



ReDREAM

change your energy

Why do we need a NEW ENERGY MODEL for allowing THE ENERGY TRANSITION

As citizens of the 21st century we are facing one of the greatest socioenvironmental crises of history. Global rising temperatures are putting many ecosystems at risk. It is undoubtful that global temperatures are motivated by the increase in CO₂ emissions. **Thus, to halt global warming and, consequently, to protect life on Earth, we need to severely reduce these emissions and reduce the dependence from polluting primary resources such as gas.**

In addition, the percentage of population at risk of being left behind is on the rise. Energy poverty refers to the difficulty or inability of a household to maintain adequate temperature conditions, as well as other essential energy domestic services, at a reasonable price. According to the EU Energy Poverty Observatory (EPOV), **37.4 million people were unable to keep their homes warm in the European Union in 2018**, thereby experiencing energy poverty. Unless we do something, more and more people will be affected by shortages in energy.

It is apparent that our energy model needs changing to face these three threats: global warming, energy dependence from gas and energy poverty. We and our grandchildren deserve clean, cheap, independent energy that develops us as communities.

European countries are devising a new energy model that counteracts these threats and facilitates economic prosperity and social cohesion. A fundamental pillar of the energy transition is to increase the intake of renewable sources of energy to facilitate the decarbonization of the energy industry. **The objective is that 45% of total energy come from clean sources in 2030.**

Why you, as a CONSUMER, have a say in the FUTURE

Since the energy market is currently undergoing disruption. It will change radically in the coming years and decades. Independence and self-determination are concepts that are manifesting themselves more and more. The decisive role in this is played by you as a consumer.

One of the main pillars is to increase the self-production of renewable energy that can satisfy consumers' needs. Self-production is enabled with the installation of solar PVs or residential windmills, for instance, in private houses.

Once we have reached a sufficient intake of renewable generation, it is necessary to make the most of this self-produced energy. Much as we do not like to waste food, we do not want to waste energy. Even if it is renewable, its production is costly, and it is smart to make the most of our resources.

If consumers produce more than they consume, they can resort to four alternatives.

1. First, they can **inject this electricity into the grid** and selling it at a price well below market price. Not all countries allow this possibility and in some countries, remuneration is no possible or even, discouraged.
2. Second, they can adapt or **replace heating technologies with innovative heating systems such as geothermal or aerothermal**. With these systems, the energy contained in the air that surrounds us is extracted to use it later by transferring it to rooms or running water. These systems are considered clean and efficient: an aerothermal heat pump uses 75% renewable energy and 25% electrical energy. An aerothermal heat pump with PVs makes a winning combination in terms of obtaining and using clean energy at marginal costs.
3. A third alternative is to **enable the storage of self-produced energy with ad hoc batteries**. However, the economy of scale makes grid-level batteries more appealing than distributed ones since the latter are more expensive. In addition, although batteries help to shift the surpluses of renewable energy, they create other negative environmental impacts, due to the chemical leakage from them. In short, batteries could help store energy but at the moment they do not seem a scalable and affordable solution.

Beyond batteries, energy can be stored in electric vehicles (cars, bikes or motorbikes) or in other devices. For instance, thermal energy can be saved inside the building and later be used for heating or cooling the house: they actually work as an air battery.

4. A fourth alternative is or **share this energy generated with other people**, for example citizens near a city hall, the next-door neighbour or a nearby store. This last solution is named collective self-consumption and allows residential, industrial and commercial buildings to share the energy generated by themselves with surrounding consumers. If you form a community with other consumers, you could give away to them the energy you are not using and, reciprocally, receive the energy that they are not using and that you need. This last alternative is very efficient: because it is generated in the same place that is consumed, it avoids losses along the distribution network. It is also cheaper, because prosumers do not have to pay distribution and transmission fees. Public organizations can form part of these energy communities: you could give your surplus energy to the local school, the local library, or the local council. They can use your donated energy to power the streetlamps, for instance. This would bring down their costs and liberate the budget for undertaking other projects that improve the quality of life of our communities, such as creating a new sport centre. By creating these micro-grids, energy communities may have access to clean and cheap energy, ensuring that neighbours are not left behind.

Local energy markets, energy communities and renewable energy cooperatives are already an important building block in the energy transition.

At least 2 million people in the EU are already involved with more than 7700 energy communities, and the engagement is on the rise. They have also contributed up to 7% of nationally installed capacities of renewables, estimated at 6.3 GW (source: <https://smarten.eu/report-energy-communities-to-increase-local-system-efficiency-february/>).

Through this massive shift towards individual and flexible use of sustainable energy sources, you can significantly reduce CO2 emissions and have more influence on sources and price through the local community.

In sum, decarbonizing the energy model demands increasing the intake of renewable energy. For this, we need to mainstream the self-production of energy. This will also contribute to gain independence. However, if we want to increase the production of renewable energy, we also need to change the way in which energy is consumed. We turn our attention to these matters next.

THE NEED FOR A NEW CONSUMER ROLE

Renewable energies are clean, abundant, and cheaper to produce than polluting energies. However, they are intermittent. This implies that the generation is not stable; when most users need a lot of energy (because we are all at home, with lights and heaters on, preparing our dinners in the oven) the produced energy may be insufficient for us all.

This intermittence of renewable energy demands a major change in how we consume energy. Consumers need to adopt a more active role for this new energy model to work. This new role is commonly referred to as demand response or flexibility. This label puts the emphasis on the fundamental change: consumers need to be flexible in their use of energy and need to respond to generation cycles.

Energy is different from other goods in that, so far, cannot be entirely stored. Moreover, demand and production need to match exactly every second. To ensure this continuous match a very complex system is required that integrates a very large number of components, including sources of electricity generation with different sources of energy, forecasting algorithms that estimate the amount of available primary energy, transformation, electrical transmission and distribution lines, electrical machines, protection, control and management systems, electrical circuits inside homes, businesses, and industries. All these components are interconnected making up what has been called the Electrical System.

Demand response or flexible demand is one of the elements of this new Electrical System that is introduced to synchronise demand with energy production in a context of growing renewable energy sources. There are different ways in which demand response can enable synchronization.

One way is through tariffs. As you have probably experienced, the price of energy is greater when there is more demand, and cheaper when there is less demand. When there is more demand, renewable energies may not be sufficient and we need to use “dirtier” sources of energy. So, at peaks, energy production is more expensive because it is also more polluting. If we shift consumption to non-peak hours, if you charge your electrical bike at 2.00 am, you are savings emissions and you will pay considerable less. Tariffs aim to shift demand from the peaks to the valleys, so to ensure that renewable production can meet the energy requirements of all.

However, tariffs may limitedly shift demand. A family with children will not cook dinner at midnight only because prices are cheaper, or energy is cleaner. Similarly, if you are teleworking you cannot unplug your computer or switch off the heating. Our practices and daily chores limit our ability to shift demand in response to tariffs.

Another alternative is to use smart plugs or smart devices. If you have a smart washing machine you can program the washing cycle for the time of the day when energy is cheaper. The same

can be said for other appliances whose operation can be postponed or shifted, like charging your electric vehicle. This can be done at the times when energy is cheaper and cleaner.

Although smart devices can help us shift our demand to synchronize with production, they demand consumers' engagement: consumers need to be attentive to energy cycles and to plan in advance the operations of their appliances. This attention and planning may not be feasible for all consumers; they have enough work and family burdens to add this chore to everything else.

It seems that these two solutions demand too much involvement on the consumers' side which limits the possibility of mainstreaming these alternatives to make the new energy model work.

There is a third way to synchronise demand and production: flexibility by design.

FLEXIBILITY BY DESIGN

Flexibility by design is enabled by technology. Most of our fixed appliances do not need to be on all the time to perform their function. If you have a freezer, the freezer does not need to be on 24/7. You could switch it off for shorter periods and it will not break down and the food will not be ruined.

Of course, consumers cannot be switching by themselves on and off their freezers or electrical heaters. They have better things to do. A potential solution is that technology makes this operation on their behalf.

If you provide information about

- your house (how big it is, how insulated it is, where it is located),
- your electrical devices (say, your heaters, EV charging post, Immersion heater, swimming pool..)
- your practices (when you are at home and need to be warm)

a smart technology can calculate when the heater needs to start working for you to be comfortable; it can also calculate when the heater can be interrupted because the thermal inertia will maintain the house's warmth. Then, this smart technology will make these decisions on your behalf.

Because the heater is not operating all the time, you save money. More importantly, you save energy: you are not wasting energy but you nonetheless reach your goal of having a warm house in the morning, while you take a shower and your kids have breakfast. You are making the best use of the resources without compromising your comfort and reducing emissions from a polluting plant or reducing the investment in new ones.

Flexibility can obtain savings of €4,6bn in generation costs and €262-690 million saved in balancing markets and the potential direct and indirect cost reduction of €371bn to people in the EU27. (<https://smarten.eu/demand-side-flexibility-quantification-of-benefits-in-the-eu/>)

This is also the alternative that demands less active involvement from the consumers. This smart technology has two parts: an algorithm operating in the back-end and you do not see and an app and website that you can control. This is similar to Amazon. You see their commercial interface where you make your choices of books or music. Their algorithm (what you do not see) learns from your choices and starts suggesting new books or music that you may like. Or it is like

Netflix: you watch programmes or add programmes to your list, and their algorithm learns from your choices and starts suggesting new programmes that you may like.

In all these systems, the algorithm needs some initial information to start working. Thus, in the case of flexibility by design, during the first two or three weeks, you need to use the app to provide information about hours and days you are at home, whether you are at home watching TV or exercising, whether you need a warmer house at a given time... With your inputs and information collected from other sources (e.g., external humidity, temperatures in your city, prices of energy), the smart technology will learn to manage your heating and optimize the energy required for you to be comfortable, to pay less or to generate less emissions.

If you also have self-production, the algorithm will adjust your production to your demands. If you also have smart appliances, it will coordinate the operation of the washing machine, say, so that it runs when it is more advantageous for you. The same can be said if you have an electric vehicle with a smart charger: it will charge the vehicle when energy is cheaper and cleaner making sure that it is charged at the time you will use it.

We said that with this automatization you are making the best use of energy. It is like this device that can be added to the shower and that pre-heat the water so that it starts pouring when it is already hot. With these systems, we avoid wasting water. These smart technologies for flexibility are similar but they present another advantage: the energy that you are not “wasting”, can be sold back to the grid if required.

If we all want to be warm in the morning, we need a lot of energy at the same time. If renewable sources are not producing this amount of energy, we may have a problem. And nobody wants to have breakfast in a freezing room in January.

However, if you have flexibility by design technology, the device will interrupt the heating for short periods, while maintaining the room warm (the thermal inertia does the trick). These interruptions liberate kilowatts that can be given back to the grid to power someone else’s heating. In some countries, you are even paid for this saved energy that is given back to the grid. If you are in an energy community, you can give back this energy to your fellows. You can even partner with energy poverty communities and give back your excess to those that most need it, so that none is left behind.

This is a smart technology indeed: it avoids waste, it saves resources, it reduces your bill, and it helps your neighbours and your community.

Of course, we can be even more flexible with our comfort levels, adapting them also to the activities you carry out. If you are cleaning your house, you may decrease the temperature a degree in winter, and this will liberate more energy to be shared in the grid. This flexibilization will also result in lower bills for you and lower footprint of the energy used, while also reducing our dependence from fuel-based energy.

Similarly, you can extend flexibility to mobility. When you reduce the speed of the car and maintain a constant speed while driving you can save fuel or electricity (if you drive an electric car). This also helps reduce carbon emissions. Some cars have built-in technology that advises how to do eco-driving. There are also apps that help you drive in a more environmentally friendly way.

Moreover, if you have this technology installed in a household you can find other uses for it. For instance, you can check whether your grandma, who lives alone, is fine by looking at her energy

consumption. Or if you are away from home, you could detect if there is something odd also by looking at your consumption.

WHY NOT?

You may wonder if this technology is so smart, why it is not mainstreamed in every household. Well, there are several reasons for this.

First, not all households are eligible for this technology. If you use gas for your heating and do not have any major electrical appliance that can be turned on and off, you are not eligible. Say, if you only have a fridge, then you are not eligible: the technology is much more expensive and environmentally impactful than the kilowatts that can be saved or flexibilised. Households with these technologies could be eligible: electrical radiators, heat pumps, immersion heaters, electric vehicles, PV and batteries (bear in mind that this list is not exhaustive).

Second, some households are afraid of changes. We have got used to having energy at our disposal and at our command 24/7. Using these technologies implies giving some control to technology. This may be scary to some people. However, using flexibility by design does not imply that the machine has control over your household. You can deactivate the device any minute and regain control.

Also, we all like simple and easy things; we do not want to complicate matters. We like switching on the light and getting light. All these innovations seem to introduce complications. Our response to these anticipated complications is to experience stress. However, we can think of many examples when innovations seemed complicated to master. Think of smartphones or smart cookers. It takes time to learn but once we learn, these technologies make our life simpler. And in the case of smart energy technologies greener! If we want affordable and sufficient energy, we may have to learn to master these technologies. And we can do it.

Related to this, some people may distrust the new model. They do not feel comfortable telling others when they are at home or not. However, these systems are based on a secure technology. EU wise, we have a strict regulation, the General Data Protection Regulation, or GDPR applicable since 2018. These energy technologies are regulated by this framework guaranteeing the protection of the data, since all data is encrypted with high security standards that makes impossible to know the content of the information.

In sum, when faced with innovations that change our way of doing things, we feel a bit anxious. This anxiety may make us feel that the risks are greater than they are and the benefits lower than they are. This is a very well-documented psychological phenomenon. Trying the innovation is one way of adjusting our feelings to the actual solution, so that we gain a more rational view of what technology can do for us, for the planet and for our communities.

Now, that you are familiar with the new energy model, are you ready to join?

Explore the ReDREAM project:

<https://redream-energy-network.eu/>