ARUP

Transitioning to a Net Zero World

Consumer choices

Transitioning to a Net Zero World

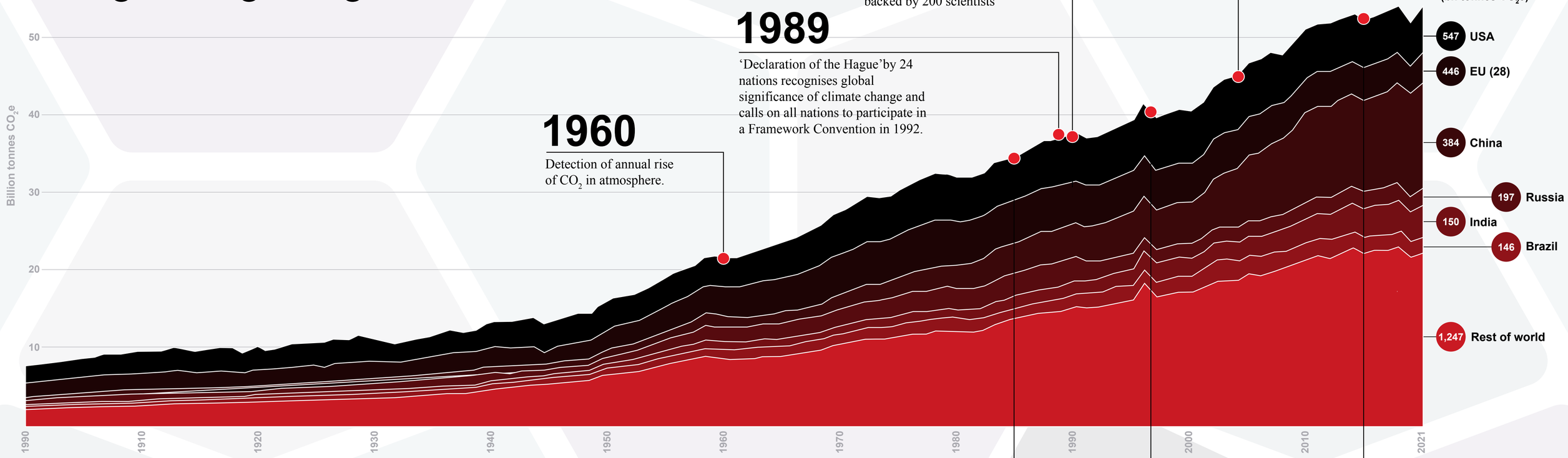
How can we shift from a period of limited change to transformational change?

Many technological solutions and visions for net zero cities, neighbourhoods, buildings, and products - while recently acknowledged at a mainstream level - have been discussed for decades. So, why is it that despite our knowledge of these ideas, and increasing attention towards them, we have not been able to make these solutions commonplace or achieve substantive reductions in global emissions?

When it comes to climate action, we primarily focus on what is needed in terms of solutions, actions, visions, plans. Our focus here is on exploring how we can effectively implement these solutions, and in particular the barriers in our path in doing so.

How do we achieve an at-scale transition towards a net zero world that goes beyond sectors and national boundaries? Our aim here is to bring attention to several issues and approaches that continue to be overlooked in the statements and solutions aiming to achieve net zero to date. We want to offer a unique and different perspective that takes a system level view, focuses on key barriers and corresponding enablers, and that highlights what is needed to truly achieve a transition to a net zero future.

Why are we not achieving the rapid cuts in emissions we need despite longstanding dialogue on climate action?



1960

Detection of annual rise of CO_2 in atmosphere.

1989

'Declaration of the Hague' by 24 nations recognises global significance of climate change and calls on all nations to participate in a Framework Convention in 1992.

1990

First IPCC Assessment Report, made to the second world climate conference in Geneva; backed by 200 scientists

1985

United Nations Environment Programme/ World Meteorological Organisation (UNEP/WMO) scientific conference calls for international action to curb emissions.

1997

Kyoto Protocol to the FCCC agrees nations to reduce emissions by 2012; signed by 163 countries.

2005

Kyoto treaty goes into effect, signed by major industrial nations except US.

2015

The Paris Agreement (ratified in 2016) signified international agreement (eventually by up to 125 countries) on strengthening the global response to climate change by aiming to reduce emissions and keep a global temperature rise this century 'well below 2 degrees Celsius above pre-industrial levels' and to pursue efforts to limit the temperature increase even further to 1.5 degrees Celsius.

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Transitioning to a Net Zero World

Introduction

Achieving net zero at scale is more of a political, economic, legal, and financial struggle than a technical problem. Climate targets and regulations are set up nationally – while consumption and production take place globally.

Big businesses commonly announce targets to reduce their emissions but outsource emissions-intensive processes further down their supply chains. Large corporations still face little pressure from government to validate their statements on climate change targets. Net zero ambitions often serve more as marketing tools than as impetus for a truly transformed business model.

Governments around the world continue to struggle to understand the role they can play in driving change while delivering on urgent needs and maintaining socio-political stability. Scaling and implementing concepts such as a circular economy are still left to the market, overlooking the fact that the lack of clear regulatory and financial incentives for manufacturers and retailers backing the concept continues to favour an economy that relies on making and selling more new things. Far-off visionary net zero targets continue to lack near-term pressures to perpetuate the required level of change.

Through this study we question how pledges to action can be more effective. Are we focused on the right actions and commitments? Are we targeting the real barriers to a net zero transition?

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Transitioning to a Net Zero World

Introduction

What do we mean by a net zero world?

The debate around the phrase ‘net zero’* continues, as does an increase in global emissions. Critics of the term net zero rightly point out that it can be used to justify inaction and excessive dependency on unknown and unproven technological solutions to mitigate climate change. In this study, we use the term net zero to represent the scale of the challenge, the general direction of travel for emissions, and to recognise that sequestration mechanisms will be required to some degree to achieve climate goals. Greenhouse gas emissions must be minimised to prevent temperature increase above 1.5 degrees and those emissions which cannot be avoided must be offset (removed) through available means – either through nature-based or technological solutions.

But we take note and guard against the loopholes within the term net zero, by making clear: the focus is first on minimising emissions as much as possible while still enabling vibrant lives for people and maintaining individual freedoms. After all attempts to achieve this balance, we must seek to sequester enough carbon, through nature-based solutions and then technological mechanisms, to remove carbon from the atmosphere to ultimately achieve and maintain a stable temperature for the Earth. Action on net zero must align as closely as possible with the need to become a more sustainable world.

While reducing greenhouse gas emissions is a priority, the planet is past its capacity to sustain human consumption in more than one way. This means that if action can be taken to reduce greenhouse gas emissions and simultaneously address other environmental and social issues such as waste, degradation of land, water and air pollution, or exploitation of people and resources, then it is the preferred course of action and should receive priority over solutions which exclusively cut greenhouse gas emissions. Actions to manage greenhouse gas emissions must also be assessed to ensure they do not worsen existing social, environmental and public health issues over the long-term.

Due to the ongoing delay in action on climate change and continued accumulation of excessive greenhouse gases in the atmosphere, we recognise that the sequestration of emissions from the atmosphere may indeed need to go beyond offsetting ongoing emissions and capture more greenhouse gases from the atmosphere than are actually being emitted at the time, in other words to achieve a ‘net positive’ effect. In the context of this study this differentiation between ‘net zero’ and ‘net positive’ is rather immaterial. Our focus is on understanding and addressing the barriers that impede progress on the transformational change required to meet these agendas.

*Formally, the term ‘net zero’ implies that we need to apply a mixture of decarbonisation and sequestration measures to rebalance the amount of carbon present in the atmosphere to optimal levels to stabilise the planet’s temperature. Getting to zero emissions requires decarbonising current greenhouse gas emitting operations as much as possible (by finding alternative to carbon-intensive resources or reducing or eliminating hydrocarbon use), and then using nature and technology to remove any remaining carbon emissions from the atmosphere.

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Overview

Challenges for a transition to net zero

In this work, we highlight three fundamental challenges to a successful, at-scale transition to net zero emissions. The aim is to build a common understanding of the barriers we must overcome and the unresolved questions we must tackle to enable the transition to a net zero world.

This document is the second release of a four part Foresight report exploring systemic challenges to a net zero transition.

1. Global Interdependencies (Released September 2023)

Business, industry, and consumption take place across borders – yet climate action will be delivered in the context of a nation's individual priorities and agenda. What does cross-border alignment look like in practice?

Featured narrative & analysis

Country Profiles: Understanding national perspectives

The global nature of agriculture & industry

2. Complexity within sectors (Released October 2023)

Each sector is made up of a complex set of systems and actors – who makes decisions and holds responsibility to action change and eliminate contradictions?

Featured narrative & analysis

Mapping the transport sector: Great Britain

Mapping the energy sector: Great Britain

3. Consumer choices

What is sustainable, and is it practical and affordable? Make sustainable choices the default and the most competitive option for consumers.

Featured narrative & analysis

How easy is to make homes more energy efficient? Examples from UK, Austria, France.

How easy is it to find and choose sustainable products? Case study: tea & smartphones

Government and big businesses must start using every lever of influence in their power

Government sets the framework for production and consumption. Businesses are the link between individual choices and systemic provisions across national boundaries. Consistent and aligned action from government and big businesses is a necessary condition to overcoming the key barriers to the net zero transition.

Featured narrative & analysis

Recognising all levers of influence: Businesses | Government

Consumer choices

Sustainable choices must become the default and most competitive option for consumers.

Cutting emissions cannot depend on the average consumer selflessly and autonomously making ‘the right choice’ despite the odds. Sustainably addressing climate change will to some extent require change in the average individual preference. But first, we must recognise that individual preferences are actively moulded by mass media marketing campaigns, and that for most people daily choices are governed by prices and accessibility. Enhancing and upholding the favourability of sustainable choices above all requires systemwide changes to make them available, convenient, practical, and affordable for the average individual.

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Consumer choices

What is sustainable and is it practical and affordable?

The individual consumer makes choices based on the set of options they are given. To successfully transition to net zero, sustainable choices must be provided to the consumer at the right price, conveniently, and with the right information.

How would this play out in practice in different sectors?

We consider typical scenarios an individual might face when they think about buying a daily needs product or managing their energy bills. These scenarios connect back to the industry and building/energy sectors and provide an understanding of how systematic parameters still require significant repositioning to make the ‘right’ choice more obvious and realistic for the average person.

How easy is it for consumers to make their homes energy efficient?

How intuitive is it to find and choose an everyday product that is ‘sustainable’?

Consumer choices

Choosing sustainable products

Finding sustainable products

The individual consumer makes choices every day about the products they buy, whether food, electronics, clothes or other things.

But is it the consumer's responsibility to ensure we reach net zero goals by choosing sustainable products each time? How easy is it to understand what is sustainable, and is the sustainable choice a practical and affordable one for consumers?

Consumer choices

Choosing sustainable products

Most companies tend to overproduce. The fashion industry, for example, overproduces between 30 and 40% each season[1]. In 2017, researchers tracked food waste in over 1,200 commercial kitchens in more than 20 countries and uncovered 13 million pounds of food waste due to overproduction.[2]

Sustainable product consumption is about two key aspects:

1. Favouring those products that have been created sustainably. For example, by using low or zero-carbon materials and resources, and extracting resources at a rate that enables their replenishment in time to meet future needs, and without irreversible damage to critical supporting ecosystems.
2. Consuming products in a manner that minimises waste, by valuing the energy and resources used in its making and distribution, and by maximising the usable life of a product, enabling repair, and repurposing, and ideally eliminating disposal.

The first aspect is in the hands of manufacturers, retailers, and their supply chains. Products made in this way must become the default choice rather than an alternative, so that consumers do not have to search for them, but easily find them as the most visible, most obvious option. The number and variety of products that use sustainable materials is currently too low. Research found that products marketed as 'sustainable' represented only 17% of the market in 2022[3]. They are also often more costly – research suggests that sustainable products are an average of 75% to 85% more expensive.[4]

The second aspect, sustainable consumption patterns, while ultimately in the hands of the consumer to choose, is heavily influenced by the market. For example, the availability and pricing of repair options, the promotion of durability over new purchases by retailers, or the built-in capability for products to be upgraded in a modular fashion over time to keep up with any major technological improvements.

The market must offer sustainable products first and foremost, with greater financial affordability for the average consumer – ultimately phasing out unsustainable products completely.

In 2017, researchers tracked food waste in over 1,200 commercial kitchens in more than 20 countries and uncovered 13 million pounds of food waste due to overproduction.

Consumer choices

Case study

Tea – an everyday product

Tea is the second most consumed drink in the world, only behind water. In 2022, 6.7 billion kilograms were consumed worldwide.[5] One kilogram represents approximately 500 cups of tea.

In 2021, China was the leading global tea producer, followed by India, Kenya, and Sri Lanka.[6] The main importers were the United States of America (USA), United Kingdom (UK), Egypt, and Morocco.[7] However, exporting countries are increasingly beginning to drink more tea, and part of their production is starting to be consumed locally.

The majority of tea is produced by smallholder farms, but the supply chain is controlled by big businesses. Around 85% of tea is sold by a few multinational enterprises (MNEs) and 20% of the global market is controlled by the three largest tea companies.[8]

The tea sector on its own is not a major contributor to climate change, but there is great opportunity to reduce its footprint from different impact categories – and the steps it must take to reduce its impact echo across other food products manufactures and consumed in large quantities globally. Tea processing is energy intensive. Withering, drying, grading, and packing requires up to 18 kWh of energy per each kilogram of tea[9] while a kilogram of steel would consume less than half of that amount. Although tea uses less water than other types of crops, irrigation demand is increasing mainly due to droughts in producer countries.[10] Tea packaging and teabags become waste, and plastic quantities involved in their packaging could be drastically reduced. Thus, how tea is manufactured is relevant to the transition to a net zero world.

Consumer choices

Case study

Smartphones – personal electronic devices

Many environmentally-concerned purchasers consider their impacts when choosing their cars or their home's energy efficiency, but few think about the impact of their smartphones.

Like many personal electronic devices, the actual lifespan of these objects is not the driving factor for their disposal. Consumers discard functioning smartphones for new ones much sooner than needed. A 2019 study found that the climate impact of all of the 211 million smartphones sold in the EU annually was equivalent to 14.12 million tonnes of CO_2 per year, nearly equivalent to emissions from four coal-fired power plants operating for an entire year.[11] Manufacturing, distribution and disposal account for around 72% of a phone's climate impact.[12]

Despite being such a small device, the average smartphone uses 75 out of the 81 stable elements in the periodic table, 62 of which are metals. They contain 16 out of 17 existing rare Earth metals.[13] The extraction of these materials significantly impacts the earth, and most phones are not designed to enable the recycling of these metals. Furthermore, smartphone components use the same rare materials needed to manufacture cleaner and greener technology and fossil fuel alternatives such as solar panels, wind turbines, hydroelectric plants and even electric cars[14], technologies that the net zero transition fundamentally relies on.

Consumer choices

Choosing sustainable products

Is the sustainable option clearly defined for the consumer?

It can be argued that there is no single, agreed, and objective definition of what sustainable means in the context of specific consumer choices. Generally, a sustainable product is one that does not deplete non-renewable natural resources, does not harm the environment during its lifespan, and is derived from socially responsible operations and transactions. In practice, the applied definition for sustainability usually varies across products, companies, and individuals due to lack of regulation, clear guidelines, and established consensus, ultimately leading to a lack of clarity and accountability. A product can be tagged as sustainable just because it reduces the amount of packaging, even if the relative baseline against which the reduction is measured is unspecified or unclear.

Although labelling is intended to inform consumers about different aspects of a product, sustainable labels often confuse rather than clarify the product's environmental impact. With a lack of consistent standards and regulation, labels can take the form of 'green marketing' or 'greenwashing' rather than functioning as signs of meeting verifiable environmental standards.[15] This lack of clarity for consumers to identify greener products, and growing scepticism towards labelling, have been recognised as major barriers to the widespread adoption of sustainable products.[16]

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i Case study – click to read more

Is the 'sustainable' option clearly defined for the consumer?

Tea

Smartphone

Consumer choices

Choosing sustainable products

How consumers make choices

Consumer choice and preferences change over time in response to wider marketing trends, fashion, culture, and education. Basic consumer psychology differentiates between two types of motivators for buyers[22]:

- Product motivation: factors that motivate a person to choose a specific product.
- Patronage motivation: factors that drive a customer to choose a product from a certain brand over others (e.g., high brand reputation, trust).

In addition to different categories of factors that influence consumer choice, consumers are also to different degrees driven by emotions (e.g., status or impulse) and logic (e.g., cost or quality) for different types of product choices. As revealed by consumer behaviour studies, consumer purchases are driven by habit and based on price, proximity, and often limited desire and time to shop. This increases the tendency for routine behaviour such as buying the same, trusted product repeatedly. Even environmentally-conscious consumers can be disinclined to find and select a more sustainable alternative to a given product, as they are constrained by the issues around clarity of information and adequate access to sustainable options in terms of time and cost. In a world where sustainable choices are offered purely on the basis of market demand, such products must cater to a wide range of consumption styles to generate high demand. They must become easier choices, more accessible, more attractive, and more logical.

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How is tea and smartphones selected by consumers?

Tea

Smartphone

Consumer choices

Choosing sustainable products

Are sustainable choices available at the right price?

Manufacturers rely on their supply chains. From their perspective, changing an entire business supply chain to use more sustainable raw materials or improve the efficiency in their production technology requires (at least initially) a costly initial investment. Even if this investment pays off years later, there is little incentive for manufacturers to invest in significantly rethinking their supply chains and raising their standards without a government-backed requirement to do so.

Under stricter regulations requiring all manufacturers and suppliers to operate with higher standards overall, prices for a good would rise initially, but stabilise again as economies of scale are created.

Until the operating conditions exist for manufacturers and suppliers to be able to identify and be incentivised to follow sustainable processes and source sustainable goods, the creation of genuinely sustainable products and business models will be difficult to scale up in a cost-competitive global market.

Externalities must start to be accounted for in the price of mainstream emissions-intensive goods. The current omission in the cost of goods of their impact on the environment, local economies, or communities, allows for unbalanced market pricing. This results in low-priced goods despite environmentally damaging extraction of raw materials, unfairness in labour wage or even the use of toxic ingredients, while fair labour and ethical practices are likely to cost more. Many companies generating large degrees of negative environmental impact continue to benefit from subsidies or the absence of taxes. Governments implement such measures to encourage production and consumption in specific industries by reducing costs.[27]

Lower baseline demand is also a factor behind higher prices for sustainable products, at least initially. Products may use sustainable materials that are not yet set up to be produced at scale and cost more.

Through research, innovation and the use of new technologies, companies are working to make sustainable options more mainstream. Offering sustainable products in larger quantities and proactively marketing them to their customers will secure the required increase in demand and justify the cost of scaling up their production. In addition to action from business, governments can also support sustainable products' competitiveness by progressively taxing carbon and waste-intensive goods and operations[28], and by promoting innovation in clean technologies and sustainable processes across the supply chain.

In many instances, sustainable products can be more efficient or better quality, generating savings for consumers over time.[29] A lack of awareness can keep consumers from considering such longer-term benefits and dissuade them from buying sustainable products due to the higher upfront cost. Provisions from manufacturers and retailers, and regulation from government, can change consumer perception of this higher upfront cost of sustainable goods. For example, the provision of longer guarantee periods, product repair or replacement services, incentives for suppliers to take responsibility for the product's end of life, and pricing for generating waste.[30]

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Are sustainable choices available at the right price?

Tea

Smartphone

Consumer choices

Choosing sustainable products

Complying with minimum standards can drive the sustainability market

Policy has an essential role to play in the transition to a net zero world for industry. It can regulate many issues that directly affect competitiveness for sustainable products. Regulations can demand minimum lifespans, right for repairability, packaging materials, product disposal and technology improvement in production. Life-cycle costs analysis can be enforced to have a complete picture of the actual costs of commodities. Yet while recognising context specific factors, policy levers also need to be applied consistently across the globe, to affect all competitors in the same way, and to avoid simply shifting impact from one place to another.

Legally enforced policies and standards would require information disclosure in a more reliable and consistent manner, making it possible for consumers to make better-informed decisions.

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Complying with minimum standards can drive the sustainability market

Tea

Smartphone

Consumer choices

Choosing sustainable products

Outcomes and impact scale of the environmental issues

Businesses could become gamechangers in the transition to net zero by taking a more creative approach to their models for competing in the market and designing and delivering product and service offerings that prioritise sustainability. Consumers navigate the market in the context of increasing concern but little guidance and support from businesses to make genuinely good choices within the unavoidable constraints of time, cost, and functionality. Far from needing a greater number of options to choose from, they need a selection of products that meet environmental standards to become mainstream, helping them to make sustainability a quick, safe, attractive, and economically viable option.

Consumer choices

Exemplars of best practice

Sheep Inc.

Woollen clothing retailer Sheep Inc. source their wool from Lake Hāwea Station, certified as New Zealand's 'first carbon negative farm' in 2019. Lake Hāwea Station's regenerative farming includes soil preservation methods and natural grazing patterns, leading to wool production sequestering carbon instead of producing it. Once the wool is produced, Sheep Inc also provide mending services to help with the 'life-long guarantee' applied to their products.[43]

Sār

Pune-based furniture company Sār produces an 'Upgrade System' alongside their pieces that extends their physical longevity but also allow the pieces to grow and change with the preferences of the owner. The furniture is designed to be compatible with physical upgrades that Sār offers in terms of scale (i.e. enlarging an existing piece by adding extra structures) or skin (i.e. the colour or design pattern), meaning items can be easily repaired or changed by their owners as time goes on and tastes change.[44]

Miele

Miele is a German high-quality appliance company which promises to integrate sustainability into every step of making and selling their products. The company is aiming to become 100% carbon neutral and is working towards a circular value chain by reusing materials from appliances and re-entering them into the manufacturing loop. While not inexpensive, Miele products are comparable in price to those of similar quality, with the added guarantees of sustainability and a product lifespan of 20 years, with the company offering spare parts for up to 15 years after purchase.[45]

Consumer choices

Exemplars of best practice

klee klee

Shanghai-based fashion label klee klee design around the concept of ‘emotional durability’ - a resilience supported by long-lasting personal investment in an item and resulting long-term use. klee klee use organic and upcycled materials and natural dyeing methods, providing information on the production process of each item for transparency and to encourage the buyer’s personal attachment to it. By offering free mending services, they enable a longer life for their products whilst encouraging positive caretaking habits in consumers.[46]

Mango Materials

Based in California, Mango Materials converts carbon from methane into commercially useful biomaterials, positioning their factories next to existing methane production facilities such as landfills, wastewater treatment plants, and agricultural facilities. Using waste methane, they enable bacteria called methanotrophs to use the gas to produce poly-hydroxyalkanoate (PHA) powder, a valuable biopolymer that is converted into pellets which can then be made into various eco-friendly plastic products such as cosmetic packaging and polyester replacement for textiles, with the biodegradable plastic alternative working in most plastic applications.[47]

Raeburn

London-based fashion brand RÆBURN has a founding philosophy which revolves around the reuse and upcycling of materials from existing products. Founder Christopher Raeburn’s first collection used decommissioned military stock to created a limited series of limited outerwear with each RÆMADE design produced by meticulously deconstructing the original items and reworking their materials into unique, limited-edition garments with a lifetime offer of free repairs and repair classes, encouraging emotional attachment to the items and circularity.[48]

Consumer choices

Home energy efficiency

Why should an individual make their home more energy efficient?

Buildings globally account for 36% of total energy use and 37% of related greenhouse gas emissions,[49] and it is estimated that, by 2050, their total energy consumption could triple.

In many regions, such as the European Union or the UK, a large proportion (around 80 to 90 %) of existing buildings, which are mostly energy inefficient, will still be in use in 2050.[50]

Buildings globally account for

36%

of total energy use

Consumer choices

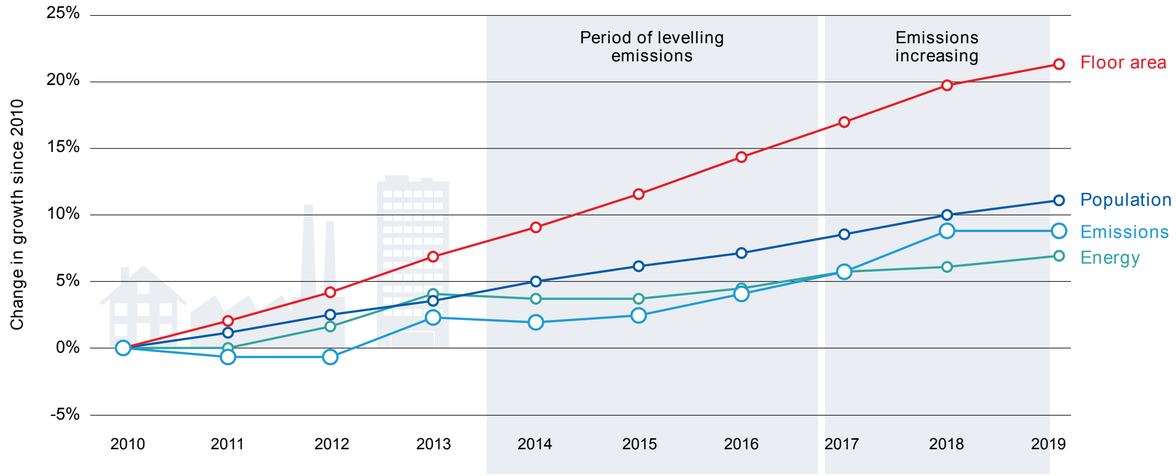
Home energy efficiency

Climate change is making building temperature management more of a necessity for occupants' comfort in buildings, with heat waves and drastic temperature drops increasingly affecting countries around the world. Furthermore, building emissions are rising as a greater proportion of the world population can afford the installation of cooling units in their homes, whose current technology continues to largely rely on carbon intensive energy sources. It is well known that meeting net zero targets involves a system-wide transformation towards a zero-carbon electricity grid – a major challenge for the energy and infrastructure sector. However, achieving net zero buildings also demands direct action from the average individual; residential buildings account for 22% of global energy consumption.[51] Retrofitting existing buildings to prevent energy losses, minimising energy demand, and enabling building compatibility with alternative zero-carbon heating energy sources is key to a net zero transition.

Well developed, implementable, and successful energy efficiency measures already exist. However, the successful uptake of these measures within homes has varied significantly globally.

Building retrofits to enable the transition to net-zero currently rely on individual building owners/occupiers to proactively choose to upgrade their homes, offices, schools, retails stores, hospitals, etc. Yet, the incentive and support for building owners to willingly take on this process is absent in most places, particularly in the residential sector. Despite the fact that decarbonising buildings is on the national agenda in key nations, individuals are expected to carry out and privately finance housing retrofits and usually independently navigate an inconvenient, costly, and complex process. On average, in most regions globally, even large government-owned housing portfolios tend to lack a coherent programme for strategically retrofitting buildings. Ideas such as the provision of 'one-stop shops,' which provide a full range of services to building owners or occupiers to navigate the complex process of retrofitting housing recognise this issue, and are beginning to take root in some places (see our case study on IDF Énergies later in this article as an example of one successful programme). As an example of the U.S. alone, the current rate at which such improvements are being carried out implies that it could take around 60 years to complete whole-building retrofits required in the commercial building stock alone, and around 500 years for the residential stock.[52]

Change in global drivers of trends in building energy and emissions 2010-2019



Source: IEA (2020b). All rights reserved. Adapted from "Energy Technology Perspectives 2020"

Retrofitting existing buildings to prevent energy losses, minimising energy demand, and enabling building compatibility with alternative zero-carbon heating energy sources is key to a net zero transition.

Residential buildings account for

22%

global energy consumption

Consumer choices

Home energy efficiency

Key barriers to accelerating building retrofit

One barrier to accelerating the building retrofit process is the lack of certainty from governments on their desired pathway to decarbonising building heating. Several technologies can be deployed to decarbonise the energy used in homes, e.g., replacing natural gas boilers with heat pumps and/or deploying large scale district heating systems. Each technology comes with its own pros and cons that can also vary by region, depending on the system currently in place, access to given energy sources, development context, and state of existing infrastructure. The chosen technology or energy alternative will determine what type of retrofit a building must undergo, alongside the timeline for the provision of the necessary enabling large-scale energy infrastructure e.g., upgrades to grid networks, adaptation of gas distribution networks, etc.

Secondly, building energy efficiency has been historically marketed as a means for consumers to save money. In reality, homeowners who look into implementing retrofit measures find that cost overshadows the economic benefits, as the return on investment is not achieved within a reasonable period. Industry data validates this, showing that renovations to enhance home energy efficiency have a very low return on investment (in the form of incremental future energy bill savings) in comparison to the cost of implementation. Required measures sometimes have such a long payback period (around 15-20 years) that it does not coincide with the length of time the individual would live in the property, given average occupancy periods[61]. Even if installation costs are taken on by regional or national governments, switching to technologies, such as heat pumps, increases dependency on electricity which typically has higher associated costs. Based on 2019 prices, this could add an additional £100 a year to a household energy bill[62] (subject to ongoing volatility in energy market prices). Ideally with increased deployment of renewables at scale this figure can expect to be reduced. While in the long-term, energy-efficiency focused renovations are likely to increase a property's value, the upfront investment required and the lack of an immediate payback continues to be a financial barrier for people to undertake the process.

In 2022, the Building Technologies & Urban Systems Division of the Berkeley Lab, published a document on the costs of home decarbonisation in the US, with a focus on electrification technologies and related decarbonisation measures for building heating. After gathering information on the total upgrade measure costs, along with the energy, utility bills and carbon savings from 1,739 energy upgrade projects across the country, the research showed there are currently no low-cost solutions able to provide significant energy and carbon savings for the US residential stock. The research showed that reductions of 50% or more in energy use would require investments of $250/m2 or $40-$50,000 per home at a minimum[53].

Finally, a lack of knowledge of the measures and support available, low costs of poor performing or fossil fuel dependent housing, aesthetics, social norms, and institutional trust also serve as key barriers to large scale roll-out of residential building retrofits. Research carried out by the Citizen's Advice Bureau in the UK found that around a third of people did not know that government support was available for insulation measures[54]. Efforts need to be taken by government to more widely publicise the available support, resources, and measures that are most suitable to different building types and residents. Marketing campaigns should also highlight the multiple benefits of retrofitting a home to be climate resilient such as health benefits, quality of life and increased value of the property itself.

Consumer choices

Home energy efficiency

People living in property vs. people living in rented housing

The process is even more complex, constrained, and inconvenient for people living in rented households. Policy and regulation to accelerate the rate of housing retrofits needs to acknowledge and address the diversity of residential occupancy models. The rented household sector is made up of those groups that either privately rent from a landlord, or those that are in social housing where they rent direct from government or a housing association with the support of a government subsidy. In countries such as the United States or Japan, it represents almost 40% of the population (as of March 2021), in the United Kingdom it is 44%, and an even higher share in other countries such as Germany and Switzerland, where it is 64% and 68%, respectively[55].

Renters are usually unable to make significant upgrades to their home due to the absence of legal ownership. In privately rented properties there is some potential to negotiate upgrades to the building's energy efficiency performance prior to entering a contract, however, it becomes difficult in competitive rental housing markets (in most major cities). Unless there is a health or structural risk, the ability to gain approval for energy performance upgrades becomes difficult once the renter is already residing in a property. Landlords are often reluctant to make energy efficiency improvements as it requires them to invest despite knowing they will not receive the benefits of the investment (in the form of energy bill reductions due to energy savings). In addition, single buildings converted into multiple separate rental units (with separate owners) or large blocks with multiple tenures are challenging to retrofit due to the required buy-in across multiple property owners.

Renters are also typically observed to have lower incomes than owner occupiers. This diminishes their likelihood of investing in even minor building retrofits, as they may not even have the additional financial means to do so in the first place. In instances where renters can afford the investment, they are still likely to find it unappealing, knowing that they will eventually leave behind any improvements if/when they move.

Social housing can potentially represent an easier starting point for change at scale in the residential sector, as they can have a single owner (government) with a relatively large portfolio of houses. Some countries, such as the UK, have safety nets in place particularly when it comes to the energy performance of the social housing sector. For example, the Energy Efficiency Standard for Social Housing requires all social housing providers to meet stringent Standard Assessment Procedure standards. In its Clean Growth Strategy, the UK government set out a requirement for all social housing providers to achieve a minimum Energy Performance Certificate (EPC) rating C by 2035 and by 2030 for fuel poor homes[56].

Rented households

40% United States and Japan

64% Germany

44% United Kingdom

68% Switzerland

Consumer choices

Home energy efficiency

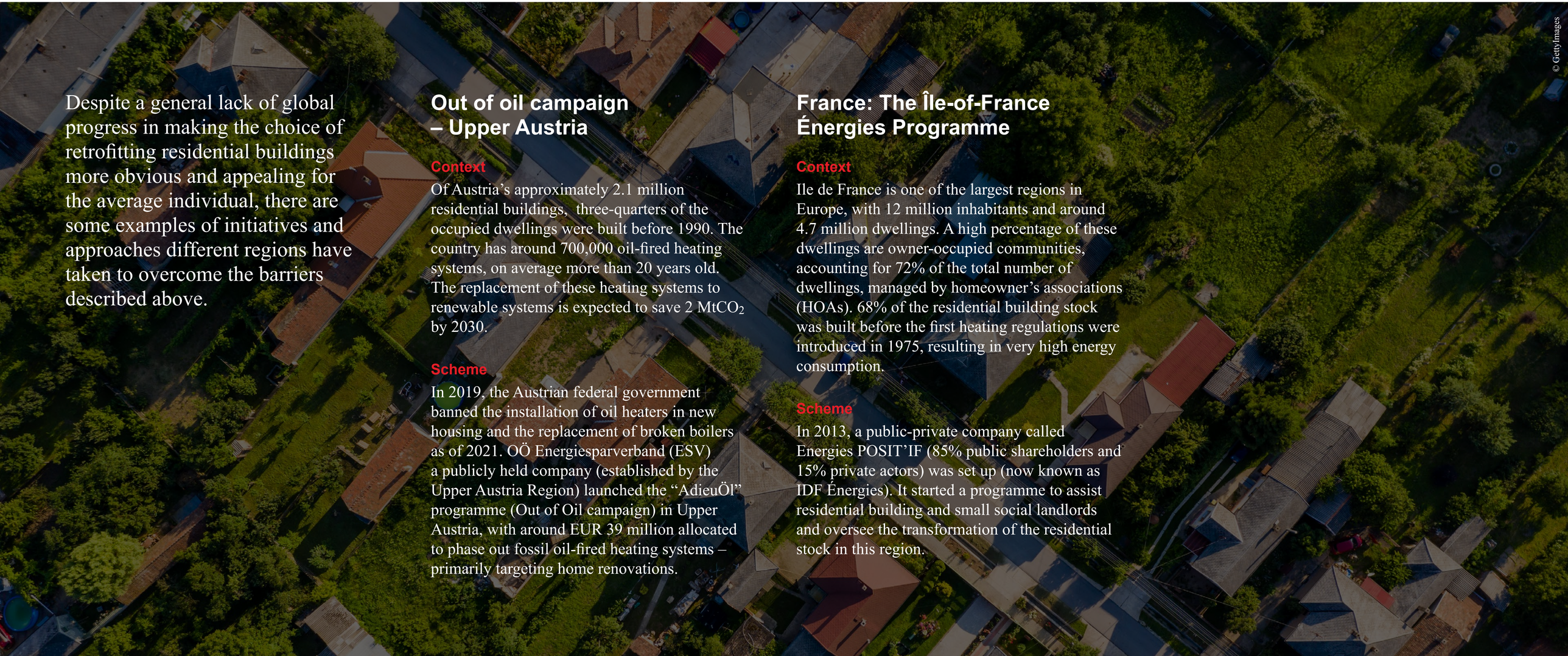
What levers of change are needed?

Governments have an important role to play. Individual countries are free to select how they promote energy efficiency measures. The social, economic, and political context, as well as other factors such as a country's energy background, will influence the measures to be implemented. Some measures that governments could adopt today to facilitate the process for the average individual, and accelerate and enable housing retrofits to get to net zero emissions, are:

- Enforcement of net zero building regulations. New buildings are currently not required to be net zero, which also contributes to increasing the number of dwellings needing retrofitting in the future.
- Promote the use of non-fossil fuel-based energy. New regulation could be designed to support the replacement of boilers for heating with a clearly designated low or zero carbon heating alternative. Regulation should apply to both new construction and existing housing.
- Introduce economic benefits that act as incentives for the consumer, either through tax improvements, reduced taxes on rehabilitation or through subsidy and grant programmes. For these mechanisms to be successful, they must have competent administration, an extensive marketing and communication strategy, clarity, and simplicity of language, as well as robust and consistent support for owners through the transition process (which often extends multiple years).
- Track targets for greater transparency, by implementing mandatory publication of indicators that monitor the evolution of housing stock retrofit. Data collection, analysis and public disclosure of such information can make progress available to consumers and put pressure on governments and other key actors to work actively towards prioritising and meeting their commitments.
- Offer support and help the industry to train qualified workers through supporting policy, legislation, and long-term government investment. Labour costs can be expensive in particular for retrofitting existing homes, due to the limited number of companies operating and the specialist skill set required.

Consumer choices

Case Studies



Despite a general lack of global progress in making the choice of retrofitting residential buildings more obvious and appealing for the average individual, there are some examples of initiatives and approaches different regions have taken to overcome the barriers described above.

Out of oil campaign – Upper Austria

Context

Of Austria's approximately 2.1 million residential buildings, three-quarters of the occupied dwellings were built before 1990. The country has around 700,000 oil-fired heating systems, on average more than 20 years old. The replacement of these heating systems to renewable systems is expected to save 2 $MtCO_2$ by 2030.

Scheme

In 2019, the Austrian federal government banned the installation of oil heaters in new housing and the replacement of broken boilers as of 2021. OÖ Energiesparverband (ESV) a publicly held company (established by the Upper Austria Region) launched the "AdieuÖl" programme (Out of Oil campaign) in Upper Austria, with around EUR 39 million allocated to phase out fossil oil-fired heating systems – primarily targeting home renovations.

France: The Île-of-France Énergies Programme

Context

Ile de France is one of the largest regions in Europe, with 12 million inhabitants and around 4.7 million dwellings. A high percentage of these dwellings are owner-occupied communities, accounting for 72% of the total number of dwellings, managed by homeowner's associations (HOAs). 68% of the residential building stock was built before the first heating regulations were introduced in 1975, resulting in very high energy consumption.

Scheme

In 2013, a public-private company called Energies POSIT'IF (85% public shareholders and 15% private actors) was set up (now known as IDF Énergies). It started a programme to assist residential building and small social landlords and oversee the transformation of the residential stock in this region.

Consumer choices

Exemplars of best practice

Out of oil campaign – Upper Austria

- Efforts were made to find the right arguments and language to appeal to the public. The core messages of the campaign revolved around three key messages: oil heating is no longer modern and soon will be completely banned (desirability), switching to other energy sources is easier than it might seem (feasibility), and the investment pays off for the consumer because of oil's consistent price increases, and for the country's economy because fewer energy imports would be needed, and, of course, for the environment (positive for the individual and the common good).
- The campaign included free on-site energy advice for homeowners by the ESV, to assist them in their investment decisions. To increase dissemination, the strategy relied on stakeholders who had joined the campaign to directly contact homeowners with oil heating.
- The financial incentives consisted of a regional subsidy of up to 3,900 euros to replace the fossil-fuel heating system, periodically supplemented by national funding.
- During its first year alone, the programme was able to approve more than 7,500 applications, resulting in CO_2 savings of 61,000 tonnes per year.

Read full case study

France: The Île-of-France Énergies Programme

- IDF Énergies started with the premise that understanding the views of property owners on the main issues around retrofitting is essential because whatever local or regional decarbonisation targets exist, they will only be developed if property owners decide to retrofit their properties.
- IDF Énergies recognised that an energy efficiency-oriented renovation is generally not economically profitable, so they tried to approach the need for transformation by identifying and emphasising other positives to try to counterbalance the lack of an economic argument.
  - that sooner or later a housing renovation will be carried out, either for aesthetic or structural reasons, etc., and that advantage should be taken of these moments to include broader actions that implement energy efficiency measures.
  - a deep retrofit can help overcome the feeling of discomfort that is sometimes experienced in older buildings.
- IDF Énergies serves as a one-stop-shop service for energy renovation for homeowners.
  - IDF Énergies carries out the detailed design of the project, the calculation of potential energy savings, consultations with specialised companies capable of carrying out these works, the development of the financing plan covering available public subsidies and loan options, support in the application process and supervision of the implementation of the agreed interventions.
  - They manage the application for financing grants both collectively and individually and structure various scenarios with the banks to obtain better conditions for homeowners, something that would not be possible for the individual homeowners to secure on their own.
  - They offer a single, and constant point of contact for all tenants in a building throughout the length of a project (approximately 5 years).
- The initiatives promoted through IDF Énergies are part of wider strategic partnerships that together accelerate action on housing retrofits. Strategies include regular means of communication such as brochures aimed at the communities' needs, awareness-raising campaigns for co-owners through letters signed by municipal authorities, or even the organisation of MOOCs (Massive Open Online Courses), in which experts in energy renovation provide insights into proper development of different types of projects, to increase the average depth of knowledge for the target audience, the owners.
- When the programme began in 2012, the target was to renovate 10,000 homes by 2020 (worth a total of 250 million EUR of refurbishment work), targeting a 40% reduction in energy consumption per home, approximately to a 104 kWh/m^2/year consumption ratio. The programme is still continuing and as of 2022, they have supported more than 15,000 home renovation processes.

Read full case study

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About Arup

Dedicated to sustainable development, Arup is a collective of designers, consultants and experts working globally. Founded to be humane and excellent, we collaborate with our clients and partners using imagination, technology, and rigour to shape a better world.

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