunnel.

Internet:

Sustainability in the Bosch Group:

<http://bit.ly/1IDFD49>

More information about the eta factory:

<http://bit.ly/1FS3uJK>

Press photo:

1-RB-19253 (eta factory)

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Taking energy efficiency to new heights **Bosch world-record dryer** Efficiency that is 10 percent better than A+++ class

October 30, 2014
PI 8743 UBE Res/SL

- ▶ The most economical¹ and the quietest² dryer on the market³
- ▶ Annual energy consumption: 158 kWh
- ▶ Patented: a self-cleaning condenser

Anyone who wants to help protect the environment can use the most economical dryer in the world. Even drying laundry on a rack consumes more energy.

Munich – A world record in the laundry room: the new Bosch HomeProfessional WTY887W3 dryer is currently the most economical and the quietest dryer in its class. With its annual energy consumption of 158 kilowatt-hours (kWh), this appliance knocks another 10 percent off the best efficiency class A+++ – making it the world’s most efficient dryer. One of the reasons is that its optimized EcoSilence compressor compresses the coolant extremely quickly and flexibly. Then there is the self-cleaning condenser, which Bosch has patented. Thanks to an automatic rinsing system, the condenser no longer needs to be cleaned. That means the dryer’s electricity consumption will stay low throughout its service life.

Protecting the environment

Dryers in efficiency class A+++ are on average 63 percent more economical than dryers in class A. According to Bosch’s own estimates, buying an A+++ class dryer makes most sense for multi-person households that want to make a lasting cut to their energy costs and at the same time help to protect the environment.

¹ It is 10% more efficient (158 kWh/year) than the threshold value for energy efficiency class A+++ for tumble dryers with an 8 kg capacity (177 kWh/year), as per Regulation (EU) 392/2012.

² At just 61 dB(A) re 1pw, it has the lowest noise emissions in the heat-pump dryer category on the standard cotton program at full load in accordance with Regulation (EU) No. 392/2012. (As of: August 6, 2014)

³ As of: August 6, 2014

For comparison, standard condenser dryers achieve no better than energy efficiency class B.

Even drying clothes on a rack is no match. Back in 2008, the German Institute for Applied Ecology confirmed in its study entitled “A comparison of the environmental impact and costs of various clothes drying systems” that a Bosch condenser dryer (in this case the EcoLogixx) featuring heat-pump technology consumes up to three times less energy than line drying – depending on how homes are ventilated. During ventilation, warm, damp air is replaced with dry, cold air – with the home heating left to make up for the resulting drop in temperature.

Washing machines remove the majority of the water from washed laundry during their spin cycle. But a lot of moisture still remains bound up in the fabric. Dryers pass warm, dry air through the damp laundry, causing the water to evaporate. Next, the hot, damp air is cooled so that the water from the laundry condenses out for collection in a container.

Press photo: 1-BSH-20670

Internet:

Link to the study (German version):

<http://bit.ly/1pFC0vt>

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Innovations cut down on CO₂ emissions **Responding to climate change with energy efficiency** Vehicle coasting and electricity from waste heat

October 21, 2014

PI 8599 UBE Res/SL

- ▶ Summary of climate report to be prepared October 27-31, 2014
- ▶ Bosch CEO Denner: “We need to tap hidden energy potential”
- ▶ Example: saving gasoline with the finest possible holes

The Intergovernmental Panel on Climate Change believes that the use of advanced technologies to improve energy efficiency could stabilize or even reduce energy consumption by 2050. Bosch already has a lot to offer.

Stuttgart: Our atmosphere is heating up – and it’s the greenhouse gases emitted by human activity that are primarily to blame. So says the Intergovernmental Panel on Climate Change in its latest internationally significant report. The scientists recommend that emissions of greenhouse gases must be reduced if we are to combat the global warming trend. One of the ways to do this is by improving energy efficiency. “Its findings present the global community with the crucial task of finding new solutions that will help us make efficient use of energy. If we approach this challenge in the right way, we can turn it to our advantage,” says Bosch CEO Dr. Volkmar Denner. “Done the right way, products that protect our environment are innovative advances that combat climate change and increase comfort. They will also save users money.”

Submission of recommendation for action to heads of state

From October 27-31, 2014, the Intergovernmental Panel on Climate Change (IPCC) will be meeting in Copenhagen to produce a condensed recommendation for action for heads of government and heads of state. This will be presented on November 2, 2014 in the presence of UN Secretary-General Ban Ki-moon. Leaders will then meet at the beginning of December 2014 for the United Nations Climate Change Conference in Peru’s capital city Lima, where they will discuss how they want to go about countering climate change.

“Globally speaking, development work to improve energy efficiency is not moving quickly enough. If we want to achieve our aim of limiting global warming to two degrees Celsius, we must give higher priority to energy efficiency improvement

initiatives,” Denner says. The Bosch CEO is a physicist by training and counts research among his areas of responsibility.

“Taking precautionary action”

Denner is at pains to point out that we don’t yet know exactly what effects our behavior today will have in the future. “But really, that is exactly what sustainable behavior is all about: understanding the relationship between cause and effect. Man-made climate change is an important example. We need to know how the energy consumption of everything from manufacturing operations to private vehicles will impact tomorrow’s environment – even if that impact is on the other side of the world. Wherever we can establish this sort of transparency, we have the chance to make the right choice. As an individual, to buy a more fuel-efficient vehicle. As a company, to invest in energy-efficient production or resource-saving products. What’s really important is that even if we don’t yet fully understand all the effects, we should still make an effort to act in a way that minimizes any negative impact of our behavior. We would be well advised to take this sort of precautionary action with regard to climate change as well.”

Bosch is responding with a whole range of innovations. Factories can be heated with the waste heat from production processes; gasoline direct injection contributes to a fuel saving of 15 percent; Bosch makes the most energy-efficient dryer in the world, which knocks another 10 percent off even the most energy-efficient A+++ class. “There’s still a lot of hidden energy potential to unlock, and we’re far from exploiting all of it,” explains Denner. “Simply by improving the way air conditioning is controlled in existing commercial buildings, we can achieve energy savings of at least 30 percent and improve comfort levels. These sorts of investments often pay off for the customer within two to three years.”

Vehicle coasting

Bosch’s start-stop coasting function means that whenever the vehicle is able to maintain its speed simply by rolling – for instance on a gentle decline – the engine is stopped. As soon as the driver touches the gas pedal, the engine starts up again. Tests carried out by Bosch have shown that the combustion engine runs needlessly about 30 percent of the time, meaning that the vehicle can simply coast for almost a third of every journey.

Electricity from waste heat

“As elsewhere, in Germany a significant portion of energy is lost as unused waste heat. Such waste is costly and bad for the environment,” says Denner. “It’s much better to channel that waste heat through a heat exchanger, for instance, so it can heat a coolant in a closed cycle. Even at low exhaust temperatures, this achieves high pressures to drive an electricity generator via a turbine.” This organic Rankine cycle (ORC) is just one of the solutions in the Bosch portfolio.

Researching our energy future

Bosch is also industry and research partner for the Technical University of Darmstadt’s “Energy-efficient factory for interdisciplinary technology and application research,” a project that aims to further reduce the amount of energy consumed in industrial production. The project members believe that the energy-saving potential is as high as 40 percent. Elsewhere, Bosch is investigating how wave energy can be converted into electricity. A research network made up of four companies and two universities aims to establish sustainable power generation along the world’s coasts.

Saving gasoline with the finest possible holes

Bosch has implemented on an industrial scale a new technology that uses ultrashort laser pulses to drill the finest possible holes. This method is able to bore out gasoline injection nozzles so precisely that the fuel distribution within the combustion chamber can be optimized, contributing to a fuel saving of up to 15 percent for gasoline direct injection systems. In 2013, the team of Bosch researchers and partners responsible for developing the idea won the German Future Prize awarded by the German Federal President. “Protecting the environment and doing business sustainably are central tenets of our corporate strategy. Bosch focuses almost half of its research and development spending on the development of eco-friendly products,” says Denner.

Voluntary commitment to cut CO₂ emissions by 20 percent by 2020

Bosch has also pledged to cut CO₂ emissions from its own value-added activities with a 20 percent reduction by 2020 – compared against 2007 levels. The company is well on its way, since value-added CO₂ emissions in 2013 were already 16 percent lower compared against 2007 levels.

This has been achieved by bringing in new, energy-efficient technology. At the Nuremberg plant, for instance, making use of the waste heat from the electrical machining has in large part replaced the need for gas and oil for heating purposes – saving 1,800 tons of CO₂ emissions every year. In the south of France, the Bosch plant in Rodez uses an efficient biomass boiler fueled by wood chips – saving 600 tons of CO₂ emissions every year. And in Schwieberdingen near

Stuttgart, a combined heat and power plant saves 1,600 tons of CO₂ a year. “This all goes to show that we don’t just set climate protection priorities at Bosch, we implement them too,” emphasizes Denner.

Internet:

Timeline for climate report summary:

<http://bit.ly/1wXGSBZ>

Start-stop coasting:

<http://bit.ly/J1gSlo>

ORC (organic Rankine cycle):

<http://bit.ly/1t4r9jP>

German Future Prize:

<http://bit.ly/1nnlYpT>

Electricity from wave energy:

<http://bit.ly/Q8G3pY>

Logano plus GB145:

<http://bit.ly/Q8IHf8>

Sustainability at Bosch:

<http://bit.ly/1bMcqSi>

Press photos:

- | | |
|----------------|--|
| 1-PE-18425 | (Dr. Volkmar Denner) |
| 1-GS-19999 | (Gasoline direct injection) |
| 1-SG-19701-d | (Start-stop coasting) |
| 1-RB-19358-d | (Wave energy) |
| 1-BEBS-19672-d | (Potential for energy savings in commercial buildings) |

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The company was set up in Stuttgart in 1886 by Robert Bosch (1861-1942) as “Workshop for Precision Mechanics and Electrical Engineering.” The special ownership structure of Robert Bosch GmbH guarantees the entrepreneurial freedom of the Bosch Group, making it possible for the company to plan over the long term and to undertake significant up-front investments in

the safeguarding of its future. 92 percent of the share capital of Robert Bosch GmbH is held by Robert Bosch Stiftung GmbH, a charitable foundation. The majority of voting rights are held by Robert Bosch Industrietreuhand KG, an industrial trust. The entrepreneurial ownership functions are carried out by the trust. The remaining shares are held by the Bosch family and by Robert Bosch GmbH.

Additional information is available online at www.bosch.com, www.bosch-press.com, and <http://twitter.com/BoschPresse>



World-record-holding dryer and fuel cells **Bosch technology for energy efficiency** Fuel economy thanks to predictive navigation

October 21, 2014
PI 8592 UBE Res/SL

- ▶ Built many times already: the energy-plus house
- ▶ Successful model: direct injection reduces fuel consumption by up to 15 percent
- ▶ Current research: electricity from wave energy

In Germany alone, the nationwide use of modern Bosch heating technology could save roughly 50 million metric tons of CO₂ per year. There are many other ways to increase energy efficiency.

Stuttgart – The climate report issued by the IPCC states that the predicted warming of the Earth’s atmosphere by more than two degrees Celsius could still be prevented if decisive action is taken. One prerequisite for this is enhanced energy efficiency. As the report states: “In the building sector, the use of advanced technologies, the energy-efficient retrofitting of existing structures, and the introduction of energy efficiency standards for new buildings could stabilize or reduce final energy consumption by 2050.”

The researchers also write: “The energy intensity of the industrial sector could be directly reduced by about 25 percent compared to the current level through widespread use of the best available technologies.” They also state that improving energy efficiency even further could lead to additional reductions of about 20 percent.

Bosch already has the necessary technology in its portfolio, and generates more than 40 percent of its sales from environmental and resource-saving technologies and products. A selection:

► Building technology examples

1. An energy-plus house has been built in Wetzlar, Germany, that generates more energy per year than its inhabitants require. The house was built by Buderus, a project team created by Bosch Thermotechnology, Buderus Immobilien GmbH (BIG), and SchwörerHaus. <http://bit.ly/R55J83>
2. Efficiency savings at Cologne Bonn airport: Technology conversions carried out by Bosch have allowed airport operators to permanently switch off the 342 circulating air cooling systems on the exterior façade of the Terminal 2 building. All nine of the airport's door air curtain systems, which prevent cold air from entering the building, are now no longer needed, even at very low outdoor temperatures. Now the conversion is complete, ventilation technology at the airport predominantly operates at partial load. Energy costs have been reduced by around 40 percent and CO₂ emissions **cut by 1,800 tons per year**. <http://bit.ly/1hk6O5w>
3. Rothaus, the state-owned brewery located in Grafenhausen, has been using a Bosch **biomass heating plant** since 2008 to generate the steam and heat energy required for its operations. The plant has reduced not only energy costs but also CO₂ emissions by **3,000 tons** per year. The plant is fuelled with natural woodchips sourced from the Black Forest that have guaranteed availability all year round. <http://bit.ly/Q8K0e3>
4. Buderus – a Bosch Thermotechnology brand – has a portfolio that includes Logapower FC10, a decentralized electricity and heat production system intended both for new installations and for refurbishments. Based on **fuel-cell technology**, it is able to supply single- and two-family homes with a high proportion of the heat and power required by the occupants. The system is fuelled by natural gas and generates both electrical and thermal energy through combined heat and power generation. Its electrical efficiency of more than 40 percent and **overall efficiency of 90 percent** make this one of the most efficient systems for decentralized power and heat generation on the market. <http://bit.ly/Q8I2KR>
5. German home-improvement retailer OBI has opted for CO₂-neutral heat at its Heidelberg store. Bosch supplies the store with renewable energy from biomass through connection to an existing power station nearby, where a biomass boiler supplies a large part of the energy required by the neighboring company, Eternit AG. Locally sourced biomass keeps transportation routes short, strengthens regional value creation, and reduces CO₂ emissions. <http://bit.ly/1hDfGy7>

6. Freizeitbetriebe Worms GmbH, the organization that operates public swimming pools in the German city of Worms, has modernized the heating and ventilation system at one of its facilities. The installation of Bosch technology to replace the control module has made the pool's muggy indoor climate a thing of the past. There is now a comfortable ambient temperature throughout the entire building, while **energy and operating costs have fallen by 30 percent.** <http://bit.ly/1jLfb6Y>
7. Thanks to Bosch, farmers in New Zealand can use **gas instead of electricity to heat** the water required to clean their dairy plants every day. This lowers their energy costs by some 60 percent while simultaneously reducing emissions of the greenhouse gas carbon dioxide. What enabled them to make this quick and cost-effective upgrade of an existing electrical system to gas was the use of a patent-protected valve.
8. The Bildungszentrum Worms (BIZ) now uses Bosch Energy and Building Solutions (BEBS) ventilation technology products and services. Over the course of a modernization project, the building shell was renovated and the building's technology upgraded. As a result, the building is now **over 40 percent more energy efficient** than the mandatory legal requirement for new buildings. <http://bit.ly/1n71eDL>
9. In Germany alone, the **nationwide use of modern heating systems** made by Bosch could save 50 million metric tons of CO₂ per year. This is roughly equivalent to one-third of all the CO₂ emitted by traffic in Germany. Bosch's product portfolio includes an oil-fired condensing boiler that significantly reduces fuel and maintenance costs. Its **modulation** makes the **Logano plus GB145** made by Buderus so flexible that it can adjust its performance at any time to suit specific heat requirements. <http://bit.ly/Q8IHf8>
10. With Bosch's **online energy efficiency advisor**, all house owners have to do is enter their building data to receive suggestions for renovating their house, from the roof to the boiler. The tool uses figures computed by the Fraunhofer Institute for Building Physics. <http://bit.ly/1faAgvP>

► **Savings through improved ventilation control**

Engineers from the Bosch Energy and Building Solutions (BEBS) subsidiary are **unlocking hidden potential for efficiency.** Measures such as controlling ventilation according to actual demand and using waste heat from production to heat offices make it possible to achieve an average 20 percent energy saving in

commercial buildings. “Such investments often pay off within two to three years,” says Michael Blichmann, general manager of BEBS. <http://bit.ly/1hBdaxp>

With conventional systems, air is forced to circulate in a certain direction, which often means it is not mixed in the best possible way. As a result, the temperature is unevenly distributed, and some areas of the space are cold and drafty. Moreover, the space needs a relatively large supply of fresh air, which has to be cooled in summer and heated in winter. This creates a poor indoor environment and frequently leads to high energy costs. By contrast, Bosch’s **innovative management algorithm** ensures an omnidirectional flow of air and thus even air distribution in a room. The result is a constant temperature and an evenly ventilated space. **Energy savings can be as much as 70 percent.**

<http://bit.ly/1n71eDL>

► **Storing energy for occupant’s own use**

1. What if I could use my own **solar power late into the night**? Photovoltaic systems generate electrical power, although in the middle of the day when often nobody is home. But in the evening, when demand is at its peak, the sun is no longer shining. The BPT-S 5 Hybrid **energy storage system** balances out supply and demand. <http://bit.ly/1izPEhO>
2. Bosch is supplying a flexible **energy storage system** for a new housing complex that comprises 180 townhouses in Kelsterbach, a town close to Frankfurt, Germany. The system has an installed capacity of 135 kilowatts. On paper, this is enough to meet the daily power requirements of ten average four-person households. The storage system helps ensure the best possible local use is made of the power generated in the complex. <http://bit.ly/R57r9o>
3. Improving the use of **intermittent wind power** as a power source: One of Europe’s largest hybrid batteries stores the electricity generated at a community wind farm in the northern German municipality of Braderup and feeds it back into the power grid as needed. The system has a total capacity of 3 megawatt hours (MWh) and comprises a 2 MWh lithium-ion storage unit and a 1 MWh vanadium redox flow battery. http://bit.ly/Eroeffnung_Braderup

► More efficient manufacturing

At its manufacturing facility in Mellansel in Sweden, Bosch Rexroth produces heavy-duty engines used on ships, in the extraction of raw materials, and in recycling plants. Engines that are later exposed to saltwater receive a multi-layered coating to protect against corrosion. The coating is applied in the factory's on-site paint shop, which was **modernized to reduce energy consumption by 75 percent**. Measures that helped improve energy efficiency include an energy recovery system using heat-pump technology, and the use of smaller drying booths instead of the drying tunnel featured in the old plant. Between 40 and 60 engines are painted each day on the new, automated assembly line. The next expansion stage is to increase the throughput from 12,000 to 16,000 units per year.

► More efficient household appliances

- 1. World record in the laundry room:** The new Bosch HomeProfessional WTY887W3 dryer is currently the most economical and the quietest dryer in its class. With its annual energy consumption of 158 kilowatt-hours (kWh), this appliance knocks another 10 percent off the best efficiency class A+++ . One of the reasons is that its optimized EcoSilence compressor compresses the coolant extremely quickly and flexibly. Then there is the self-cleaning condenser, which Bosch has patented. Thanks to an automatic rinsing system, the condenser no longer needs to be cleaned. That means the dryer's electricity consumption will stay low throughout its service life. <http://bit.ly/1oCHx6A>
- 2.** Bosch's KSV36AW40 refrigerator in the best energy-efficiency class A+++ requires 75 kWh per year to operate 24 hours a day for 365 days. That's **half the amount of energy required by an 18 W energy-saving lamp**, which would need 157.68 kWh per year. <http://bit.ly/1gP2V3t>
- 3.** Based on the European energy label, **BSH** Bosch und Siemens Hausgeräte GmbH brings its most efficient products together in the **super-efficiency portfolio**. Appliances in this portfolio must meet the condition of consuming extremely low levels of energy or water, and therefore have the best energy-efficiency class for their category. The portfolio includes washing machines, dishwashers, and refrigerators graded A+++ or A++, and also cookers, ovens, and driers that achieve an A label with their most efficient model. In 2011, the portfolio products sold **saved a total of 1.87 billion kilowatt hours of electricity** – that is equivalent to the average annual electricity consumption of 525,000 households. <http://bit.ly/P2FL2T>

► Researching our energy future

1. Bosch is an industrial and research partner on the Technische Universität Darmstadt's "eta factory" project – the "energy-efficient factory for interdisciplinary technology and application research." Their objective is to further reduce and improve energy consumption in industrial production. The project members believe that the **energy-saving potential is as high as 40 percent**. <http://bit.ly/1qw2jVW>
2. Bosch invests **roughly half its R&D budget** worldwide in technologies that conserve resources and protect the environment. Bosch spent some 4.5 billion euros on research and development in 2013 alone – almost 10 percent of its sales – and applied for some 5,000 patents worldwide.
3. Bosch has implemented on an industrial scale a new technology that uses ultrashort laser pulses to drill the finest possible holes. This method is able to bore out gasoline injection nozzles so precisely as to **optimize fuel distribution within the combustion chamber**, contributing to a fuel saving of up to 15 percent for gasoline direct injection systems. In 2013, the idea won researchers from Bosch, TRUMPF Laser GmbH, and Friedrich Schiller University of Jena the German Future Prize awarded by the German Federal President. <http://bit.ly/1nnlYpT>
4. Eco-friendly **electricity from wave energy**: A demonstrator model in a Bosch laboratory illustrates how wave energy can be converted into electricity. A publicly funded research network made up of four companies and two universities aims to establish sustainable power generation along the world's coastlines. <http://bit.ly/Q8G3pY>

► More efficient packaging technologies

Just one of its plants for packaging chocolate bars, biscuits, and other foods saves Bosch Packaging Technology some 390,000 square meters of plastic film annually – an area equivalent to the size of **54 football fields**. This is possible because the ends of the packaging are sealed using ultrasonic technology, which requires only a very small contact area between the films forming the seal. Over the course of a year, this adds up to a huge amount of material saved. What's more, there is no need to produce, print, or transport any more film than is required. <http://bit.ly/1k4PuCc>

► More efficient automotive technology

Bosch extras that **make new cars more economical**:

- Continuously variable transmission – reduces fuel consumption by up to 7 percent.
- Start/stop – fuel is no longer used at a red light, reducing fuel consumption by at least 5 percent.
- Electrification – reduces fuel consumption by up to 60 percent.
- Adaptive cruise control (ACC) helps drivers maintain a constant speed and reduces fuel consumption by up to 5 percent. <http://bit.ly/1kNjaC9>
- Bosch gasoline direct injection helps reduce fuel consumption by **up to 15 percent**. <http://bit.ly/1e4dvJc>
- Bosch has developed the **iBooster**, an electromechanical brake booster that provides situation-dependent support when the driver initiates braking. The iBooster makes hybrid and electric vehicles even more efficient, while enhancing safety through shorter braking distances. Depending on vehicle design, the iBooster can increase the range of electric vehicles by **up to 20 percent**. It also allows more comprehensive use of fuel-saving functions that stop the engine for periods of time, such as start-stop or coasting. If hybrid and electric vehicles are to achieve their intended range and fuel efficiency, they must **recover as much electrical drive energy as possible** when braking. Ideally, cars would be slowed down purely as a result of their electric motor converting their kinetic energy into electricity. This would avoid the loss of valuable energy through braking. The iBooster recovers almost all the energy lost in typical braking operations. <http://bit.ly/1qXPEeE>
- Bosch's **start-stop coasting function** means that whenever the vehicle is able to maintain its speed simply by rolling – for instance on a gentle decline – the engine is stopped. As soon as the driver touches the gas or brake pedal, the engine starts up again. Tests carried out by Bosch have shown that the combustion engine runs needlessly about 30 percent of the time, meaning that the vehicle could simply coast for about a third of every journey. Although these phases are not taken into account in the New European Driving Cycle (NEDC), **under real traffic conditions the function will give drivers a fuel saving of roughly 10 percent**. Reduced fuel consumption also means lower CO₂ emissions. In Germany, some three million new vehicles were sold in 2012. According to statistics, the annual average distance driven is around 11,500 kilometers. If every new car were equipped with the coasting system and emitted just ten grams less CO₂ per kilometer as a result, the theoretical annual reduction in CO₂ would amount to over 30,000 metric tons. <http://bit.ly/J1gSlo>
- In stop-and-go traffic, the Bosch **eClutch** allows drivers using manual transmission to use first gear without using the clutch. This electronically

controlled clutch closes the gap between automatic and manual transmission. In addition, the eClutch makes the coasting function possible, which saves fuel. <http://bit.ly/1ixpGdr>

- The pioneering **Eco.Logic motion** navigation system enables more economical driving for commercial vehicles. In the new Mercedes-Benz Actros, information about inclines is used to calculate an efficient driving strategy for engine management and transmission control. By accelerating at the right time in advance of inclines and by avoiding unnecessary gear shifts, **fuel consumption can be reduced by 3 percent** on average. (<http://bit.ly/RIGGxz>)
- **Electromobility** will play a major role in the future. Bosch is already firmly established in this area, producing essential components such as electric motors, power electronics, energy-recovering braking systems, and battery systems. Although a **volume market here will likely develop only after 2020**, by the end of 2014 at the latest Bosch will have completed 30 projects relating to powertrain electrification in production vehicles. The goal for electric powertrain systems by the end of the decade is to **more than double the energy density of batteries** and to develop engine concepts that require either fewer rare earth elements or none at all. “Electromobility is currently still a niche business, but after 2020 it could very well become a mass market. I expect that by 2020, electric cars will have a range of at least 300 kilometers,” says Dr. Volkmar Denner, chairman of the Robert Bosch GmbH board of management and who is responsible for research and advance engineering.
- E-mobility goes far beyond the traditional automotive product business. With components for e-bikes and e-scooters, Bosch supports **multi-modal transport concepts** in urban centers. Its subsidiary Bosch Software Innovations is developing the necessary infrastructure. For example, the system enables e-roaming, which allows vehicles to use charge spots belonging to different providers. The company has developed such a software platform for Berliner Huject GmbH, a consortium of automotive and energy companies.

► **Savings through combined heat and power plants, heat recovery, and ORC**

Bosch has already installed **1,200 combined heat and power plants and waste heat power plants**, with this figure set to reach more than 5,000 by 2020.

A **combined heat and power (CHP) plant** produces electrical energy and heat at the same time. A combustion engine, for example fuelled by biogas, drives a generator. The waste heat it produces heats water – hence we refer to combined heat and power generation.

The warm water is usually used to heat houses located directly by or close to the CHP plant, but it can also be fed into a heat network. This combination is much more energy efficient than producing electricity in a large power plant and heat in many separate small heating systems in homes. CHP plants therefore conserve both financial resources and the environment, as less gas is required to achieve the same output as in separate power and heat generation. Emissions are also lower as a result. This is true not only for CO₂ emissions; NO_x (nitrogen oxides) and CO (carbon monoxide) levels also drop to significantly below legally established limits. <http://bit.ly/1ilaljZ>

Primary energy savings compared to conventional solutions can be as high as 40 percent. CHP plants built by Bosch KWK Systeme GmbH achieve **overall efficiencies of up to 95 percent**. By way of comparison, conventional energy supply systems that provide electricity generated by power plants and heat from boilers can achieve an overall efficiency of only 56 percent. Bosch CHP plants improve the economic and ecological balance in many cases. One example is the Hetlingen sewage treatment plant in Schleswig-Holstein, which treats more than 30 million cubic meters of waste water from over 480,000 people. The CHP-plant modules achieve an electrical efficiency of 41 percent and an **overall efficiency of almost 84 percent**. <http://bit.ly/Q99bh0>

Heat recovery steam boiler

Bosch Industriekessel heat recovery steam boilers are good additions to energy concepts involving combined heat and power generation. They provide an efficient way of using accumulated flue gas heat by converting it into process steam. Depending on the version, it is possible to generate between 400 and 4,100 kilograms of steam per hour. Used in conjunction with a combined heat and power unit, heat recovery boilers can play a significant part in strategies for using primary energy efficiently. This additional option for using heat means that combined heat and power units can generally be designed on a larger scale than thermal heat-driven plants. The result is that the **plant operator is able to obtain more of its own electricity**, which in turn leads to excellent savings on energy costs and short payback periods. <http://bit.ly/1hDlzeN>

Organic Rankine cycle (ORC): Electricity from waste heat

A large proportion of all energy used around the world is lost in the form of waste heat. This is not only an expensive waste, but one that is also damaging to the climate when we consider that a major proportion of this energy is generated from fossil fuels.

The **ORC solutions** offered by Bosch KWK Systeme enable waste heat to be used to generate electric power. The process is based on an organic coolant that makes it possible to generate electric power at comparatively low temperatures. ORC technology involves passing waste heat through a heat exchanger, **transferring its thermal energy to a coolant in a closed cycle** that creates high steam pressure, even at low temperatures. This pressure is used to drive a turbine connected to a generator. The steam is returned to its fluid state in an air-heat exchanger, cooled, and then fed back into the vaporization cycle. Depending on the situation, the electrical power this generates can be fed into the public grid or be used as a **personal power supply on site**. <http://bit.ly/1t4r9jP>

Press photos:

- 1-GS-19999 (gasoline direct injection technology)
- 1-RB-19358-d (energy from ocean waves)
- 1-UBE-20365 (large energy storage facility)

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