

Transition in Industrial Energy Use

Toward a Sustainable Future

Abstract

Energy production and use contribute to two-thirds of global greenhouse gas (GHG) emissions, making it a critical factor to control climate change. The demand for energy has historically been met by burning fossil fuels, a trend that is gradually changing. Stringent regulations to curb GHG emissions, a fall in renewable energy prices, greater operational efficiency, rising consumer awareness on environmental implications, and emerging sustainability standards are driving this shift.

The industrial sector consumes a third of global energy and accounts for 24% of energy-related emissions. High emission levels have made many industries to focus on low-carbon energy sources and to achieve higher operational efficiency. Monitoring needs to be their first step towards energy management. This paper highlights how energy management solutions can facilitate energy monitoring and play a vital role in enhancing industrial energy efficiency.

Introduction

The global energy demand will rise 30% between the present time and 2040, driven by economic growth worldwide, which is growing at an average annual rate of 3.4%, and population expansion, which will rise from 7.4 billion in 2016 to 9 billion in 2040, a report by the International Energy Agency, titled World Energy Outlook 2017, shows.¹ The increase in energy demand will mean a larger global carbon footprint. Given the threats posed by climate change and the increased competition for green products, enterprises have no option but to improve process efficiency, limit the use of fossil fuels, and optimize energy consumption throughout the value chain.

To achieve these, tracking energy data in real time will become a mandate, and this can only be done by overhauling inflexible legacy systems. This paper discusses a systematic approach to optimize energy consumption in the manufacturing industry through energy monitoring systems and digitization.

Evolving energy mix

As shown in Figure 1, worldwide energy consumption patterns have changed significantly since 1990 with the emergence of alternate sources of energy, data from the US Energy Information Administration (EIA) shows.²

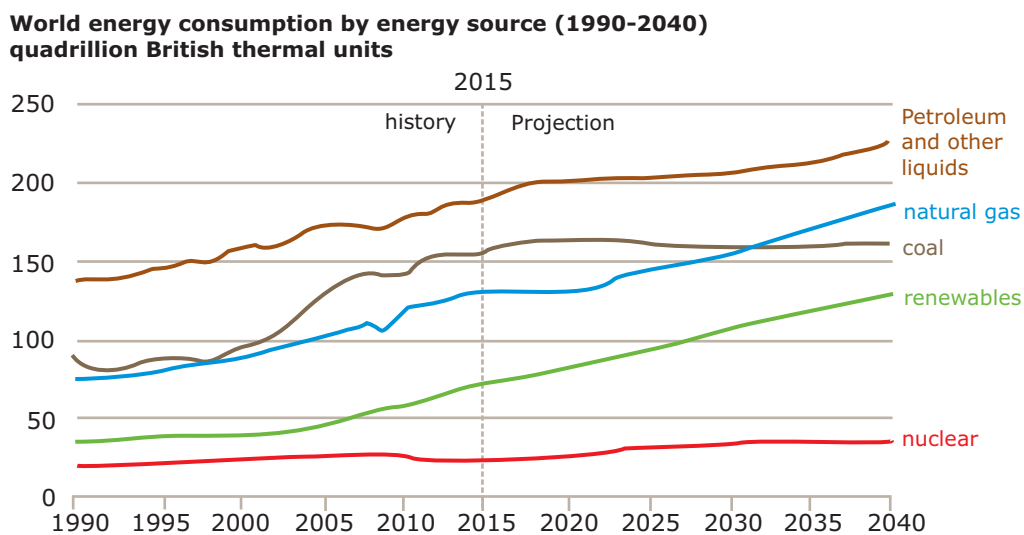


Figure 1: World energy consumption by energy source 1990-2040

Credit: US Energy Information Administration, International Energy Outlook 2017

1. International Energy Agency; World Energy Outlook 2017; November 14, 2017; <https://www.iea.org/weo2017/>

2. US Energy Information Administration; International Energy Outlook 2017; September 14, 2017; [https://www.eia.gov/outlooks/ieo/pdf/0484\(2017\).pdf](https://www.eia.gov/outlooks/ieo/pdf/0484(2017).pdf)

However, fossil fuels like coal, petroleum, and natural gas continue to be widely used. Together, they fulfill 81% of the world's primary energy demand, with oil being the leading contributor followed by coal and natural gas, the EIA's International Energy Outlook 2017 report stated.³ The IEA's World Energy Outlook 2017 report found that coal demand increased only 1% in 2017 after dropping for the previous two years, whereas natural gas demand increased 3%, the highest among fossil fuels.

This change in energy mix, i.e., moving from conventional to low carbon sources such as natural gas and renewables, has brought about lower emission levels globally. This is primarily driven by technological advancement as well as the political will of growing economies like the US, Europe, and China. Emerging carbon regulations, changing consumer preferences and subsidized renewable energy have accelerated the adoption of low carbon energy sources, driving down emissions.

Drivers of Energy Transformation and Investment

To refine their energy management processes, organizations must incorporate a number of factors over a 10-20-year period in their business strategies.

1. Emerging regulatory frameworks

By 2040, global carbon emissions are expected to rise only slightly. Despite this, the impact of climate change will still be acute, the World Energy Outlook 2017 report stated. To tackle this impact, governments have strengthened their energy regulation efforts. In its 2018 report, the World Bank's Regulatory Indicators for Sustainable Energy (RISE) found that the number of countries adopting stringent regulations for sustainable energy grew three fold from 17 to 59 between 2010 and 2017.⁴ Such policies are aimed at helping countries meet their sustainable energy and climate change goals, the report stated.

It further added that countries such as the US, the UK and China, which are large energy consumers, have strengthened

3. International Energy Agency ; Global energy demand grew by 2.1% in 2017, and carbon emissions rose for the first time since 2014; March 22, 2018; <https://www.iea.org/newsroom/news/2018/march/global-energy-demand-grew-by-21-in-2017-and-carbon-emissions-rose-for-the-firs.html>

4. The World Bank; Regulatory Indicators for Sustainable Energy 2018; December 9, 2018; <https://www.worldbank.org/en/topic/energy/publication/rise-2018>

regulations and set clear targets for both renewable energy and energy efficiency based on the 2015 Paris Agreement. Industrial energy efficiency has significantly improved due to a number of factors: minimum energy performance standards for key equipment, mandatory measures to increase scrap metal collection and recycling, producing sustainable products, and adopting energy management systems. For example, data available with the nonprofit, American Council for an Energy-Efficient Economy, shows that California made it mandatory for the automobile industry to manufacture more plug-in and fuel-cell vehicles from 2018 to 2025, as part of its updated zero-emission vehicle program.⁵ Data from DieselNet, an online information portal on diesel engines, fuel, and more, showed that GHG emissions from new California vehicles decreased by 22% in 2012 and 30% in 2016, as compared to 2004 vehicles.⁶

2. Declining renewable energy prices

The International Renewable Energy Agency (IRENA) has found that towards the end of 2009, the costs of solar photovoltaics have fallen approximately 80% and wind turbine prices by 30-40%,⁷ making them cheaper than traditional fossil fuels.⁸ Though renewables will grow the fastest in the electricity sector, they will increasingly be used to provide heat for buildings, industry, and transportation worldwide. The World Energy Outlook 2017 report has estimated that the global consumption of direct and indirect renewable energy across all three sectors is expected to rise from 9% in 2016 to 16% by 2040.

The manufacturing industry is a crucial end-use sector implementing alternative methods of power generation from renewable sources. Tesla Motors, for example, has built a factory in Nevada, US, that runs entirely on solar, wind, and geothermal energy.

3. Operational efficiency

Energy efficiency is crucial not only to deliver the emission cuts needed at the necessary speed but also to reduce operational costs and increase productivity. Renewables have the greatest impact on the power sector. In end-user sectors, including

5. American Council for an Energy-Efficient Economy; Tailpipe Emission Standards; <https://database.aceee.org/state/tailpipe-emission-standards>

6. DieselNet; United States: California: Light-Duty Vehicles: GHG Emissions; https://www.dieselnets.com/standards/us/ca_ghg.php#2017

7. The International Renewable Energy Agency; IRENA Renewable Cost Database; <https://www.irena.org/costs>

8. BusinessGreen; Cheaper than fossil fuels: Global renewables costs hit record low; May 30, 2019; <https://www.businessgreen.com/bg/news/3076511/cheaper-than-fossil-fuels-global-renewables-costs-hit-record-low>

industries, buildings and transport, energy efficiency is perhaps even more important.

In a report titled Energy Efficiency 2017, the IEA found that energy intensity in the industrial sector dropped 20% between 2000 and 2016,⁹ thanks largely to energy management systems. Technological advancement, innovations, and expansion of production capacity have also significantly reduced energy intensity in industries like mining, cement manufacturing and automobiles, the report added. Energy management standards have further improved awareness on improving efficiency. In 2015, the number of certifications for such standards reached 12,000, of which Europe accounted for 85% of these, said the report.

On the back of these developments, global energy intensity fell 1.8% in 2016. This decrease has flattened GHG emissions since 2014, the IEA's report stated.

4. Rising consumer awareness

In the manufacturing industry, fuel is being converted into thermal and electrical energy to manufacture daily-use products. Additionally, much energy is consumed to transport manufactured goods. Consumers are now increasingly concerned about the environmental implications of products, which in turn significantly affects their purchasing decisions. Environmental awareness, green promotional activities, and reporting on sustainability standards impact buying behaviors in a positive way.

Industries see this as an opportunity to build a strong brand image. For example, automobile companies launch eco-friendly vehicles such as electric and hybrid cars in response to stringent emission standards and customer expectations. A study by data information firm Nielsen in late 2018 found that consumers are more likely to purchase products from companies that support sustainability, thereby leading to a rise in a company's profits.¹⁰

5. Reporting on sustainability standards

Environmental disclosures comprise about 35-40% of the sustainability reporting standards such as the Global Reporting Initiative (GRI) and the Sustainability Accounting Standards Boards (SASB). Energy and emissions together constitute 40%

9. International Energy Agency; Energy Efficiency 2017; October 5, 2017; <https://www.iea.org/efficiency2017/>

10. Nielsen Holdings; Sustainability Sells: Linking Sustainability Claims to Sales; October 16, 2018; <https://www.nielsen.com/us/en/insights/article/2018/sustainability-sells-linking-sustainability-claims-to-sales/>

of these environmental disclosures. Other standards such as the Carbon Disclosure Project, which tracks climate change risks and captures end-to-end information on energy and GHG emissions, evaluates risks posed by companies. Organizations need to collect, process, analyze, and report energy and emission data, for which they need to monitor and manage their data.

Business Perspective on Changing Energy Portfolio

Organizations must re-evaluate their operating models to understand the energy metrics that drive industrial operations and the value chain. This will help them draw up corporate sustainability goals.

Industries now have the following approaches toward developing low carbon industrial processes:

1. Avoid GHG emissions through renewable electricity mix.
2. Minimize operational energy through innovation, technological enhancement, and energy optimization.
3. Look into the use of industrial by-products and recycle/reuse end products.

Leading manufacturing companies, such as Ingersoll Rand, Owens Corning, PPG, and Toyota, have long set in place energy intensity reduction goals through process control, automation, design improvement, intelligent production schedule, and other steps.¹¹

Energy management

An organization must know its energy consumption levels in order to set reduction targets. An energy management system (EMS) monitors energy consumption, identifies energy cost saving opportunities, plans and allocates resources, and monitors the efficiency of critical systems. Combining energy management solutions with internet of things and smart data analytics can offer a firm unexpected opportunities to boost efficiency and expand its renewable energy portfolio by proactively steering and predicting leading indicators. Research firm Future Market Insights found that the global industrial

11. GreenBiz; Why Energy Reduction Goals Are Moving Up the Corporate Agenda; March 15, 2011; <https://www.greenbiz.com/blog/2011/03/15/why-energy-reduction-goalsl-moving-up-corporate-agenda>

energy management system market is expected to be valued at \$50,300 million by the end of 2028, growing at a compounded annual growth rate of 9.6% between 2018 and 2028.¹²

Energy management solutions can be linked to Sustainability reporting frameworks. The system can fetch energy data from over 14 sustainability reporting frameworks, process the data further, and generate the reports, all simultaneously, saving time and efforts at user's end.

Conclusion

From defining energy goals to embracing energy management systems, companies are taking multiple steps for energy transition. Decision makers can smoothen this process by collaborating with policymakers, improving awareness, investing in technology, and aligning their organizational strategy to long-term change.

Organizations will have to increasingly rely on digital solutions such as energy management systems that provide enterprise-wide visibility and share energy key performance indicators with investors, customers, and regulators. Digital energy management solutions will help reduce energy use and make well-informed and intelligent decisions on demand-side operations. The demand for EMS-based solutions and services will thus grow, enabling businesses to cap wastage and pollution.

12. Future Market Insights; Adopting Cloud Computing & Smart Meter Technologies to Empower Businesses in Industrial Energy Management Systems Market; June 6, 2018; <https://www.futuremarketinsights.com/press-release/industrial-energy-management-system-market>

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