Longer Term Investments

Energy efficiency

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Alexander Stiehler, CFA, Analyst; **Sundeep Gantori**, CFA, CAIA, Analyst

- Energy demand continues to grow, particularly in emerging markets, due to increasing populations, ongoing urbanization and rising wealth levels.
- Energy efficiency helps end-users reduce power demand at source, cutting CO2 emissions and saving resources, making efficiency a key business factor for companies and consumers. Energy efficiency is often referred to as the best "alternative fuel."
- The International Energy Agency (IEA) expects the demand for energy-efficient products to grow by 7–8% annually. Investment could reach USD 530bn in 15 years, up from on average USD 210bn annually during the 2014-2020 period.
- Stricter regulation to protect the environment and secure energy supplies is the most important driver for energy efficiency. This offers good long-term opportunities for investors focused on sustainable investing, since we expect earnings growth rates for companies offering such products to remain in the high single-digits for our energy efficiency theme.

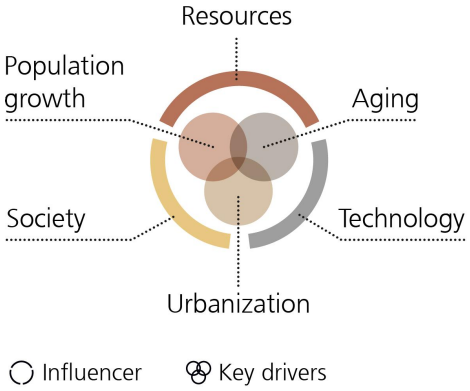
Our view

Urbanization, population growth and an expanding middle class are leading to higher energy consumption. Given the consequences of rising emissions, energy efficiency is becoming ever more important. An IEA scenario projects that energy consumption could almost double by 2050. The good news is that policymakers have already started to react. The Climate Summit in Paris in December 2015 paved the way for efforts to mitigate climate change. Energy efficiency is considered the most effective way to lower energy consumption, and the easiest and generally cheapest way to reduce energy demand and lower CO2 emissions.

While some investors consider the price of oil as a proxy for high or low energy prices and base their energy efficiency investment decisions accordingly, we believe energy efficiency is not only about economics or short-term fluctuations in demand and supply. It involves a long-term commitment to addressing global warming and energy security, and so should remain a key priority for policymakers. Thus, regulation plays a critical role in what is spent on energy efficiency. We expect investments in energy efficiency to continue growing. With the industry expected to increase in scale (based on IEA estimates of 7–8% annually), we also expect margins to improve in the long term and see our theme delivering above-average sales and earnings growth in the decades to come.

Introduction to the Longer Term Investments (LTI) series

- The Longer Term Investments (LTI) series contains thematic investment ideas based on long term structural developments.
- Secular trends such as population growth, ageing, and increased urbanization create a variety of longer term investment opportunities.
- These investment opportunities are influenced by the interplay of technological advancement, resource scarcity, and the societal changes.
- Investors willing to invest over multiple business cycles can benefit from potential mispricings created by the typically shorter term focus of stock markets.



Introduction

"Less is more" could be the motto for the coming decades. Energy efficiency is the response to many challenges humankind is facing, such as the much sought-after reduction in the use of fossil energy sources or the lack of storage technologies for renewable energies. Saving energy directly at the source lowers costs, while also conserving resources and cutting back on emissions. The growing pace of urbanization (see Fig.1) in developing countries in particular and global population growth are leading to an increased demand for efficient buildings, transport and equipment. Since 2008, 50% of the world's population living in cities have accounted for a disproportionate 75% of global primary energy use and produced 50-60% of greenhouse gas emissions. If you include the indirect emissions of urban areas the amount rises to 80% (source: UN). Fig. 2 and 3 show that many developed countries have very high CO2 emissions per capita, but also work to improve the energy intensity. Energy efficiency is an important instrument to achieve it. Based on the mentioned underlying trends, the energy efficiency investment theme fits perfectly into our Longer Term Investment series.

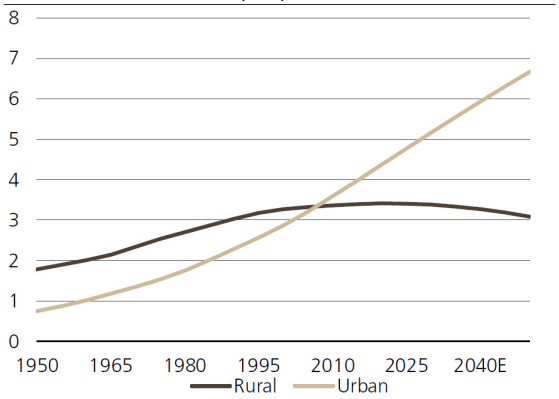
In the report we examine the most important product solutions and services that we expect will benefit from energy efficiency investments: i) buildings, ii) industrial processes (including smart grids), iii) information technology (IT), iv) transport efficiency, and v) the automotive sector. We think that companies exposed to these end-markets will benefit from the rising demand for energy-efficient products and services.

Buildings

Buildings offer the greatest potential for reducing energy consumption; the buildings segment currently accounts for c40% of energy demand and emits c30% of CO2 emissions (Source: IEA). In developed countries CO2 emissions are even higher, at close to 40% (Source: EU, EIA). The growth in energy demand is propelled by population and urbanization (more commercial and residential floor space). Based on various forecasts, the amount of energy consumed in buildings could be reduced 30–50% through energy efficiency in the coming decades. The potential to lower energy demand is huge: a) worldwide there is too little investment in sustainable buildings, b) policies could be stricter, and, c) both a) and b) could be solved using existing energy-efficient technologies.

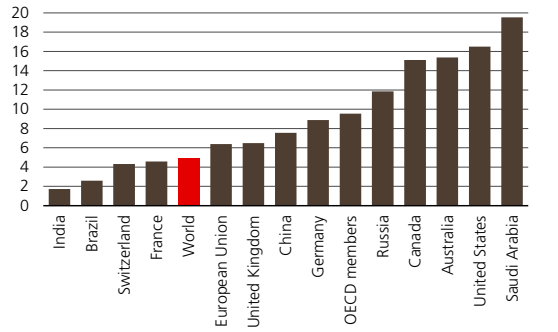
On average, a building in the US is used for 50–75 years, and 60–85% of the costs associated with it are operating costs (for fuel, maintenance, and repair, etc.), compared with just 5–10% spent on design and construction (Source: US National Institute of Building Services). This makes energy efficiency a simple way to bring down maintenance costs. According to Ingersoll-Rand, energy costs represent 40% of the EU's operating costs. High electricity prices (see Fig. 4), laws that prescribe stricter standards and tried-and-tested technologies at acceptable prices all have a role to play in promoting energy efficiency. The driving force, in our view, is more stringent regulation, not only for old buildings, but also for new ones.

Fig. 1: Urban population
1950–2050E, in billion people



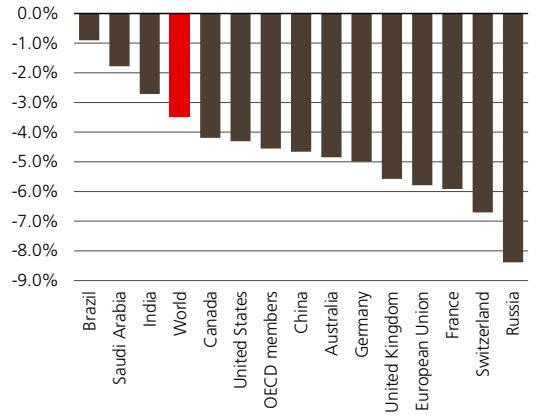
Source: United Nations, The Urbanization Prospects, 2018

Fig. 2: CO2 emissions per capita
In metric tons per year



Source: World Bank (latest data 2014), as of October 2019.

Fig. 3: Changes in primary energy intensity for selected countries (CAGR 2004–14)
Changes in energy intensity (CO2 emissions kg per USD of GDP, USD basis is 2010)



Source: World Bank (latest data 2014), as of October 2019.

As more countries have recognized the advantages of energy-saving investments, demand for efficiency-boosting measures in the construction industry has risen in recent years.

Several countries have already introduced building standards and classification instruments to improve knowledge about the sustainability of existing buildings. This provides countries with precise information about the respective building conditions and the need for political intervention by means of control instruments.

So-called smart buildings will be an important way to save energy. Building management systems centralize the building control and manage lighting, heating, ventilation and air conditioning systems in an efficient and well-coordinated way. Fig. 5 shows how energy savings have progressed in Switzerland over the years.

Trends differ between EM and DM

In EM, the ongoing urbanization trend combined with higher incomes and greater access to technology should drive demand for more energy-efficient buildings.

The example of Switzerland (see Fig. 5) indicates what countries can achieve. In stark contrast, the primary challenge in developed markets is the large stock of older buildings (see Fig. 6, example Switzerland). In the US, the average age of owner-occupied homes is close to 40 years, according to the US Census Bureau. An IEA study shows the big difference between EM and DM. Around 75% of the buildings in OECD countries will still be standing (base year 2010) in 2050, compared to only 40% in non-OECD countries, leading to a sharp rise in new builds. The building stock in non-OECD countries is expected to double by 2050 (see Fig. 7 on the next page).

Strict regulation the strongest support

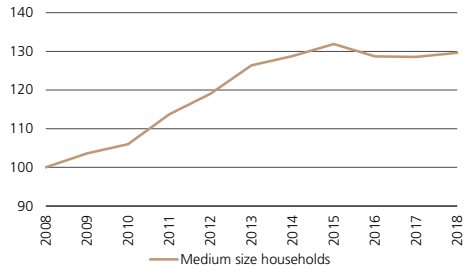
Although the payback period for most energy efficiency applications is only a few months (e.g. LEDs) to some years (e.g. insulation), the strongest support for energy efficiency comes from government incentives and regulations. The EU has one of the strictest and most ambitious programs. By 2020, emissions are expected to be cut by 29% for residential buildings and 13% for commercial buildings (base year 2008). As a result, the EU expects to lower its energy dependence. On top of that, EU countries are expected to make annual energy-efficient renovations to at least 3% of buildings owned and occupied by central governments. Other developed and emerging countries have similar codes in place to improve building efficiency. However, we think more can be done. Based on IEA estimates, policies cover just 40% of the energy consumed in buildings (2018 data). Stronger policy could improve energy efficiency still further.

Market opportunity

From an investment perspective, building efficiency includes several end-markets. The range of companies active in this field is broad. Over the next five to 10 years, we expect growth rates of 5–7% a year depending on the segment; the highest growth is in building automation (i.e. systems that control the mechanical and lighting systems in a building), at a good 7%.

Fig. 4: Strong rise in household electricity prices over the last 11 years

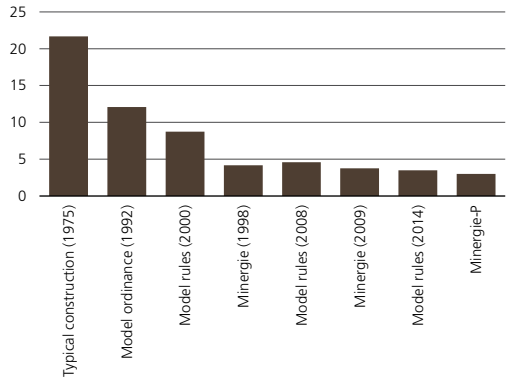
Electricity prices EU28 (indexed to 100 = 2008)



Source: Eurostat as of October 2019

Fig. 5: Progress in energy savings over time in Switzerland

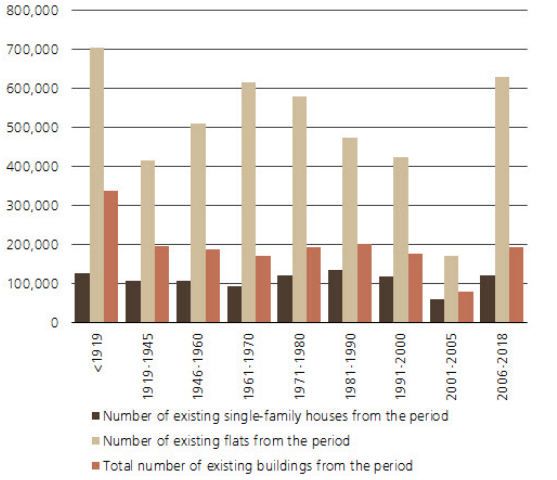
Consumption in liters of oil equivalent per square meter and year



Note: Minergie is a Swiss-registered quality label for new and refurbished low-energy-consumption buildings.

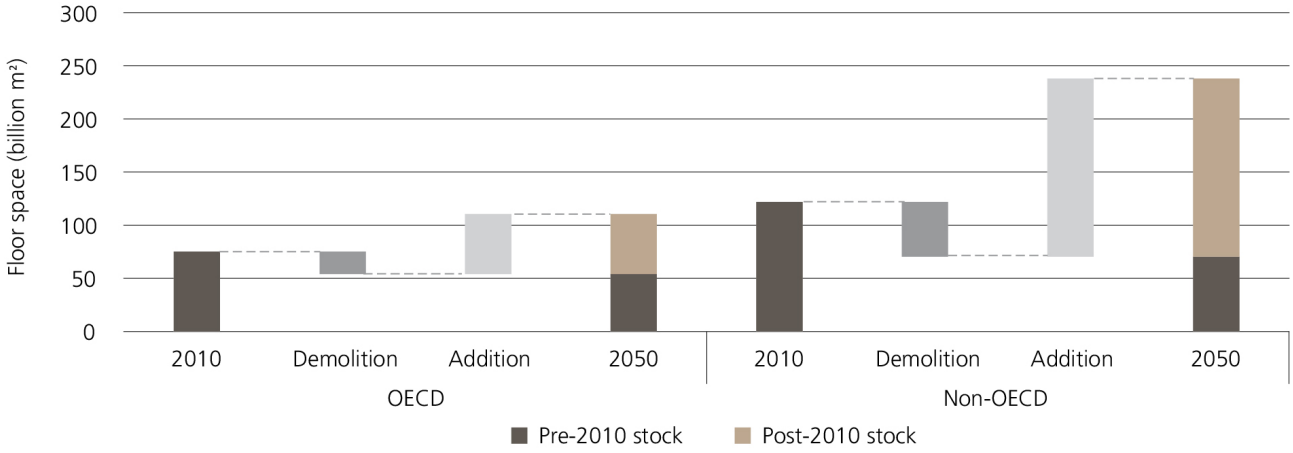
Source: Schweizerische Energie-Stiftung SES as of October 2019

Fig. 6: Around half of the existing buildings in Switzerland are older than 50 years



Source: Swiss Federal Office for Statistics, as of October 2019

Fig. 7: Evolution of building stock between 2010 and 2050



Source: Based on OECD/IEA data (2013): Technology Roadmap, Energy Efficient Building Envelopes, All rights reserved, UBS

Industrial processes

Based on IEA data, global energy demand has been growing due to an increase in energy-intensive sub-sectors such as chemicals, cement, pulp and paper, and aluminium etc. In India, for example, the industrials sector saw a 3.9% annual increase in energy consumption between 2010-17, while China, despite lower annual growth rates, was responsible for the biggest absolute increase in energy used, representing 60% of the overall net increase. In developed markets, energy consumption fell due to an established industrial footprint and greater energy efficiency. The energy mix in the industrial sector remains dominated by fossil fuels (70%), mainly coal (around one-third of the total demand). ABB estimates that around 80% of energy is lost between the extraction of the resource (e.g. coal) and the final use of electricity. In between, diverse industrial applications are used to transport the energy and to produce the final end-products (see Fig. 8).

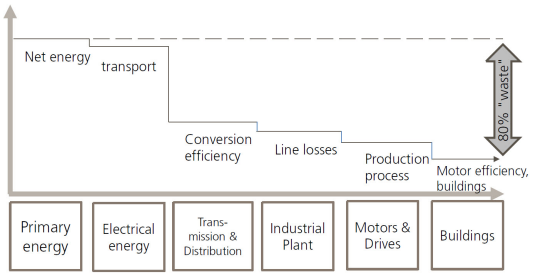
Energy efficiency has not only an immediately positive effect on lowering emissions, but also a positive multiplier effect. For every unit of electricity saved, three units are saved at the power plant as most thermal power plants only have conversion rates of 35% (the rest is wasted). Modern combined cycle gas turbines have conversion rates of 60%, but natural gas accounts for only around 20%. Therefore, it is important that the produced energy (electricity) is transported very efficiently. So-called smart grids provide an efficient way to reduce losses and save resources (more about this topic later in the text).

The IEA estimates that, with today's technology, one-third of the energy could be saved (best-in-class approach). The expected payback period would be only three years in OECD countries and five in non-OECD countries. The largest industry sectors in terms of energy consumption are steel production, chemical companies, non-metals (cement, glass, ceramics), and the paper industry.

Given the large number of applications in the industrial sector, there are an equal number of opportunities for increasing efficiency in this area. In one of our Longer Term Investment themes, *Automation*

Fig. 8: Up to 80% of energy wasted from resource extraction to final use

Capital goods companies can help reduce waste along the value chain



Source: ABB, as of May 2015

and Robotics, we estimated that the smart automation industry, with current annual revenues of just under USD 180bn, is still in the early growth stages.

We also said that we expect the industry to post long-term, mid-to-high single-digit rates on average due to strong growth in industrial software.

Smart grids

Smart grids reduce energy consumption and avoid CO2 emissions. They break up the supply-demand relationship in electricity as we know it today.

Traditionally, utilities supply electricity from large power plants through transmission and distribution (T&D) networks to end-customers (private or industrial consumers; see Fig. 9). The "upgrade" of the conventional grid to a "smart grid" allows the usage of decentralized, smaller electricity generation resources, e.g. solar panels and energy storage (electric cars). It also enables the grid operator to collect and analyze electricity demand in real time and adjust energy generation accordingly (see Fig. 10).

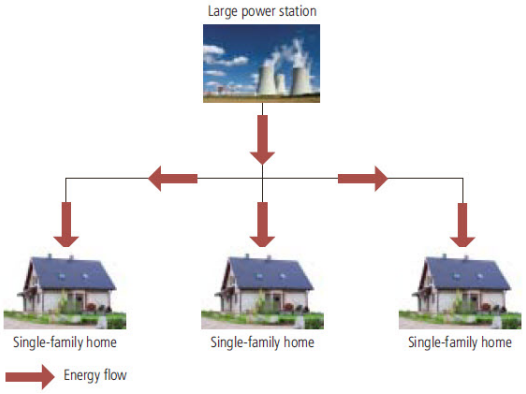
Households can be more than just consumers; they can consume according to their needs, and in future sell back their surplus electricity stored in batteries. This provides both parties (utilities and customers) an advantage and improves energy efficiency; and the ones managing the grid can respond, for instance, to the volatile power generation (wind, solar) by temporarily storing power in batteries that can supply the networks again when required. While traditionally only T&D companies were involved in this sector, we now see more IT companies entering the market. This new infrastructure promotes greater transparency of energy consumption and electricity costs. End-consumers can also adjust their consumption patterns through smart meters. As a result, consumers could adjust air-conditioning systems, for example during peak times, to lower their energy bills, or industrial companies could operate fewer machines if necessary.

On the supply side, utilities can invest less in generation capacities. A second advantage is clearly the better connectability of renewable energies, where we expect strong volume growth over the next decade. A characteristic of these energy resources is coincident generation of electricity. The sun does not always shine, nor does the wind always blow. The power system must be ready to compensate for temporarily declining renewable output with redundant supply or reduced demand. A smart grid could integrate these alternative sources better in the future.

IT applications

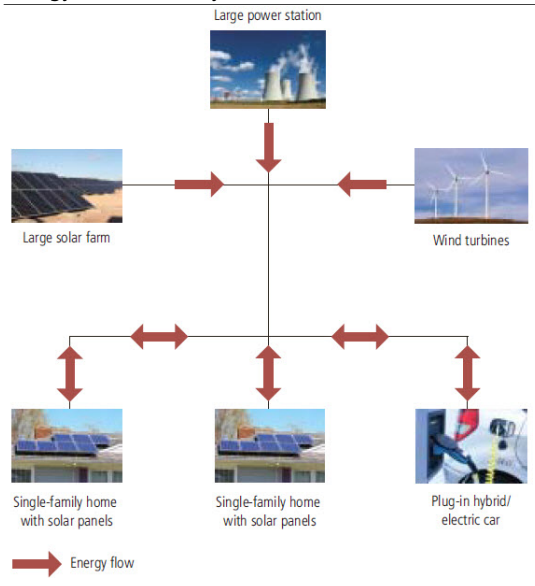
The IT sector provides vast scope for energy efficiency by offering multiple solutions. Software will be at the center, since we believe that when the limits of energy efficiency equipment or hardware are reached, software could extend the benefits of energy efficiency. Hence, we believe IT is a key enabler of energy efficiency and remains a top priority for investments in the next decade. In the next section, we explain how IT can drive energy efficiency based on the three energy end-markets: buildings, transport and industry.

Fig. 9: Conventional electricity grid
Energy flows in only one direction



Source: Nomura, UBS

Fig. 10: Smart grid
Energy flows in many directions



Source: Nomura, UBS

IT applications in buildings

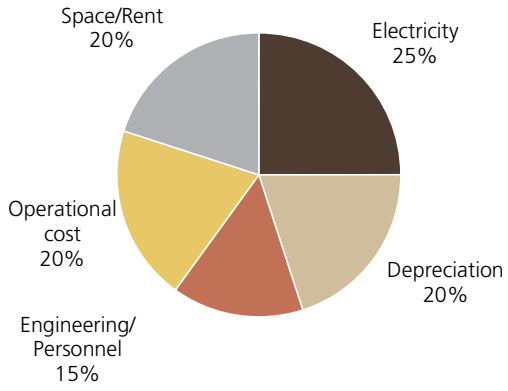
Renewables including LED: We believe ongoing advances in semiconductor technology are changing the way we consume and preserve energy. The two major areas powered by technology include renewables like solar and LED. Solar cells, a kind of semiconductor material, are one of the greenest technologies to generate energy with a low carbon footprint. With falling polysilicon prices and subsequent reduction in assembly and system management costs, the leveled cost of solar power has become very attractive. While costs are a primary driver of investments in renewables like solar, the carbon intensity of electricity generation is an equally important factor.

On these metrics, solar's carbon intensity measured for every kWh is only a fraction of fossil fuels like coal or oil. LED is another development driven by the advancement in semiconductor technology, where falling prices coupled with a favorable carbon footprint are driving incremental investments. Currently, a quality LED bulb is available for less than USD 3, driving not only increasing adoption by consumers but also from the public sector.

Cloud computing: The relevance of cloud computing is significant for the energy efficiency of buildings because IT infrastructure-related investments typically account for one-fifth of enterprise capital expenditure, and the ongoing cloud revolution will change how enterprises and consumers access IT. Studies by such companies as Amazon and IBM highlight that enterprises could reduce their carbon emissions by more than 50% if they migrate their data storage operations to the cloud. According to NIST, US Department of Commerce, cloud computing is a model for enabling ubiquitous, convenient, on-demand network access to a shared pool of configurable computing resources (e.g. networks, servers, storage, applications, and services) that can be rapidly provisioned and released with minimal management effort or service provider interaction. Fig. 11 shows the cost breakdown of a traditional data center. The shift to a third-party vendor or cloud processing and storage significantly cuts these costs, including for electricity (see Fig. 12).

Other technologies: IT applications will be an important driver in improving energy efficiency in buildings. Building management technologies, which are primarily computer-based control systems, are being installed to monitor the functioning and the energy consumption of electrical and mechanical equipment of a building. The need for building management technologies is driven by the inability of conventional buildings to communicate and intelligently manage the vast amount of data generated and available from a building. A few technology-driven building management developments include smart security and surveillance, including biometrics, smart metering, flexible telecom cabling, predictive fault detection tools, and smart monitoring systems.

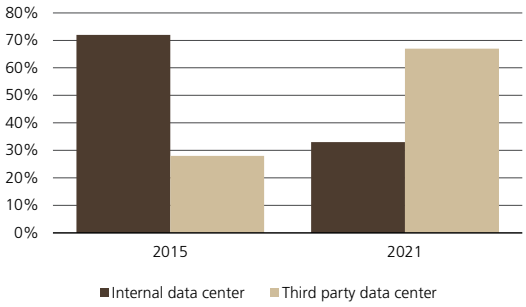
Fig. 11: Cost breakdown of a traditional/internal data center



Source: Company reports, UBS

Fig. 12: Third-party data centers to gain market share

as % of new data center capacity



Source: IDC, Bloomberg Intelligence, UBS

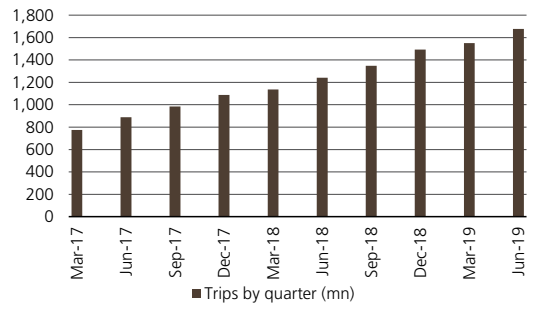
IT applications in transport

Video-conferencing and telecommuting: The way we travel and communicate have been reinvented by advances in networking technologies. Video conferencing and telecommuting are among them. Telecommuting, an arrangement in which employees are allowed to work outside the office, either from home or other locations, is another positive development driving emissions lower. By connecting to a virtual private network and cloud-based applications, telecommuting is becoming increasingly attractive to enterprises. According to a US federal study, an average US resident spends 264 hours every year commuting to work; telecommuting can reduce such travel and save energy in a few cases.

Apps: The progress in smartphones and other hand-held devices has forced us to multi-task throughout the day and made us digital omnivores. Use of the Global Positioning System (GPS) in both inbuilt devices and smartphones is the biggest way technology provides energy efficiency in transport by optimizing routes and creating alerts for fleet management. The advantage of GPS technology is that it can not only significantly reduce travel time, but also cut fuel consumption. While GPS is widely used in developed markets, emerging markets offer the biggest potential given low GPS penetration rates. Meanwhile, the growing trend of service sharing through mobile apps should also impact transport as ride and taxi sharing apps become more popular in the future (see Fig. 13).

Other technologies: The other technologies that can drive energy efficiency in the area of transportation include electric vehicles, e-commerce and shared economy services. E-commerce platforms use centralized warehouses and manage smart deliveries (one driver delivering across the street) as compared to each family in the street going to a supermarket by a car to buy the item. Electric vehicles mainly use electric motors with electrical energy stored in rechargeable batteries. According to a US government study, electric vehicle (EV) greenhouse gas emissions are around 40% lower than those of conventional vehicles (also depending on how the electricity is being produced). With global EV penetration still in low-single digits, the rising costs of internal combustion engines and the falling costs of EVs, coupled with government subsidies and regulations, should fuel EV adoption. Meanwhile, the increasing popularity of e-commerce should boost the energy efficiency of transport as consumers travel less to purchase items and e-commerce providers leverage an efficient warehouse and logistics platform. Studies by Alibaba and Amazon highlight that e-commerce energy consumption is up to one-third below that of the traditional bricks-and-mortar retail model. For more details, please refer to our other Longer Term Investment theme on *Smart Mobility* and *e-Commerce*.

Fig. 13: Number of trips on Uber platform
In million



Source: Company reports, Bloomberg Intelligence, UBS as of October 2019

IT applications in industry

Internet of Things (IoT): IoT refers to a network of connected devices where everyday objects are linked to a network, constantly sending and receiving data. The concept can be best explained by the photo in Fig. 14; with IoT, users can remotely control connected devices like thermostats or refrigerators. While an interesting development for consumers, the opportunity in the manufacturing industry is huge. The ability to connect virtually any equipment or product with sensors or smart tags allows companies to run intelligent networks and machine-machine interaction. Machines that can predict failures and trigger maintenance automatically save considerable time and energy. The same is true for automatic alerts to logistics teams about unexpected changes in production or material shortages. Industry studies by firms such as Ericsson indicate that IoT can reduce energy consumption by 5–25% depending on the extent to which IoT devices are used in the manufacturing process. For more details, please refer to our other Longer Term Investment theme on *Digital Data* and recently publish report about the *IIoT (Industrial Internet of things)* in the CIO *Executives and Entrepreneurs* series.

Industrial software: Despite the dominant presence of the manufacturing industry, the amount the industry spends on software accounts for less than 10% of the overall software industry. However, software's role in driving energy efficiency cannot be underestimated, because it not only helps track manufacturing activities with poor energy efficiency but also – thanks to its predictive power from big data analytics – provides a future road-map on energy consumption. One example of this is the effectiveness of supply chain management software in managing inventories in the value chain.

Supply chain management (SCM) software refers to programs that provide oversight of materials, information, and finances as they move in a process from supplier to manufacturer to wholesaler to retailer to consumer. According to industry leaders like SAP, firms with locations worldwide can reduce their warehouse costs by around 25–30% with an effective SCM software installation.

Other technologies: Other technologies in the industrial segment mainly refer to the use of upcoming technologies like drones and 3D printing. While these technologies are still nascent, we foresee that increased usage will not only reduce costs but save energy by reducing time-to-market and removing redundancies. We have addressed these topics in detail in our other Longer Term Investment report, *Automation and Robotics,* and *Enabling technologies*.

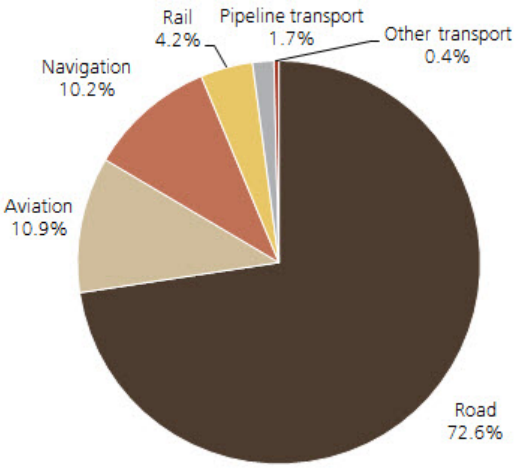
Transport efficiency

The transport sector is responsible for around 30% of energy consumption. Within this sector, road vehicles alone consume three quarters of the energy used (see Fig. 15). Over the last few years, the transport industry's share has gradually increased and, considering that demand rises with spending power in EM, energy efficiency is a key factor to limit further growth. The increase has been mainly driven by Asia and demand in road transport.

Fig. 14: Internet of Things enables remote handling of consumer and industrial operations

Source: Dreamstime

Fig. 15: Transportation fuel by end market (2015)
Road transport dominates the theme



Source: OECD/IEA 2017, (Railway Handbook 2017, elaboration by Susdef based on IEA 2017). All rights reserved.

Comparing the fuel consumption per transport mode, it is quite obvious that trains and buses are much more energy efficient for passenger transport than cars or aircraft (see Fig. 16). Rail is among the most environmentally friendly transport options. This sector consumes only close to 2% of the transport final energy demand while representing a share of 8% of total passenger-kilometres and 7% of total tonne-kiliometres in freight (source: IEA). The explaination for the big gap is explained by the good energy efficiency.

Considering the continuing urbanization in EM, we expect rail to gain market share over the next few decades (see also our Longer Term Investment theme *EM Infrastructure - update)*. Based on studies in Japan, a country with a dense railroad network and high-speed trains, the inflection point in overall efficiency regarding time and expense is between 800 to 1,000 kilometers for rail versus air. Above 1,000 kilometers distance, traveling by train is too long.

Since 2000, we have also seen a structural trend in the US with trains substituting truck volumes. We expect this trend to continue, first because rail inter-modal (e.g. train and truck) transportation is on average 15–25% cheaper than trucks based on the longer length of haul, and second it is more fuel efficient. Also, highways have been getting more crowded. As such, some shippers have started to switch to the cheaper alternative.

Buses are another option in passenger travel. Several factors support this segment, which is similar to rail. In Europe, one full bus can replace 30 cars; this number rises to 55 in the US. Not surprisingly, buses have ascended among the fastest growing long-distance means of transport in recent years in various countries. Buses also benefit from urbanization in emerging markets. Without rail infrastructure, many workers travel by bus to work. China, for instance, is the largest market for buses and is also the biggest producer of buses globally.

Market opportunity

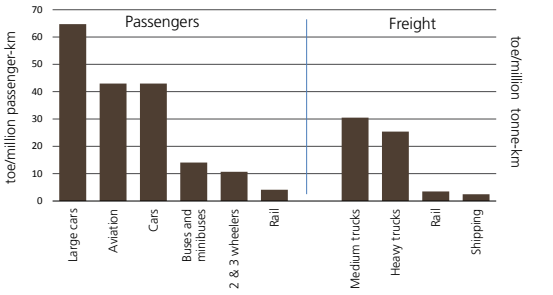
We believe railroad and bus operators are well placed to benefit from the energy efficiency inherent in transporting people and goods with lower emissions and congestion. The main drivers are urbanization in emerging markets, more crowded highways in developed markets, and growing consumer awareness of how to reduce CO2 emissions. Market growth depends on the region and several other factors such as a) the development of volumes; b) productivity gains/cost performance of operators; and c) inflation, which has an impact on pricing. In the past decade, US railroads, for instance, achieved exceptional EPS growth, outperforming the S&P 500 Index with few exceptions for many years.

Automotive

The automotive sector demonstrates a strong capacity for innovation and continual reduction in fuel consumption per kilometer, but the increase in energy consumption and CO2 emissions resulting from the massive rise in demand in developing countries and higher share of SUVs has more than offset these efficiency gains (with strong economic and population growth having led to a rising demand for cars).

Fig. 16: Trains and buses are among the most efficient transport alternatives

Average energy intensity of different transport modes worldwide



Note: toe = ton of oil equivalent

Source: IEA (The Future of Rail Opportunities for energy and the environment, 2019). All rights reserved.

Similar to other sub-sectors, energy efficiency developments in the automotive sector are mainly driven by tighter regulations. All important regions have laid out their road-maps to lower fuel consumption and thus CO2 emissions. The incentive for governments is massive, given that only 18–25% of the energy in gasoline reaches the wheels in an average vehicle (based on the US Department of Energy). For electric cars, the ratio is much better, with around 60% of energy conversion from the grid going to power at the wheels. However, the amount of CO2 saved depends heavily on the type of electricity (e.g. coal or renewables) that charges the battery and on transmission losses (see Fig. 8, ABB analysis).

We believe that automotive suppliers of engine technology that improves fuel consumption should benefit from stricter regulations globally. Downsizing has been a hot topic in the automotive industry for many years.

Reasons for downsizing are regulation, technical progress, increasing energy prices (at least in the longer term), and cost reductions through reduced raw material use. This means reducing engine size through efficiency enhancements, while the capability remains the same (for example, improved engine control, use of turbochargers, reduction of internal friction through the use of smoother materials, reduction of moving masses). Over the last few years, the automotive industry introduced "right-sizing," which aims to fit the right engine size to the right cars, since small engines for large cars could result in even higher consumption at high speeds.

Turbochargers can help solve the dilemma of losing output when engine capacity is reduced because they increase the power or the efficiency of an engine. Intake air is compressed by a pump and a turbine driven by the waste heat from the exhaust or newly electric turbochargers. This process helps to improve thermal efficiency and reduce pumping losses as air is pushed into the cylinders. As a result, more air is available for fuel combustion and the engine is able to deliver more torque at lower engine speeds. Growth rates are particularly high for gasoline cars, where penetration is still low. The result is lower fuel consumption.

New developments in tires can cut rolling friction at low speeds by up to 10%; at higher speeds this drops to 5%. A reduction of 10% translates into a 1–2% reduction in fuel consumption (Source: US National Research Council). Stop-start technology, whereby the engine cuts out when the vehicle is stopped, can cut fuel costs by up to 25% in city traffic, depending on how it is used. New is also the increased usage of 12 and 48 Volt mild-hybrid vehicles. An extra 48 Volt battery can also be used to power an electric turbocharger, and is recharged via regenerative braking.

Emission targets cannot be met without electrification

The EU's 2020–21 targets of 95 grams/km of CO2 (see Fig. 17) definitely make a technological shift to electrification necessary. We are convinced that the road to electrification of vehicles is well paved (for more details please see our Longer Term Investment theme *Smart Mobility*).

The commercial success of electric cars is set for take-off as upcoming tougher regulation leaves no choice to auto manufacturers other than increase the share of electrified cars. We expect growth to be exponential rather than linear from 2020 onwards. We think that by 2025 around 25% of new cars could be electrified, of which at least 10% will be battery powered full-electric vehicles and the rest plug-in and full hybrids. We also expect a further 20–25% of mild hybrids based on 12 and 48 volt technology.

The role-out of full-electric vehicles will be supported by technological advances and ongoing cost reduction of the battery, the major cost item in an electrified power train, as well as possible (financial) incentives from governments around the globe. Further out (beyond 2025), we see a chance that fuel-cell powered vehicles might also gain in importance, as more auto companies will diversify their technology in order to manage the dependency / access to commodities and certain geopolitically sensitive areas.

Air and sea

Thus far we have focused on the automotive sector, since road vehicles alone consume around three-quarter of the energy in the transport sector. Nevertheless, the other two major transport subsectors, air and sea, warrant some discussion. Similar to cars, planes have also increased efficiency.

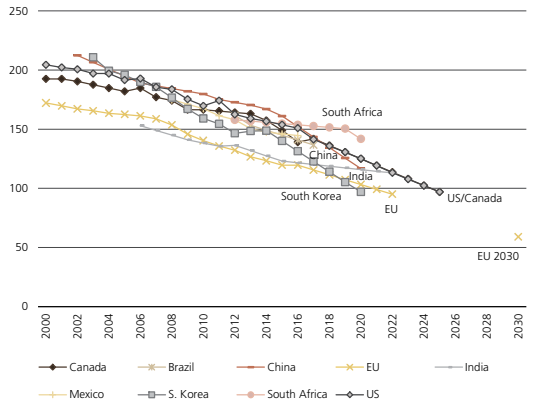
Today's planes need 70% less fuel than 40 years ago and 20% less compared to 10 years ago, according to International Air Transport Association (IATA). The shipping industry, which accounts for only 10% of transport energy demand but carries 90% of world trade, has improved over the last few decades, but not as much as planes and cars. According to the Danish Shipowners' Association, energy efficiency has improved by 20% since 1970.

Market size and valuation

There is no standard definition of the energy efficiency market. Our approach is similar to the IEA's, which defines energy efficiency investments as additional expenditure made by households, firms and governments to improve the energy performance of their energy-using equipment. The IEA, using a bottom-up approach, calculated annual spending of around USD 130bn for 2013; it expects average spending of some USD 210bn annually during 2014–2020, reaching USD 530bn by 2035 (see Fig. 18). In our analysis, we found that compared to other forecasts from independent consultancy companies these estimates are rather moderate. The IEA expects total investments of around USD 8trn in this period (USD 0.7trn for industry, USD 4.9trn for transport, and USD 2.3trn for buildings). Although we estimate that our bottom-up analysis results in a slightly higher market size (we include more IT applications), we think that the projected growth rate is similar to what the IEA expects – around 7–8% a year.

Fig. 17: Internal combustion engine vehicle productivity gains – historical and envisaged

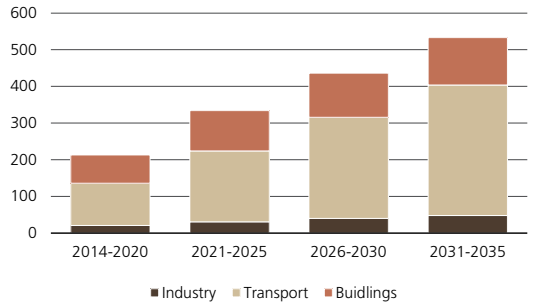
CO2 emissions in grams/km



Source: ICCT (Policy Update January 2019), UBS

Fig. 18: Average annual investment in energy efficiency in the New Policies Scenario*

In USD bn



*Note: The New Policies Scenario includes policies in place and those announced, and is the IEA's central scenario

Source: IEA World Energy Investment Outlook 2014 (Special Report), All rights reserved, UBS

Link to sustainable investing

In our view, energy efficiency can be considered a sustainable investing theme. It aligns with two of the UN's Sustainable Development Goals (SDGs): 7 "Affordable and clean energy" and 13 "Climate action" due to its aim of reducing energy use and improving energy efficiency to optimize energy consumption. According to the IEA, energy efficiency can contribute as much as 48% to global emissions reduction by 2030[1]. This is based on a scenario that global energy demand will grow by 30% in the same time period and put more pressure on our limited resources. In recent years, a number of academic studies have indicated that strategic development and implementation of energy efficient solutions in power generation, heating and transport can help limit global warming to 1.5°C, as per the UNFCCC Paris Agreement.[2]

In addition, improving energy efficiency can have far reaching impacts beyond simple energy savings. These include improved air quality, leading to better health and well-being, as well as reduced costs and greater productivity. Several other of our Longer Term Investment themes like "Water scarcity", "Clean air and carbon reduction", "Agricultural yield", and "Renewables" are also linked to this challenge.

The environmental contribution of this theme is twofold: First, the less energy used, the fewer emissions produced. Second, cost-effective energy efficiency achieves these environmental benefits at low cost, and thus can reduce the economic costs of achieving climate policy goals[3]. The need to invest in energy efficiency in the coming decades is accelerating: a growing population, ongoing urbanization and rising wealth levels contribute to more stringent regulation and corporate competition to improve product efficiency (the more efficient products are, the shorter the payback period for them). As a result, energy efficiency is becoming a key business factor for a growing number of companies and consumers.

Private market investors can achieve measurable environmental and social impact by addressing opportunities in innovative clean technologies and energy efficient real estate, where USD 300bn of annual investments[4] will be needed to upgrade building energy systems sufficiently to meet regulation and industry standards.

Melissa Spinoso, Senior Sustainable Investing analyst
Antonia Sariyska, Impact Investing analyst

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3. Eichholtz, Kok, & Quigley. (2013). The Economics of Green Building. The Review of Economics and Statistics.
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Investment conclusion

Energy is crucial for our society. It is in the products we consume every day and it drives our economy. Global demand for energy is rising, and in some regions supply is tight and environmental issues are becoming problematic. Energy efficiency helps us face these challenges. Politicians in many countries have long recognized that energy efficiency offers cost-effective solutions.

We regard improved energy efficiency as an opportunity to limit the demand growth for energy. Based on IEA forecasts, the market for energy-efficient products and services will grow by mid-to-high single digits over the next two decades. It is becoming a key business factor for an increasing number of companies. Hence, our theme should see above-average sales and earnings growth in the decades to come.

Last but not least, our Energy efficiency theme classifies as a Sustainable Investing Investing theme, addressing an enormous challenge humankind faces (sustainable energy supply). It enables investors to support the UN Sustainable Investing targets.

Risks

We see political risks as the biggest challenge to our energy efficiency investment theme. As identified throughout most sub-sectors, we think stricter regulation is a leading driver for energy-efficiency investments. A significantly looser regulatory environment could hurt companies exposed to the respective end-market.

Tight government budgets are another factor that could restrain investments, curbing spending in government-owned commercial buildings. The IT-specific risks include frequent communication or service outages that defeat the purpose of energy efficiency, since backup plans not only prove expensive but are also energy inefficient.

Security concerns about cyber threats regarding building automation, electric cars, cloud computing, etc. must be considered as well (see also our Longer Term Investment theme about *Security and Safety*). While energy efficiency is a structural theme, we do not rule out short-term cyclicality given the underlying exposure to sectors like automotive, capital goods, IT and transportation, which are heavily dependent on economic development.

Non-Traditional Assets

Non-traditional asset classes are alternative investments that include hedge funds, private equity, real estate, and managed futures (collectively, alternative investments). Interests of alternative investment funds are sold only to qualified investors, and only by means of offering documents that include information about the risks, performance and expenses of alternative investment funds, and which clients are urged to read carefully before subscribing and retain. An investment in an alternative investment fund is speculative and involves significant risks. Specifically, these investments (1) are not mutual funds and are not subject to the same regulatory requirements as mutual funds; (2) may have performance that is volatile, and investors may lose all or a substantial amount of their investment; (3) may engage in leverage and other speculative investment practices that may increase the risk of investment loss; (4) are long-term, illiquid investments, there is generally no secondary market for the interests of a fund, and none is expected to develop; (5) interests of alternative investment funds typically will be illiquid and subject to restrictions on transfer; (6) may not be required to provide periodic pricing or valuation information to investors; (7) generally involve complex tax strategies and there may be delays in distributing tax information to investors; (8) are subject to high fees, including management fees and other fees and expenses, all of which will reduce profits.

Interests in alternative investment funds are not deposits or obligations of, or guaranteed or endorsed by, any bank or other insured depository institution, and are not federally insured by the Federal Deposit Insurance Corporation, the Federal Reserve Board, or any other governmental agency. Prospective investors should understand these risks and have the financial ability and willingness to accept them for an extended period of time before making an investment in an alternative investment fund and should consider an alternative investment fund as a supplement to an overall investment program.

In addition to the risks that apply to alternative investments generally, the following are additional risks related to an investment in these strategies:

- Hedge Fund Risk: There are risks specifically associated with investing in hedge funds, which may include risks associated with investing in short sales, options, small-cap stocks, "junk bonds," derivatives, distressed securities, non-U.S. securities and illiquid investments.
- Managed Futures: There are risks specifically associated with investing in managed futures programs. For example, not all managers focus on all strategies at all times, and managed futures strategies may have material directional elements.
- Real Estate: There are risks specifically associated with investing in real estate products and real estate investment trusts. They involve risks associated with debt, adverse changes in general economic or local market conditions, changes in governmental, tax, real estate and zoning laws or regulations, risks associated with capital calls and, for some real estate products, the risks associated with the ability to qualify for favorable treatment under the federal tax laws.
- Private Equity: There are risks specifically associated with investing in private equity. Capital calls can be made on short notice, and the failure to meet capital calls can result in significant adverse consequences including, but not limited to, a total loss of investment.
- Foreign Exchange/Currency Risk: Investors in securities of issuers located outside of the United States should be aware that even for securities denominated in U.S. dollars, changes in the exchange rate between the U.S. dollar and the issuer's "home" currency can have unexpected effects on the market value and liquidity of those securities. Those securities may also be affected by other risks (such as political, economic or regulatory changes) that may not be readily known to a U.S. investor.

Emerging Market Investments

Investors should be aware that Emerging Market assets are subject to, amongst others, potential risks linked to currency volatility, abrupt changes in the cost of capital and the economic growth outlook, as well as regulatory and socio-political risk, interest rate risk and higher credit risk. Assets can sometimes be very illiquid and liquidity conditions can abruptly worsen. CIO GWM generally recommends only those securities it believes have been registered under Federal U.S. registration rules (Section 12 of the Securities Exchange Act of 1934) and individual State registration rules (commonly known as "Blue Sky" laws). Prospective investors should be aware that to the extent permitted under US law, CIO GWM may from time to time recommend bonds that are not registered under US or State securities laws. These bonds may be issued in jurisdictions where the level of required disclosures to be made by issuers is not as frequent or complete as that required by US laws. For more background on emerging markets generally, see the CIO GWM Education Notes, Emerging Market Bonds: Understanding Emerging Market Bonds, 12 August 2009 and Emerging Markets Bonds: Understanding Sovereign Risk, 17 December 2009. Investors interested in holding bonds for a longer period are advised to select the bonds of those sovereigns with the highest credit ratings (in the investment grade band). Such an approach should decrease the risk that an investor could end up holding bonds on which the sovereign has defaulted. Sub-investment grade bonds are recommended only for clients with a higher risk tolerance and who seek to hold higher yielding bonds for shorter periods only.

Appendix

Terms and Abbreviations

Term / Abbreviation	Description / Definition	Term / Abbreviation	Description / Definition
2011E, 2012E, etc.	2011 estimate, 2012 estimate, etc.	A	actual i.e. 2010A
bn	Billion	CAGR	Compound annual growth rate
COM	Common shares	E	expected i.e. 2011E
EIA	Energy Information Administration	EPS	Earnings per share
EV	Enterprise value = market value of equity, preferred equity, outstanding net debt and minorities	GDP	Gross domestic product
H	half year	Shares o/s	Shares outstanding
UP	Underperform: The stock is expected to underperform the sector benchmark	CIO	UBS WM Chief Investment Office