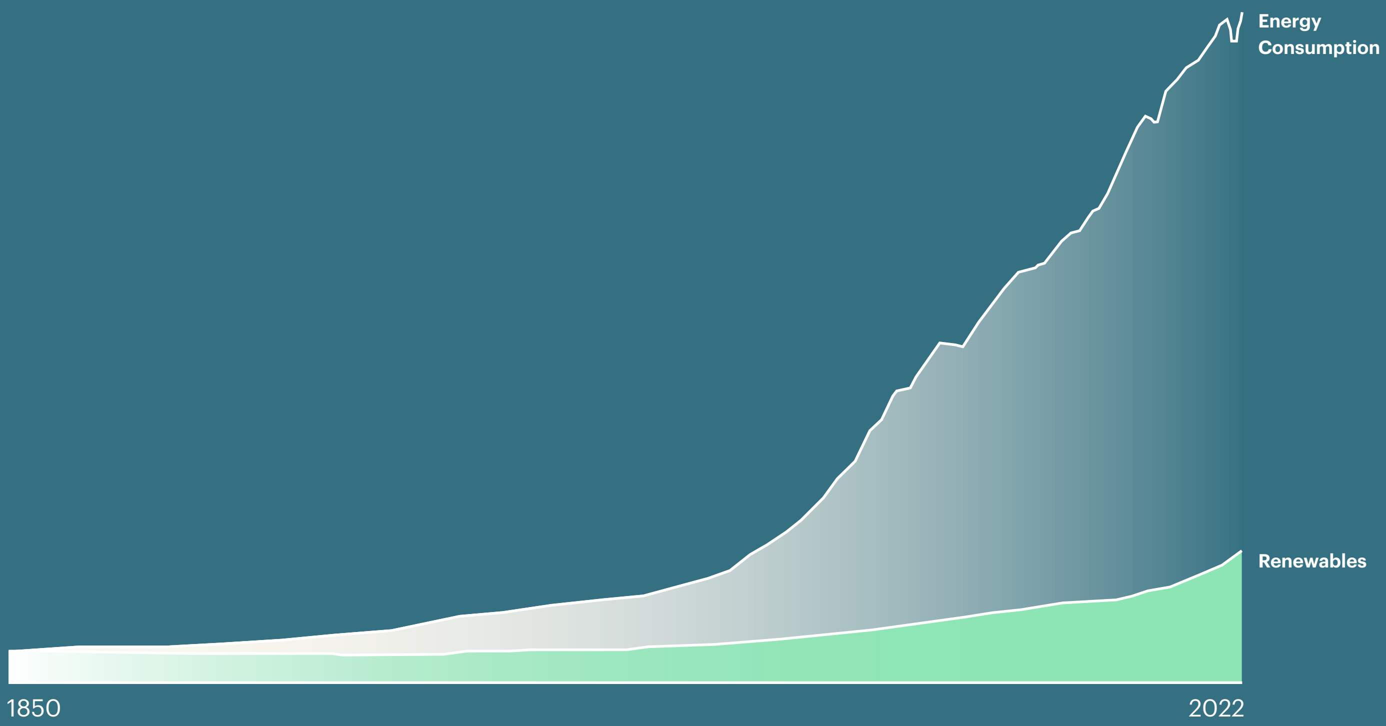
Danfoss Impact
Issue no. 1

The neglected demand side of the green equation



Source: Our World in Data (2022). Energy mix

Let's close the gap between promises and action

Foreword *by Kim Fausing, CEO Danfoss*

Human-induced global warming has reached approximately 1.2 degrees above pre-industrial levels[1] and **with current policies warming will hit around 2.8°C by the end of the century[2].** 2022 was the year of sustained droughts resulting in widespread wildfires, declines in food production and heatwaves from the United States and Africa, to China and Europe. Glaciers are melting in the Andes and the Himalayas, taking with them the source of drinking and irrigation water for thousands of people. And in the Arctic, sea ice is melting much faster than scientists predicted. **Climate change is an immediate, not a future, crisis.**

Paradoxically, as a group of leading climate scientists including Kathrine Richardson, professor in Biological Oceanography and leader of Sustainability Science Centre at Copenhagen University, pointed out in June 2022, the political responses to the crisis have so far been centred around long-term climate goals and, to a lesser extent, immediate action. **We need to close the gap between promises and action[3].**

The good news is that we have the solutions at hand, and we don't need to wait. **In fact, most of the global reductions in carbon emissions through 2030 needed for the Net Zero by 2050 Scenario developed by the International Energy Agency (IEA) come from technologies readily available today[4].** We are seeing a massive build-out of renewable energy to tackle the supply side of the green equation. This is indeed necessary, and we need even more. But if we don't, at the same time, pay attention to the demand side of the green equation (the acceleration in energy consumption) the build-out of renewables won't be even near sufficient.

As the IEA has pointed out, **energy efficiency can take us one-third of the way to net zero[5].** Energy efficiency simply means **using less energy to perform the same task – that is, eliminating energy waste.** In this paper, we explore why energy efficiency plays such a significant, yet politically overlooked, role in the battle against climate change. **By using our energy smarter and electrifying everything across industry, transport and buildings, we can curb emissions now, make our economies more resilient and create millions of green jobs.** The greenest, safest and cheapest energy is the energy we don't use. Let's get started.

> **"By using our energy smarter and electrifying everything across industry, transport and buildings, we can curb emissions now, make our economies more resilient and create millions of green jobs."**

1. State of the Global Climate 2020. Provisional Report, p. 3
2. UNEP (2022). Emissions Gap Report 2022
3. Mandag Morgen 24 (2022). Vil inflationen bide sig fast?
4. IEA (2021). Net Zero by 2050 – A Roadmap for the Global Energy Sector, p.15
5. IEA (2022). The value of urgent action on energy efficiency, p. 7

This is the first in a series of new whitepapers – Danfoss Impact – that we are writing to share our view on the potential of energy efficiency and electrification to transform our energy system. In the dialogue around the energy crisis and the green transition, energy efficiency is often politically overlooked. One reason is that energy efficiency is not as tangible as renewable energy technology. Another reason is that we have fallen short of adequately explaining the enormous potential in energy efficiency and the critical role it must play to reach the full electrification of our society. In June this year, one of the most significant ministerial gatherings focusing solely on energy efficiency took place, when representatives from 27 governments attended the IEA's Annual Global Conference on Energy Efficiency in Sønderborg, Denmark. This whitepaper builds on the strong statement agreed at the conference and the analysis "The value of urgent action on energy efficiency" published by the IEA at the conference.

We are writing these whitepapers to shine a light on evidence from credible sources on the role of efficiency in transforming our energy system. We do not intend to provide all the answers to what it takes to limit global warming to 1.5 degrees, but we want to stress the importance of curbing demand for energy as a basis for replacing fossil fuels with green energy. We also want to demonstrate that we already have the necessary technologies at our disposal.

Martin Rossen, Senior Vice President,
Head of Group Communication and Sustainability,
Danfoss

The paper was prepared by Head of Analytics in Group Communication and Sustainability at Danfoss, Sara Vad Sørensen. Comments or questions can be addressed to: sara.sorensen@danfoss.com.

Danfoss Impact
Issue no. 1

Only got 2 minutes?

These are the key takeaways

- Without urgent action, energy demand will grow significantly, getting us off track to meet global climate goals. Instead, according to IEA **a collective push for energy efficiency can deliver one-third of the total emissions reductions needed to reach net zero[6].**

- **Cooling is a global blind spot in climate change mitigation.** As economies grow and adapt to a warmer climate, especially in the Global South, demand for cooling will make the second-largest contribution to the overall rise in global electricity demand over the coming decades[7].

- **Energy efficiency is an enabler of electrification.** To grow the role of electricity in the energy mix it is a fundamental, yet overlooked, fact that we need to reduce energy demand first. An early analysis found that for every dollar spent on energy efficiency, we can avoid spending more than 2 dollars on energy supply[8].

- **Most of the global reductions in carbon emissions through 2030 needed for net zero come from technologies readily available today[9].** This paper presents concrete policy measures to increase energy efficiency across sectors.

6. IEA (2022). The value of urgent action on energy efficiency, p. 7
7. IEA (2022). World Energy Outlook 2022, p. 22
8. IEA (2007). World Energy Outlook 2006, p. 43
9. IEA (2021). Net Zero by 2050 – A Roadmap for the Global Energy Sector, p.15

Danfoss Impact
Issue no. 1

The neglected demand side of the green equation

Life is inseparable from the use of energy. We need energy for heating, cooling and lighting in buildings; the powering of cars, buses, trains and ships; and for the industries that provide us with the goods we consume. Even communication demands energy: just think of the data centers that provide the information to the screen you are probably looking at right now. All aspects of human activity require vast amounts of energy.

This may sound intuitive. However, the logical consequence of this simple fact is often overlooked: since human activity requires energy, energy demand will rise significantly as the population grows. **In 2030, eight years from now, it is projected that the world will be home to 750 million more people and in 2050 it is projected that the global population will have grown by nearly 2 billion people[10].**

Adding to that, economic development and energy demand have historically been closely related. As we get richer, we consume more energy and vice versa.

At the same time, energy access remains a crucial issue. Hundreds of millions of people – the majority in Africa – are right now deprived of access to basic energy infrastructure. A significant 13% of the world population remains without electricity for lighting, communications, education, refrigeration or keeping cool[11]. Our energy systems must be able to satisfy the expected and just demands for access to energy.

In sum, two interrelated and unavoidable trends mean that we can no longer neglect energy demand: global population growth, with rising incomes pushing up demand for energy services, and many developing economies navigating an energy intensive period of urbanization and industrialization. To understand why this blind spot in combating climate change occurred and how we can change it, let's take a closer look at the misunderstandings that lie beneath the surface.

> *"Energy efficiency is a critical solution to so many of the world's most urgent challenges – it can simultaneously make our energy supplies more affordable, more secure and more sustainable. But inexplicably, government and business leaders are failing to sufficiently act on this."*
>
> *Fatih Birol, executive director of the International Energy Agency (IEA)*

Quote source: IEA (2022). Meeting of Ministers from around the world can turbocharge energy efficiency progress to combat energy crisis and meet climate goals

Two myths in the climate debate debunked

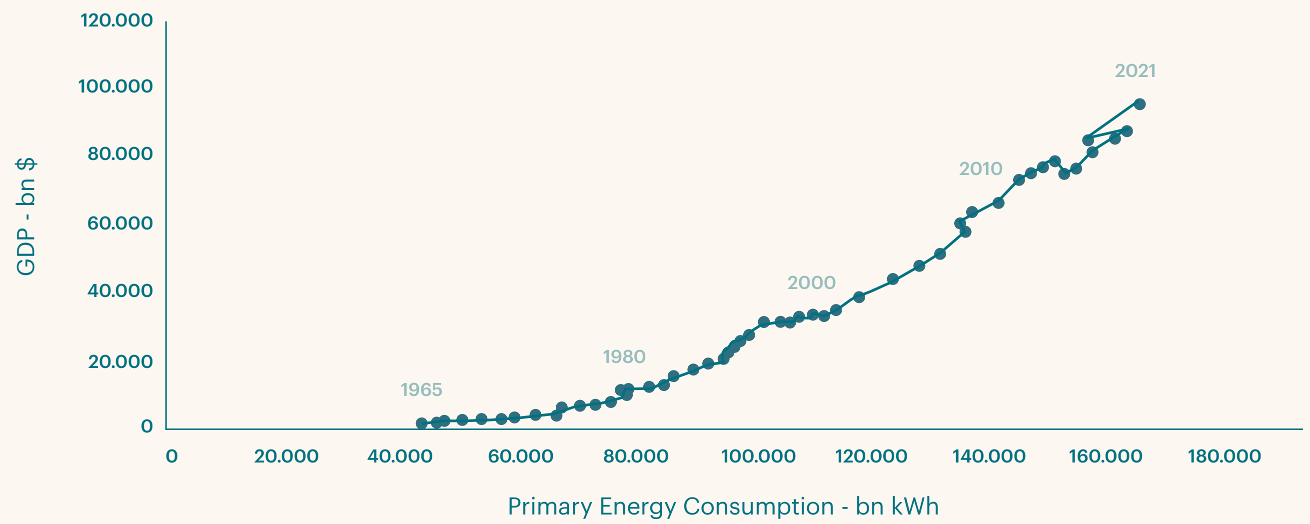
Why do decision-makers continue to overlook the demand side of the green equation? Two long-held political myths can explain this.

Myth number 1: Economic growth and increasing energy demand are inseparable

The first myth has its roots in the historical relationship between economic growth and energy use. As Figure 1 shows, there is a close correlation between the two.

However, this does not mean that lowering energy consumption by increasing energy efficiency will hinder economic growth.

Figure 1: World GDP vs Primary Energy Consumption since 1965



World GDP Source: The World Bank (2022). National Accounts Data
Primary Energy Consumption Source: BP (2022). Statistical Review of World Energy

10. IEA (2021). Net Zero by 2050 – A Roadmap for the Global Energy Sector, p.50
11. Our World in Data (2020). Access to Energy

First, the relationship between economic growth and energy consumption is not causal, but a two-way relationship. Higher energy consumption leads to higher economic growth. But the opposite is also true: higher levels of economic growth foster higher energy consumption[12].

Second, in the past we have managed to improve energy intensity[13] (a key measure of the economy's energy efficiency) while experiencing high rates of economic growth[14], and analysis suggests that we're beginning to see a decoupling between the rates of economic growth and energy demand globally[15].

Third, climate change is a costly affair and delays in lowering emissions will only make it more expensive to do so in the future[16]. Extreme events like droughts and storms can cause long-term economic damages because of their impact on health and labor productivity. Recent studies show that by 2100, global GDP could be 37% lower than it would be without the impacts of warming when taking the effects of climate change on economic growth into account[17]. According to the IEA, **without the global energy intensity improvements of the last two decades, emissions growth would have been almost double, or about 8 Gt per year higher in 2019[18].**

For households alone, enhanced efficiency and related avoided energy demand could help contribute to reducing global household energy bills by at least USD 650 billion a year by 2030 in the Net Zero Scenario[19]. Adding to this, higher investments to achieve these energy savings can support an **extra 10 million jobs by 2030 in efficiency-related fields,** such as new construction and building retrofits, manufacturing and transport infrastructure[20].

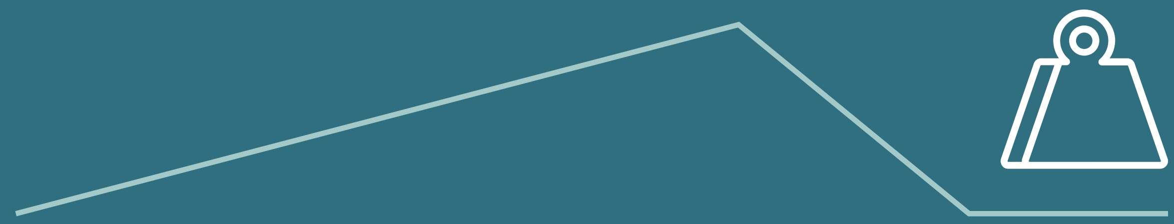
In sum, it is possible to experience economic growth without a rise in emissions thanks to energy efficiency. Making our buildings, industries and transport more efficient does not make us poorer – on the contrary, according to the **IEA's Net Zero Scenario,** where each unit of energy will deliver more than it does today, **final energy demand can be around 5% lower by 2030 but serving an economy 40% larger[21].**

Myth number 2: The energy supply is green; we don't need to worry about increasing energy demand

Wind turbines, solar panels and other renewable energy sources are being built out on still larger scales. This is indeed encouraging and necessary. We must substitute fossil fuels with renewable sources if we are to meet our climate goals. However, a common misunderstanding is that the significant increase in renewables means that we don't need to worry about how we use energy. This is false for three reasons.

12. Zhixin and Xin (2011). Causal Relationships between Energy Consumption and Economic Growth
13. IEA (2021). Energy Efficiency 2021, p. 8
14. The World Bank (2022). National Accounts Data and BP (2022). Statistical Review of World Energy
15. McKinsey (2019). The decoupling of GDP and energy growth: A CEO guide
16. Council of Economic Advisers (2014). The Cost of Delaying Action to Stem Climate Change
17. UCL (2021). Economic cost of climate change could be six times higher than previously thought
18. IEA (2022). The value of urgent action on energy efficiency, p. 3
19. IEA (2022). The value of urgent action on energy efficiency, p. 10
20. IEA (2022) The value of urgent action on energy efficiency, p. 6
21. IEA (2022). The value of urgent action on energy efficiency, p. 5

Higher in 2019



8 Gt per year

Without the global energy intensity improvements of the last two decades, emissions growth would have been almost double, or about 8 Gt per year higher in 2019[18].

First, **even though use of renewables is growing, they are not even close to replacing fossil fuels**. In 2021, the share of renewable technologies in total global energy supply was 11.9%, a modest 0.2% increase from 2020. This slow growth was due to increasing global energy demand, the highest absolute increase in history as economies rebounded following Covid-19[22].

Second, even if we assumed that most of our primary energy was green, energy efficiency is still necessary. In many areas electrification is only doable with high levels of energy efficiency. For instance, in the heavy vehicles used at construction sites, energy efficiency is key to reducing the size of batteries needed and therefore paving the way for large-scale electrification. See construction case.

22. IEA (2022). Renewables

Furthermore, even in a scenario where we have electrified everything, we would still need energy efficiency because the production of renewable energy is fluctuating. When the wind blows and the sun shines, electricity supply is plentiful and cheap. Energy demand also has peaks. Generally, less energy is used at night when we are at rest, but in the morning and early evening demand spikes. As we continue to scale up renewables, the gap between supply and demand is increasing during peak hours. Digitally enabled **energy efficiency devices and systems could help level out these peaks from the supply and demand side.** As an example, active and intelligent energy efficiency measures in buildings, such as digitally controlled space heating or cooling, allow us to shift demand and thereby shave the peaks. In the same vein, integrating sectors allows for the surplus heat generated in one sector (for example, the excess heat from a data center) to be used in another sector (for example, the heating of local homes), thereby lowering the demand in peak periods.

Third, given the increase in demand for green electricity in the years to come, there are challenges in moving towards renewables at the pace needed. Renewable energy build-out requires space, public support and raw materials. In the case of raw materials, there is increasing demand for resources like nickel, cobalt, copper, lithium and rare earth elements used to make renewable energy technologies. In the EU, which relies heavily on imports of many of the raw materials required for the green transition, the European Commission has warned that current decarbonization scenarios could be endangered by weaknesses in future supply security for several materials[23].

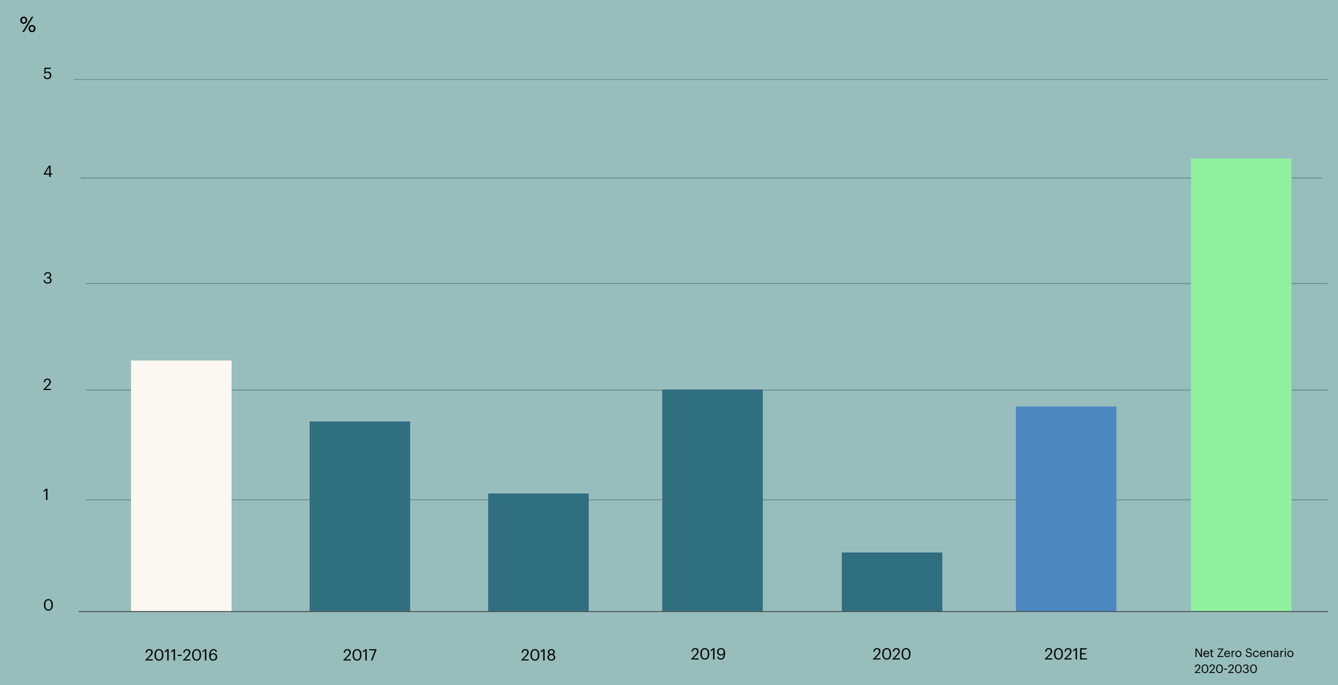
Energy efficiency is key to reducing these challenges. **An early analysis found that for every dollar spent on energy efficiency we can avoid spending more than 2 dollars on energy supply[24].**

In sum, without early action on efficiency, the transition to net zero emissions will be more expensive and much more difficult to achieve[25]. When looking at the improvements in energy intensity – a key measure of the economy's energy efficiency – during the past decades, it is clear that efficiency measures have been neglected. To reach net zero emissions the rate must double as can be seen in Figure 2[26].

In the next section, we deep dive into one area that clearly demonstrates the danger of overlooking the demand side, namely the growing demand for cooling.

23. European Commission (2020). Raw materials demand for wind and solar PV technologies in the transition towards a decarbonised energy system
24. IEA (2007). World Energy Outlook 2006, p. 43
25. IEA (2022). The value of urgent action on energy efficiency, p.4
26. IEA (2022). The value of urgent action on energy efficiency, p. 4

Figure 2: Global primary energy intensity improvement 2011-2021 and in the Net Zero Scenario 2020-2030



2011-2016 five-year average. 2021 estimate based on World Energy Outlook 2021. Net Zero Emissions Scenario = IEA Net Zero Emissions by 2050 Scenario, 2020-2030 intensity improvements, ten year average.

Source: IEA (2021). Primary energy intensity improvement, 2011-2021

Cooling: A blind spot in the fight against climate change

Cooling is essential for life across the planet. It is essential for storage and transport of food and medicine. In warmer parts of the world, space cooling keeps us healthy and comfortable at work, school and home, and is just as necessary for human well-being and productivity as space heating[27].

But cooling remains a global blind spot in climate change mitigation. If urgent action is not taken, growing demand for cooling could drive one of the most substantial increases in greenhouse gas emissions we have ever seen[28]. As recent analysis from the IEA has shown, demand for cooling will make the second-largest contribution to the overall rise in global electricity demand over the coming decades[29]. The ignorance of the growing demand for cooling demonstrates exactly why we need more attention on the demand side of the green equation.

The need for cooling is increasing rapidly around the world, particularly in developing countries. The increase is caused by economic development and adaptation to a warmer planet due to climate change. The years from 2013 to 2021 ranked among the 10 warmest on record[30] and in 2022, intense and prolonged heatwaves were experienced across the globe. Heat and lack of cooling pose a significant risk. According to a study in the journal The Lancet,

27. Harvard Kennedy School (2018). When the heat is on, student learning suffers
28. Khosla, R., Miranda, N.D., Trotter, P.A. et al. (2021). Cooling for sustainable development
29. IEA (2022). World Energy Outlook 2022, p. 22
30. NOAA (2022). Climate Change: Global Temperature

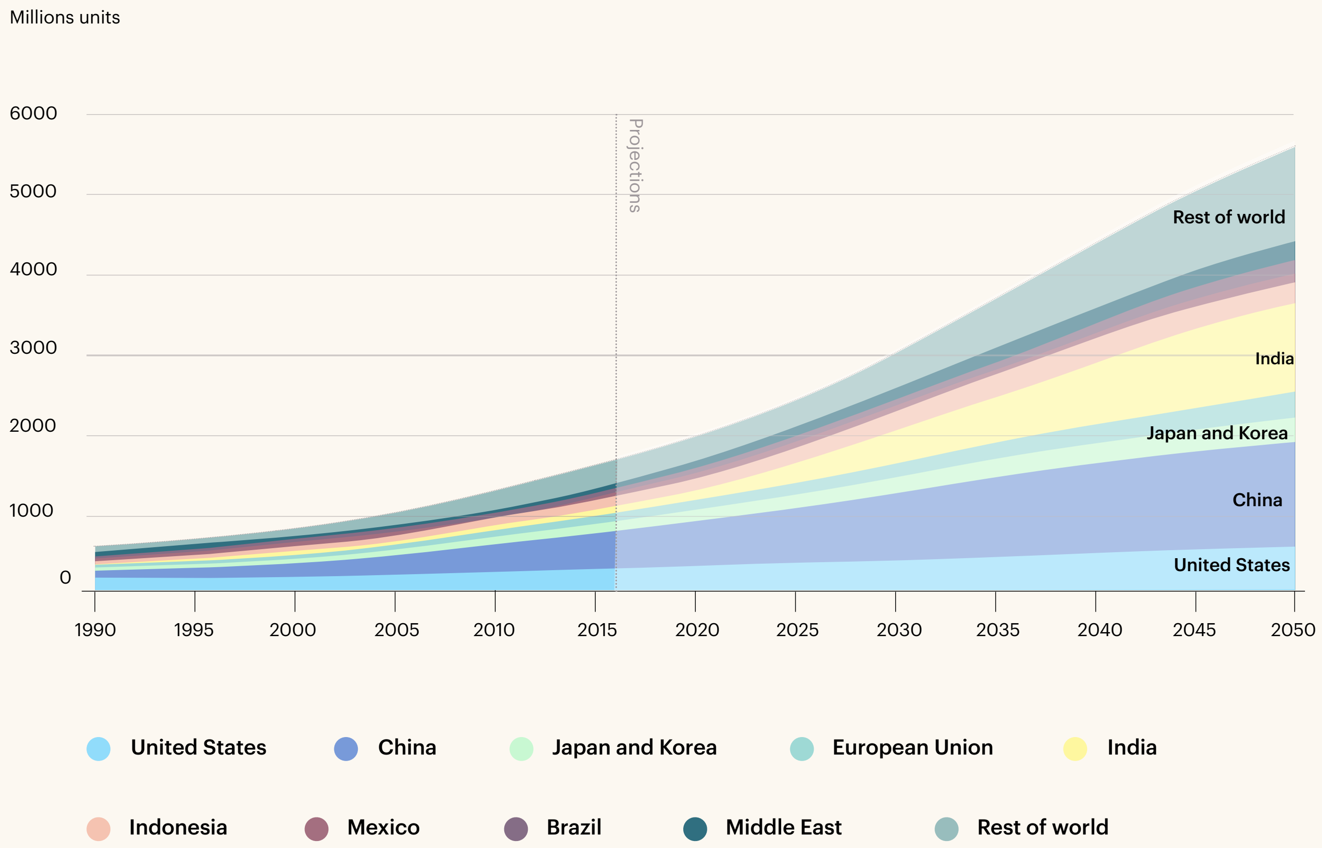
around 500,000 people die from non-optimal temperatures each year[31]. There have been warnings that the number of deaths due to extreme temperatures – heat as well as cold – will increase in the coming years[32].

At the same time, 13% of all food produced globally is lost due to a lack of cold chains, the continuous series of refrigerated transport and storage that keeps food at the correct temperature. This is particularly significant in developing countries where access to refrigeration is much lower than in developed countries. It is estimated that this lost food could feed 950 million people a year[33].

Lack of cold storage and refrigerated transport also contributes to 1.5 million vaccine-preventable deaths[34].

With the potential to impact health, well-being, productivity and food security the need for cooling is clear. It is a necessity, not a luxury. Due to global warming, population growth, urbanization and rising incomes, it is projected that demand for cooling will increase rapidly over the next decades. But cooling consumes large amounts of energy and this energy use could increase rapidly without targeted actions to increase efficiency.

Figure 3: Global air conditioner stock, 1990-2050



Source: IEA (2019). Global air conditioner stock, 1990-2050

31. Zhao et al. (2021). Global, regional, and national burden of mortality associated with non-optimal ambient temperatures from 2000 to 2019: a three-stage modelling study
32. The Guardian (2021). Extreme temperatures kill 5 million people a year with heat-related deaths rising, study finds
33. IIR (2020). The role of refrigeration in worldwide nutrition
34. The World Bank (2019). Four Things You Should Know About Sustainable Cooling

In terms of space cooling, the energy use of the roughly 2 billion AC units in operation is already having a significant impact on both overall and peak energy demand[35]. Space cooling accounted for nearly 16% of the total electricity used in buildings, or around 2000 TWh of final electricity consumption in 2021[36]. This places pressure on electricity grids, particularly during extreme heat days when equipment is used at full capacity. Space cooling can represent more than 70% of peak residential electrical demand on extremely hot days in some countries[37]. Energy demand for space cooling in buildings could more than triple by 2050 – consuming as much as all of China and India today[38].

Despite improvements in efficiency and less carbon-intensive energy production, CO_2 emissions from cooling continue to rise. Emissions from space cooling more than doubled to 1 Gt between 1990 and 2020[39].

This leads to a vicious feedback loop: as the world gets warmer, demand for cooling increases and this drives yet further warming. The question is, how do we break the cycle so that the world has access to affordable cooling and still becomes climate neutral in 2050? The short answer is that we employ energy efficient cooling solutions that make it possible.

Energy efficient cooling

For food storage and transport, available cold chain technology can reduce food loss by up to 40% in developing countries according to Danfoss' estimates. Packing, storing and transporting perishables at the right temperature extends their lifetime and ensures that more food reaches the tables of today's growing population[40].

For space cooling, we can also do much more to promote more energy efficient solutions. The energy performance of air conditioning units can vary up to 70%. **We can almost halve global energy consumption for cooling simply by choosing efficient options[41].**

District cooling is another promising solution. Singapore has the world's largest district cooling system, and the nation has reduced its energy bill by 40% and the country's emissions by the equivalent of 10,000 cars per year[42]. District cooling also offers the potential to replace dangerous refrigerants with efficient and climate-neutral alternatives, for example, natural refrigerants such as propane.

We already have the technology available to cut the energy demand of cooling technology; now the focus must be on action. Investments in energy efficient cooling solutions will reduce emissions, energy bills and pressure on the electricity grid while ensuring that we can all live healthy and comfortable lives.

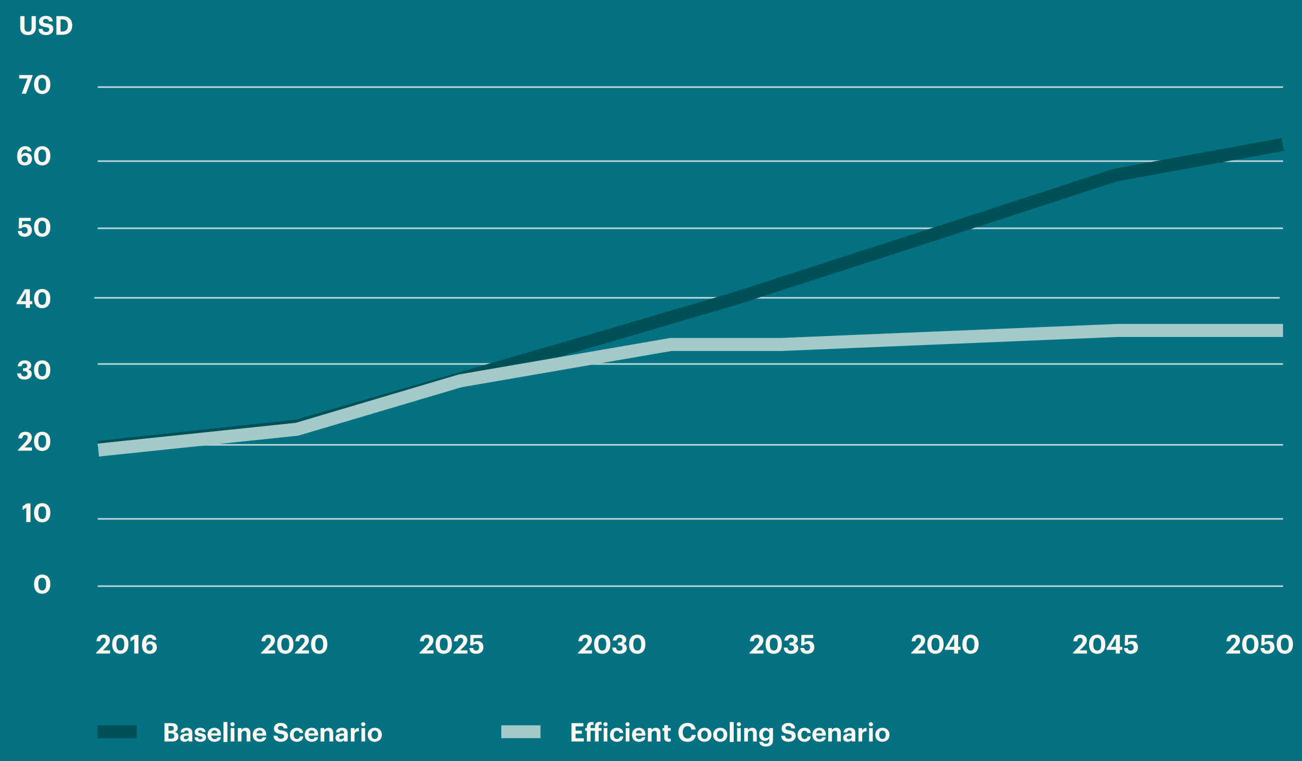
Cooling is just one example of the risk of neglecting the demand side. As we will see in the next section, reducing energy consumption is possible across multiple sectors and it offers significant potential for reducing emissions, improving livelihoods and creating jobs.

35. IEA (2022). Space Cooling
36. IEA (2022). Space Cooling
37. IEA (2018). The Future of Cooling. Opportunities for energy-efficient air conditioning, p.11
38. IEA (2018). The Future of Cooling
39. IEA (2022). Space Cooling
40. World Economic Forum (2017). Appetite for destruction: to save the planet, we must fight food waste
41. IEA (2018). The Future of Cooling. Opportunities for energy-efficient air conditioning, p.69
42. The World Bank (2019). Four Things You Should Know About Sustainable Cooling

Just like heating, cooling is a necessity, not a luxury

Figure 4: Annual electricity costs per capita

Annual electricity costs per capita to meet space cooling needs by scenario

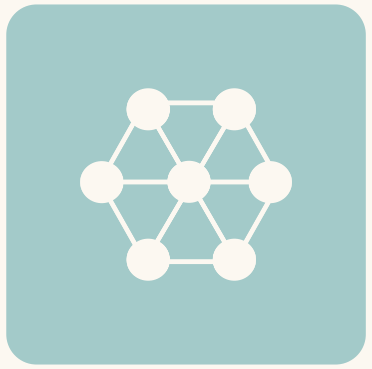


Source: IEA (2018). The Future of Cooling, Opportunities for energy efficient air conditioning, p. 70

The solutions exist

1. Save energy

2. Electrify



3. Integrate

Overall, experts agree on the three fundamental steps in combatting climate change and reaching net zero: we must make electricity green by substituting fossil energy with renewable sources; we must electrify everything possible across all sectors; and then we must remove the small remaining emissions stemming from processes that cannot be electrified (for instance, by carbon capture and storage or by reforestation).

Renewable energy is a theme well covered and in most places politically unquestioned. Building out renewables is gathering pace and scale, although still more needs to be done. **However, to grow the role of electricity in the energy mix, it is a fundamental yet often overlooked fact that we need to reduce demand for energy in the first place.** In other words, energy efficiency is an enabler of electrification.

Let's take a deep dive into the relationship between energy efficiency, electrification and sector integration to see why these three interrelated processes together with the build out of renewables constitute the main levers in the green transition.

1. Save energy

Energy efficiency simply means **using less energy to perform the same task – that is, eliminating energy waste.** Today energy is being wasted everywhere across sectors. In the transport sector, inefficient vehicles and ships burn much more fuel than necessary. In the industrial sector, inefficient electric motors waste energy and the excess heat that is generated from production is not utilized. And in buildings – both commercial and residential – vast amounts of energy is wasted every day because simple measures to monitor and control energy use are not in place.

The good news is that we already have the solutions at hand. Even though efficiency measures are often associated with heating and cooling in buildings, a long list of technologies exist that can reduce energy waste across sectors – in buildings, transport and industries.

For instance, we can improve the fuel economy of machines and reduce demand for diesel. The construction industry accounted for a total of 13% of global energy-related CO_2 emissions in 2021[43]. A significant source of these emissions are the heavy vehicles operating at construction sites. Today, the average excavator is only 30% efficient, meaning 70% of energy is wasted. The technologies exist to increase energy efficiency in heavy vehicles, for instance by reducing energy consumption when the vehicle is not operating, by reducing hydraulic losses and by recycling energy used during operations. In an efficient and electrified excavator, only 25% of the energy input is needed to do the same job as an inefficient diesel excavator. In other words – energy efficiency and electrification can reduce the energy waste in some excavators by 75%. See construction case.

In buildings, we can use both simple and smart technologies to curb emissions significantly. Measures to monitor and adjust energy use can be implemented very simply. Electronic thermostats, model predictive controls and hydronic balancing can reduce energy consumption significantly, while at the same time improving indoor climate. See Linde Haven case. Simple measures such as replacing fossil fuel boilers with high-efficiency heat pumps can reduce energy use by up to 75%[44]. As we saw in the last section, the technologies that can immediately reduce the energy demand for cooling buildings can also be implemented right away.

Likewise, the energy efficiency of our industries can be accelerated. Implementing better energy management practices has been shown to deliver savings of up to 15% in the first 1-2 years with little or no capital investment[45]. Simple measures to improve the energy efficiency of our industries – such as efficient drives that can reduce the energy consumption of electric motors – already exist and are cost-effective. See industry case.

In short, energy efficiency, that is learning to do more with less, is crucial for meeting our net zero targets. Energy efficiency technologies can be implemented and will have an impact right away. This is why, according to the IEA, a step-up in action on energy efficiency could reduce CO_2 emissions by an additional 5 Gt per year by 2030, compared with current policies. This is about one-third of the total emission abatement needed this decade in the Net Zero Emissions by 2050 Scenario[46]. The technologies are already cost effective and pay for themselves through energy savings, even more so at today's energy prices.

With the direct benefits of higher energy efficiency presented, let's take a closer look at some of the more indirect, yet crucial, benefits. That is, energy efficiency as the enabler of electrification.

43. IEA (2021). Tracking Buildings 2021
44. IEA (2022). 7th Annual Global Conference on Energy Efficiency Policy Toolkit, p.8
45. IEA (2022). 7th Annual Global Conference on Energy Efficiency Policy Toolkit, p.9
46. IEA (2022). The value of urgent action on energy efficiency, p. 7

2. Electrify

Electrification means fully or partially switching from technologies that directly use fossil fuels to those that use electricity. As most people know, electrification is one of the most important levers driving the green transition. One obvious reason is that electrification makes it possible to replace fossil fuel energy with renewable electricity generation. Electricity is also one of the only carbon-free carriers of energy: after electricity is generated there are no emissions related to its use.

Adding to that there is one crucial, but overlooked, reason that electrification is key in all decarbonizing strategies: electrification saves energy consumption due to the higher efficiency of electric technologies. As we just learned in the previous section, energy efficiency opportunities in our buildings, transportation and industrial sectors save energy, and they often do so by switching from inefficient fossil fuel technologies to more efficient electric ones. Electric equipment is much more efficient than the equivalents powered directly by fossil fuels. Electric heat pumps, for example, are three to four times more efficient than burning fossil fuels for heat[47]. High-efficiency heat pumps are therefore both an energy efficiency measure but also a way of electrifying space and water heating. This is one reason why energy efficiency and electrification are so closely related.

However, the relationship between electrification and energy efficiency is more profound than the simple fact that electric technologies are more energy efficient than fossil technologies. Energy efficiency is an enabler of electrification.

As the construction case illustrates, higher energy efficiency can reduce the cost of electrification: if you want to electrify transport, the size of the battery you need depends on how much energy the vehicles consume. By employing energy efficiency measures that reduce idle and hydraulic losses and recycle energy, we can significantly reduce the power needs of construction vehicles. It then becomes possible to reduce the battery size required and, thereby, the cost of electrification.

Grid stability is another reason why energy efficiency is an enabler of electrification. Energy efficiency can level out the peaks of energy supply and demand. It thereby provides the stability to the grid necessary for full electrification of society. For instance, cooling places pressure on electricity grids, particularly during extreme heat days when equipment is used at full capacity. Energy efficiency allows us to reduce these peaks, both because it directly reduces the energy input needed, but also because it allows us to cool (or heat) our homes when it is cheapest and therefore most efficient to do so.

In addition, by shaving peaks energy efficiency also shaves carbon emissions. Fossil fuels are often used as the residual fuel to supplement renewables when the amount of clean energy is insufficient. By reducing the amount of energy needed in peak periods, energy efficiency directly reduces the amount of fossil fuels needed in the energy mix.

One of the key challenges in decarbonizing our grid and increasing electrification is ensuring that supply matches demand. Energy efficiency can make the use of energy more flexible and reduce peaks. However, to exploit the full potential of energy efficiency and electrification, sector integration is the last crucial lever in the green transition.

47. IEA (2021). Energy Efficiency 2021, p. 14

3. Integrate

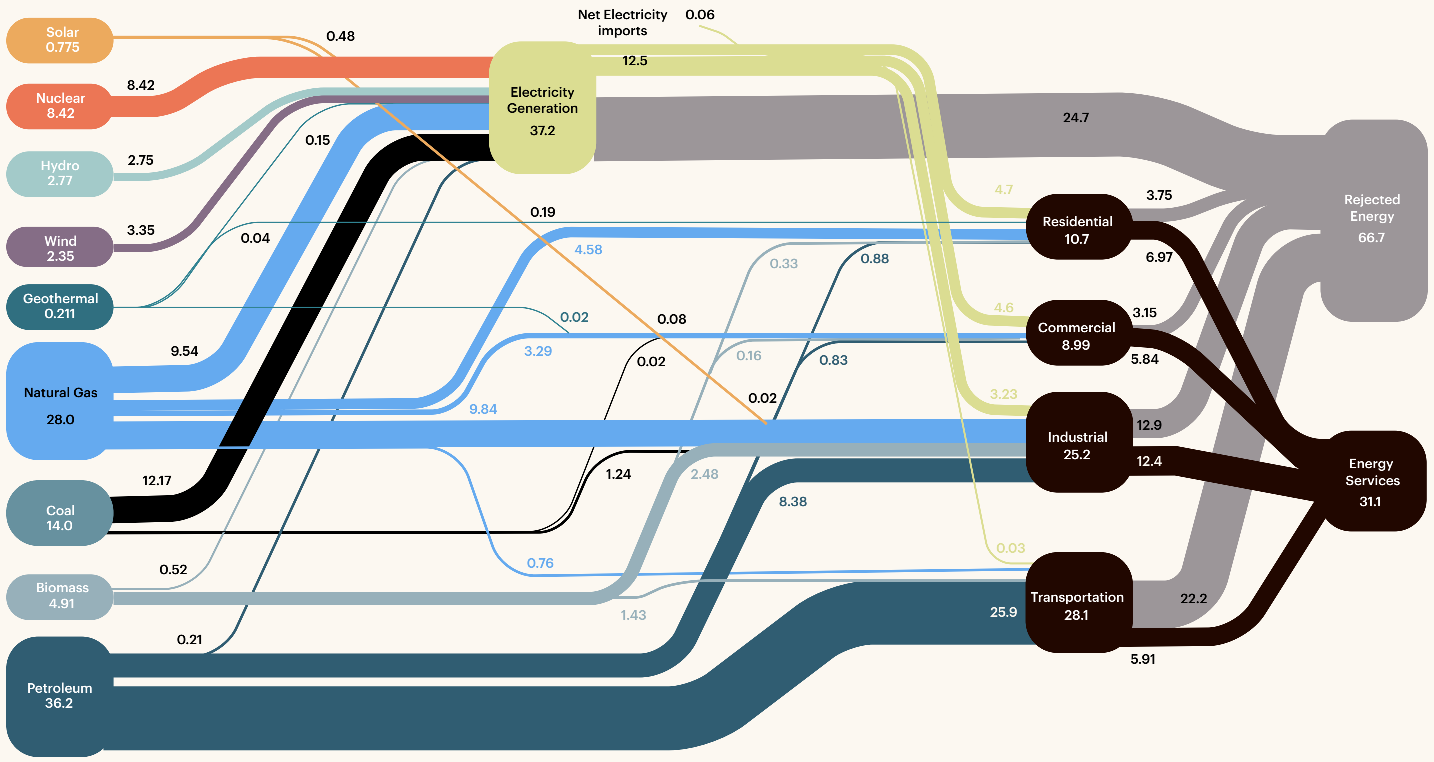
Energy is being wasted everywhere. Figure 5 illustrates the energy consumption in the US. Of all the energy consumed, only one-third is actually used to generate services, and as much as two-thirds of the energy is rejected, meaning pure waste.

Sector integration is the final main lever in decarbonizing our energy system because it makes it possible to reuse the rejected and otherwise wasted energy. Sector integration is about maximizing synergies between sectors, connecting energy consumers with energy producers, and converting and storing energy.

Take waste heat. Supermarkets, data centers, wastewater facilities and industries all produce excess heat. See wastewater case & see supermarket case. Take a moment to notice the heat generated from your laptop and then imagine this on the scale of a data center. Instead of just releasing that heat into the air, it can be captured and used for heating surrounding buildings and the local community. Similarly, supermarkets use a lot of energy for cooling, and the heat generated in the cooling process can be captured and reused.

One of the key challenges in decarbonizing our grid and increasing electrification is ensuring that supply matches demand. By looking at the energy system holistically and linking different energy sources, sector integration allows for flexible use of power. It enables discrepancies in supply and demand to be evened out so we can exploit the full capacity of the grid. Balancing the peaks will be particularly important as we increase the use of renewables and electrification takes pace. Sector integration enables the full potential of energy efficiency and electrification, and the three solutions together are fundamental to reaching net zero.

Figure 5: Estimated U.S. Energy Consumption in 2017



Source: [World Economic Forum (2018). Visualizing US energy consumption in one chart]

To grow the role of electricity in the energy mix, it is a fundamental yet often overlooked fact that we need to reduce demand for energy in the first place

Danfoss impact
Issue no. 1

Policy Recommendations

Save energy and electrify everything across transport, industries and buildings

Buildings
On an overall level, set targets for energy efficiency in buildings including renovation rates. Set building energy codes for new buildings and retrofits to accelerate the transition to zero carbon-ready buildings. Set minimum standards for energy efficient cooling, heating, ventilation, pumps and fans, and energy efficient appliances such as refrigerators and washing machines. For instance, efficiency standards are a key measure to avoid the lock-in of inefficient air conditioning units in coming decades. While highly efficient air conditioning units are available on the market, most efficiency standards – and consequently the units purchased by consumers – have two-to-three times lower efficiencies than those of the best available technologies[48].

Industries
Set minimum energy performance standards for key equipment, such as motors and pumps, that can drive up overall industrial efficiency levels. Make sure that taxes and fiscal policy push industries towards becoming more energy efficient, such as by utilizing carrot-and-stick policies that encourage action (for instance, carbon pricing) and address or alleviate barriers.

Transport
As the global sale of passenger EVs is gathering pace, the technology for the full electrification of buses, construction machinery, city boats and ferries already exists. Create a market for these technologies by setting high carbon-intensity standards for new machinery and vehicles. Vehicle taxation and duties can be structured to incentivize the purchase of more efficient vehicles. For the vehicles and ships that have a long lifetime, make sure that legislation and tax regimes provide incentives to retrofit existing diesel engines to enhance energy efficiency. This can be done by setting high carbon intensity standards and making sure not to create short-sighted incentives – for instance, to electrify systems that are only 30% efficient.

48. IEA (2022). Space Cooling

Look at the energy system holistically and push for more systematic use of wasted energy

In general, begin to consider waste as an energy resource. Almost all waste can be used for energy production – whether excess heat, excess cooling, sludge from wastewater systems or household waste. Energy planning begins with a strategic view of excess energy. For instance, map existing heat demand, existing heat supply method and amounts of energy used. Prepare overall energy plans to show the priority of heat supply options in any given area and identify locations for future heat supply units and networks.

Remove both financial and legislative barriers. The current design of the energy market is, in many places, a barrier to sector integration technologies, either by hindering the participation of sector integration technologies in specific markets or by not internalizing all positive and negative externalities of respectively low and carbon-intensive technologies. Aspects such as cost-reflective energy price signals, adequate carbon pricing, market accessibility and liquidity, and appropriate network tariff structures should be considered.

whyee.com

Learn more about how energy efficiency solutions can accelerate the green transition.