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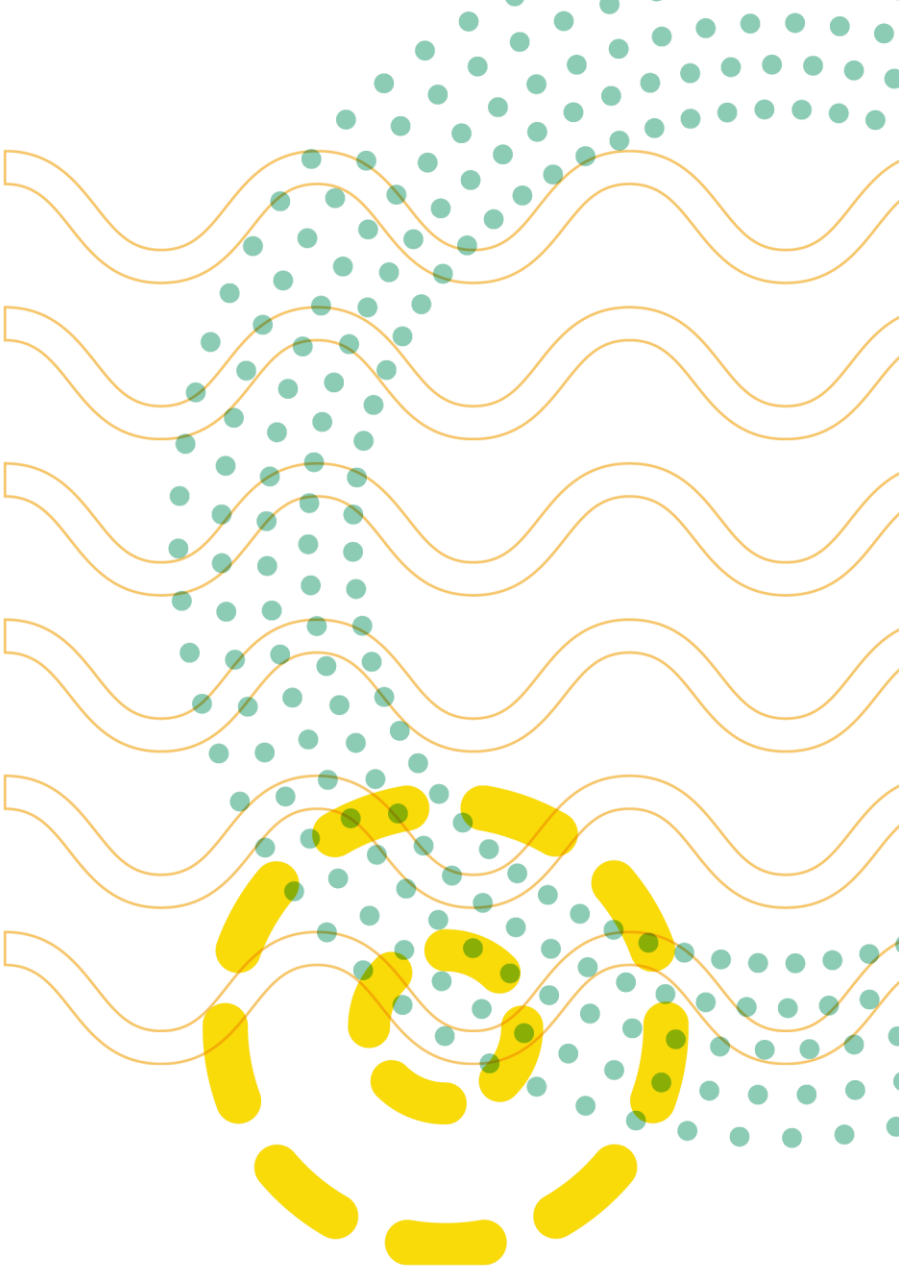

Smart energy sharing through energy communities

A white paper of Energie Samen

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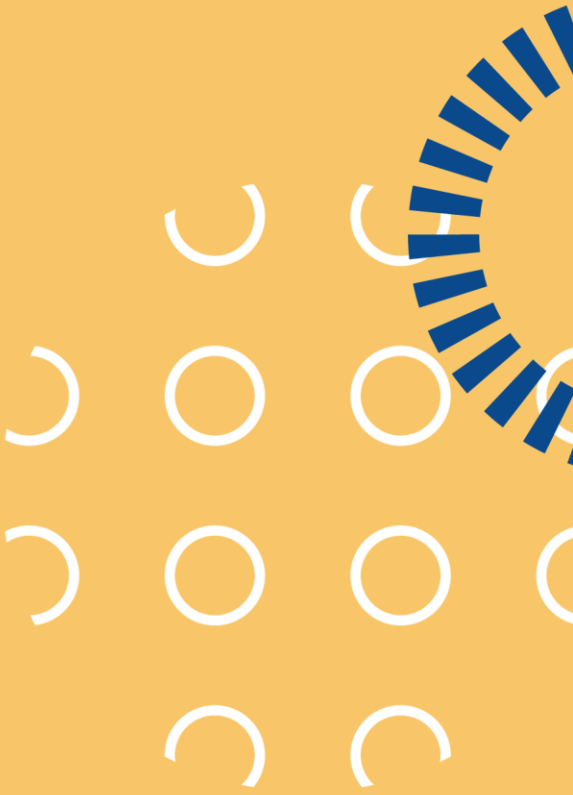


Chapter 1 Introduction

1.1 Smart energy sharing

Many energy communities would like the renewable energy they generate, directly to be used by their members or, for example, by people in the neighbourhood. Currently, the energy is fed into the grid and purchased by an energy company. However, In practice, it makes no difference whether members and neighbours buy their energy from the energy supplier. If they do, it is merely administrative processing of the supplied and purchased energy.

In the meantime, grid operators are running up against the limits of their grids as more renewable energy is connected to the grid and more processes are electrified, such as driving and heating. If smart technical solutions are not applied, expensive grid reinforcement is the only way to feed more renewable energy into the grid. This will ultimately make citizens' energy bills higher.

By sharing energy *smart*, the ambitions of energy communities can be achieved and at the same time, the grid is spared, allowing us to save costs. A win-win situation for all parties. Smart energy sharing is a form of energy sharing that aims to minimise the transport of electricity. The members of the energy community ensure that the electricity produced is immediately purchased, stored or converted locally.

What is necessary to enable smart energy sharing? Grid managers need to make a distinction between electricity that is shared within the energy community and electricity that is delivered or returned through the energy supplier. An energy community will become an integral organisation at the centre of the energy system that smartly combines production and consumption, not only technical but also organisational and financial.

To make smart energy sharing possible, the new Dutch Electricity Act must be amended. First of all, energy sharing should be included in the law. Moreover, it is recommended to enable the prioritisation of projects that minimise the impact on the electricity system through the use of flexibility tools, such as energy sharing. And rewarding electricity customers if they align their offtake with renewable generation over time.
Smart energy sharing by energy communities leads to:

- More involvement of citizens and thus more support for the energy transition;
- Lower social costs of energy transition through better utilisation of electricity infrastructure capacity.

This white paper explains what energy sharing is, what *smart* energy sharing is, how it works, why it is a good idea and what it takes to implement.

Purpose and context

The purpose of this white paper is to accelerate the development of knowledge among all interested parties and to take a first step towards embedding smart energy sharing in our energy system.

Clean Energy Package

Through the Clean Energy Package, the European Commission wants to promote the active participation of consumers in the energy system. The Netherlands is implementing this package by:

- stimulating energy communities
- stimulating collective renewable production through a Cooperative Energy Production Subsidy Scheme
- a Development Fund for Energy Cooperatives
- aiming for 50% of production to be owned by the local environment (citizens and businesses)

Energy communities

Supported by this policy, in most towns and cities, energy communities are actively engaged in realising local, collective and renewable production. In doing so, the energy communities are making a significant contribution to the energy transition, while at the same time the members are becoming less financially dependent on the existing energy prices that are rising as a result of developments in the international gas market. The profits from their local production are then invested in other projects, such as collective heat projects or collective mobility.

The right to share self-generated energy

In 2030, many energy communities will have developed different activities in the energy system, either on their own or through regional cooperation. They will generate renewable energy, have electric vehicles, several collective heat pumps and a large number of *prosumers*.
The Clean Energy Package offers another possibility, which has not been utilised so far. Part of the package are Directives (EU) 2018/2001, on the promotion of the use of energy from renewable sources, and (EU) 2019/944, on common rules for the internal market in electricity. Articles 21, 22, and 16 of these directives give consumers and energy communities the right to share self-generated energy.

Delivering and sharing

European regulations make a distinction between supply and sharing of energy. In contrast to energy supply, energy sharing is not yet sufficiently defined. For this reason, many member states are currently doing little or giving the concept of energy sharing their own interpretation. Also, the Netherlands has not yet developed the concept of energy sharing. In Dutch legislation, and even in the Energy Law, energy sharing does not occur; only the supply of energy with or without a licence is mentioned.

However, the Energy Law does define an energy community, which will give the role of the energy cooperatives a formal place in legislation. For now, it remains with this definition. Under certain conditions, an energy community is allowed to supply energy without a licence, however, it will not be given a specific role or extra possibilities in the energy system.
In line with the European Directive, it is useful and important to include such additional possibilities in the legislation and regulations, namely smart energy sharing by energy communities. This leads to:

- greater involvement of citizens and thus greater support for the energy transition;
- lower social costs of the energy transition through better utilisation of electricity infrastructure capacity.

Chapter 2
Energy sharing

2.1 What is energy sharing?

If energy communities collectively produce renewable energy locally, they would prefer to buy it locally: 'local 4 local'. However, the electricity system is not designed in that way. The electricity that the members of an energy community produce, for example, with a collective solar installation is fed into the public grid. According to the administration, the electricity is sold to an energy supplier. At another time, the members use electricity from the public grid, which they buy administratively from an energy supplier, which is not necessarily the same as the one to whom the electricity was sold.

Energy sharing means that the members of an energy community can administratively share the local collective generated electricity with each other, without the intervention of an energy supplier.
The concept of energy sharing does not yet exist, but it is currently being researched and discussed. There are different interpretations and different definitions. For example, it can refer to the building complex, the low-voltage grid, the street, the zip code or the municipality. It is expected that the legislator will demand clarity on how to define *local*.
Where it is legally required, the energy community must of course pay taxes for energy sharing.

We propose to delineate energy sharing *within the local electricity grid*, as this will relieve congestion in the downstream grid if production and offtake are properly coordinated within the energy community: *smart* energy sharing. This concept is further elaborated in Chapter 3 on smart energy sharing. This leads to the following definition:

Energy Sharing is the exchange of electricity from generation facilities of an Energy Community (or its members) within the Energy Community itself or on an individual basis between its members, within the low-voltage or medium-voltage (<110 kV) section in which the Energy Community operates. [1]

This could be about sharing energy:

- between occupants within a building, or
- between residents and businesses within a municipality, provided that these residents and businesses are connected to the same medium-voltage substation (< 110 kV) on the electricity network.

Sharing and supplying energy without a licence

Sharing energy is different from *supplying energy without a licence*. The fundamental difference is the balancing responsibility. Energy sharing is treated the same as production behind the meter. This means that people who share energy cannot cause imbalance and cannot be fined for it. Sharing without a licence does bring balancing responsibility and related costs.

There are several reasons for energy communities to start with energy sharing. The members may like to generate their renewable energy and share it with their neighbours, similar to a neighbourhood garden. Or they want to gain access to the electricity market themselves so that they are not dependent on large, anonymous energy suppliers. Or they want to reduce the cost of energy consumption by eliminating middlemen. Or they want to switch entirely to locally generated renewable energy.

Vulnerable consumers and tenants

By joining an energy community, vulnerable consumers and tenants can also benefit from the lower costs of energy sharing. This increases solidarity and involvement in the community and support for the energy transition.

[1] As defined in the report "Energy Communities in the Clean Energy Package: Best Practices and Recommendations for Implementation" by the EU ASSET project.

2.2 How does energy sharing work?

The energy community wants to share the electricity produced by the collective renewable energy system with its members. Or members produce on an individual basis and want to share the production with their neighbours.

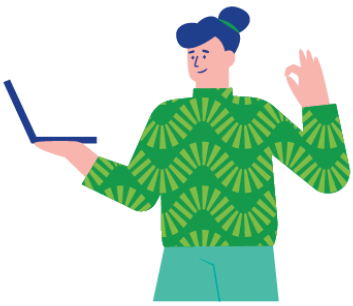
The electricity generated in each quarter-hour is registered via kilowatt-hour meters. The members of the energy community also consume electricity, which is also registered on a quarter-hourly basis via kilowatt-hour meters. Energy sharing means that the kilowatt-hours generated and the kilowatt-hours consumed within the energy community can be offset against each other *on a quarter-hourly basis*. This fits in with the existing market model in which it must be possible to allocate electricity production and electricity purchase to market parties unambiguously (*electricity allocation*).

Smart meter

The introduction of energy sharing is possible with the existing smart meter, which has separate counters for supply (MP1) and feed-in (MP2). The production of electricity by the members of an energy community can therefore be administered separately from the sharing of electricity between those members. Therefore, there is for energy sharing no need to acquire a second smart meter.

Adjusting facilitating services

It must be possible to allocate the energy that producing members share with consuming members of the energy community unambiguously. This requires network operators to adapt their facilitating services to some extent to the market: currently, network operators collect the measured quarterly data from counters MP1 and MP2 of each meter and pass it on one-to-one to the connected energy supplier. For energy sharing, they have to distinguish between electricity that is shared within the energy community and electricity that is delivered or returned via the energy supplier.



2.2.1. Energy sharing methods [2]

- The electricity produced by a member of the energy community (prosumer A) is physically measured by counter MP2(A) in its smart meter.
- This electricity is administratively shared with another member, consumer B.
- The electricity physically consumed by this consumer is measured by counter MP1(B) in his/her smart meter.
- This quantity of kilowatt-hours must be divided administratively into a part shared by the prosumer and a part supplied by energy supplier B.

This requires the administrative use of virtual allocation points (AP):

- The electricity supplied by energy supplier A to the prosumer is measured by its counter MP1(A), so AP1 = MP1(A).
- In this simple example, the kilowatt-hours produced by the consumer and measured by counter MP2(A) are administratively shared with the consumer via AP2, i.e. AP2 = MP2(A).
- The amount of kilowatt-hours received by the consumer administratively via AP3 is the same, i.e. AP3 = AP2.
- Energy supplier B is administratively allocated a number of kilowatt-hours delivered via AP4, thus AP4 = MP1(B) - AP3.

Imbalance

This working method, therefore, requires that the network operators pass on the calculated *allocation values* to the energy suppliers, rather than the physical measured values. This process must be set up in such a way - using a conclusive allocation table - that the sum of the calculated values in each quarter-hour precisely equals 100% of the kilowatt-hours measured physically so that no imbalance occurs. An energy community that only shares the generated energy among itself is therefore by definition always balance-neutral and does not need any balance responsibility.

The grid operator should make it transparent to the energy supplier to what extent a connection, in addition to supply, also involves energy sharing. The supplier can then adjust its energy programme accordingly so that the imbalance risk does not increase.

If, in addition to sharing energy, an energy community also wants to supply electricity to the market or purchase it from the market, it will have to organise its own balance sheet responsibility in line with the existing market model.

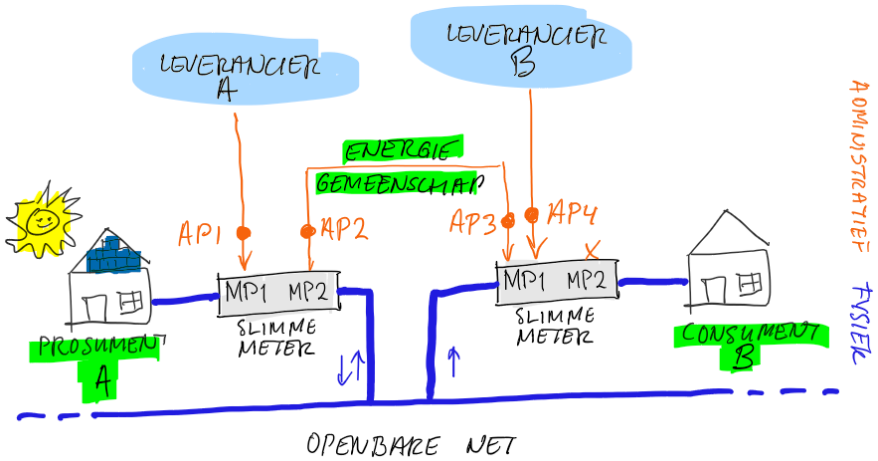


Figure 1. Illustration of an energy sharing method

[2] The method described above is a simplification of the reality, aimed at making the concept understandable. A description of all occurring situations would go too far for this document. A more detailed description is available for those interested.

Chapter 3
Smart energy sharing

3.1 What is smart energy sharing?

With energy sharing, the kilowatt-hours generated and consumed within the energy community are settled with each other every quarter-hour. This is an administrative process that results in a monthly net settlement between the members and with the energy supplier. However, this says nothing about the electricity that needs to be transported through the electricity grid at any moment of the day. This requires *smart energy sharing*.

Smart energy sharing is a form of energy sharing aimed at minimum electricity transmission, where the members of the energy community ensure that the electricity produced is immediately purchased, stored or converted locally.

3.1.1 Congestion

The need to apply solutions such as *smart energy sharing* is rapidly increasing: on the one hand, the rapid growth in the number of solar production installations means that more and more electricity is being fed into the grid during the day. On the other hand, the growth in the number of electric vehicles and heat pumps means that more and more electricity is being purchased at the end of the day. As a result, there is a risk that - due to both the growing production during the day and the increasing consumption in the evening - situations will arise in which the components of the relevant sub-grid reach their limits. It is then not justifiable to connect even more production installations, charging stations or heat pumps to that sub-grid, otherwise, the grid components could be damaged at peak times. Current legislation and regulations do not allow the grid manager to transport additional production or purchase; this is known as *congestion*. The grid must then be reinforced before additional production can be transported.

Solving transport bottlenecks

The grid managers are faced with the major challenge of realising sufficient transmission capacity to meet our climate targets on time and at acceptable additional costs. They must make major investments in the electricity networks in a relatively short time to solve the upcoming transport shortages and to keep up with the expected growth in renewable production, electric vehicles and heat pumps. Therefore, the grid managers strongly support smart location choices for production assets and flexibility tools to better match production and consumption. Smart energy sharing responds to both these needs.

3.1.2 Local use of flexibility tools

By deploying flexibility tools, more renewably produced electricity can be transported. This section discusses flexibility through demand response, storage, conversion and electrification.

Demand response

Congestion can be avoided by purchasing sufficient local electricity at the same time as the local production of the electricity. Deliberately managing this is called *demand response*. With demand response, the generated electricity is purchased directly and as close as possible to the neighbourhood. In this way, the electricity can be transported over the shortest possible distance, via the cables between producers and consumers. In this way, the electricity consumed does not flow through the other cables and grid components in the sub-grid, or through the transformers to an upper medium-voltage or high-voltage grid. As a result, congestion can be avoided.

Demand response is smartly driven by ICT. This smart control is necessary to give users a signal or a price incentive to buy more electricity or to switch on car charging or a neighbourhood battery.

If local demand response possibilities are maximised, a remaining surplus of renewable electricity production can be stored in (car) batteries, converted to heat, or converted to gas. These are more expensive solutions than demand response. However, they will become increasingly cheaper in the coming years.

Electrifying energy demand

In addition to electricity, local energy use also includes other energy, such as natural gas (heat) and fuel for cars. By electrifying that energy demand, locally generated electricity can potentially also meet that demand, and therefore does not need to be fed into the regional grid. Examples are the transition to electric transport and electric heating. Smart control is crucial, however: if it is not available, electrification will only put more pressure on the electricity grid.

With demand-response, storage, conversion and electrification, energy communities can buy their generated electricity locally. This reduces the investment pressure of the grid managers and thus in the long run the network tariffs for consumers, and increases the support among consumers to change their behaviour towards supply-driven energy purchase.

Schoonschip

In Amsterdam, the Schoonschip is a floating residential area, consisting of 46 homes and its own smart grid, was set up under the Experiments Scheme in The Netherlands. Through the application of demand response, storage, conversion and electrification, the Schoonschip smart grid requires much less connection capacity. The 46 homes with a combined capacity of approximately 900 kVA are connected to the public grid with a single connection of only 160 kVA!

Figure 2. Floating residential area Schoonschip in Amsterdam

3.1.3 Cooperation with network operators

Smart energy sharing changes the relationship between energy communities and grid operators. The energy community becomes an integral organisation at the centre of the energy system that intelligently combines production and consumption, not only technical but also organisational and financial. Consequently, the energy community will also become a supplier of flexibility services. As a result, network operators will no longer regard energy communities as any other producer, but as a long-term partner in keeping the energy system affordable and reliable.

Coordination and cooperation

Energy communities are uniquely placed to ensure that the necessary coordination for the deployment of demand response is in place and that the local use of the electricity is properly regulated and managed. This can be done in cooperation with service providers who specialise in this, such as aggregators.

There is a shared long-term interest between energy communities and grid operators: both are locally based and cannot depart from their grid level. There will be close cooperation to keep the energy system stable and reliable at that grid level. The energy community, with its organised off-take, collective production, mutual demand response and local storage, thus becomes an ideal partner to limit the impact on the energy system.

3.1.4 Recommendations on legislation and regulations

To enable and stimulate smart energy sharing, we recommend the following five improvements in legislation and regulations.

1. Include energy sections in the Energy Act, in line with Articles 21 and 22 of Directive (EU) 2018/2001 and Article 16 of Directive (EU) 2019/944.
2. Redefine the allocation point in the Energy Act in line with the method described in chapter 2 of this white paper: "the allocation point is a point in an installation whose energy value (delivery or feed-in) *can be calculated unambiguously from one or more measurement points*, and to which *a single market party* can be unambiguously linked." This makes it possible in the market model to 'share energy' alongside 'supply energy'.
3. When subsidising renewable electricity generation, give priority to projects that minimise the impact on the electricity system through the use of flexibility tools.
4. Reward electricity customers with lower connection or transmission tariffs if they gear their purchase in an organised way over time to renewable production.
5. When allocating transmission capacity, give priority to projects that minimise the impact on the electricity system by applying flexibility tools.

Epilogue

This white paper outlined how smart energy sharing will lead to greater citizen involvement, greater support for the energy transition and better utilisation of the electricity infrastructure. We invite the parties involved - network operators, public authorities and market players - to take the first steps, together with the energy communities, to embed smart energy sharing in our energy system.

Colophon

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