ENERGY SUPPLY
ROUND TABLE

# New rules for a sustainable and stable energy system

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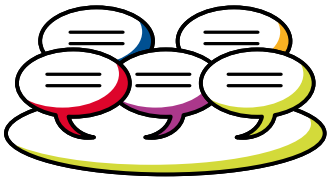
**September 2015**



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**Publisher's imprint**

**Publication**
Energy Supply Round Table,
September 2015

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Energy Supply Round Table

# New rules for a sustainable and stable energy system

# Table of contents

## Disclaimer

*The technological and social developments in the field of energy come thick and fast. It is by no means the intention in this report to make predictions about the future. It has also been a deliberate policy not to make any pronouncements about specific technological developments, such as energy storage or the advent of other energy carriers (such as hydrogen). We have only looked at the trends and developments that are currently visible and at the impact they may have in themselves.*

*The developments in the field of ICT and (open) data are not set out in detail in this report. ICT and data are increasingly playing a part in the energy supply and are a precondition for nearly all the problem-solving approaches proposed. The Round Table has initiated a separate process to consider this in greater depth and to work jointly on a data processing system that will provide for this.*

# The reasons for this report

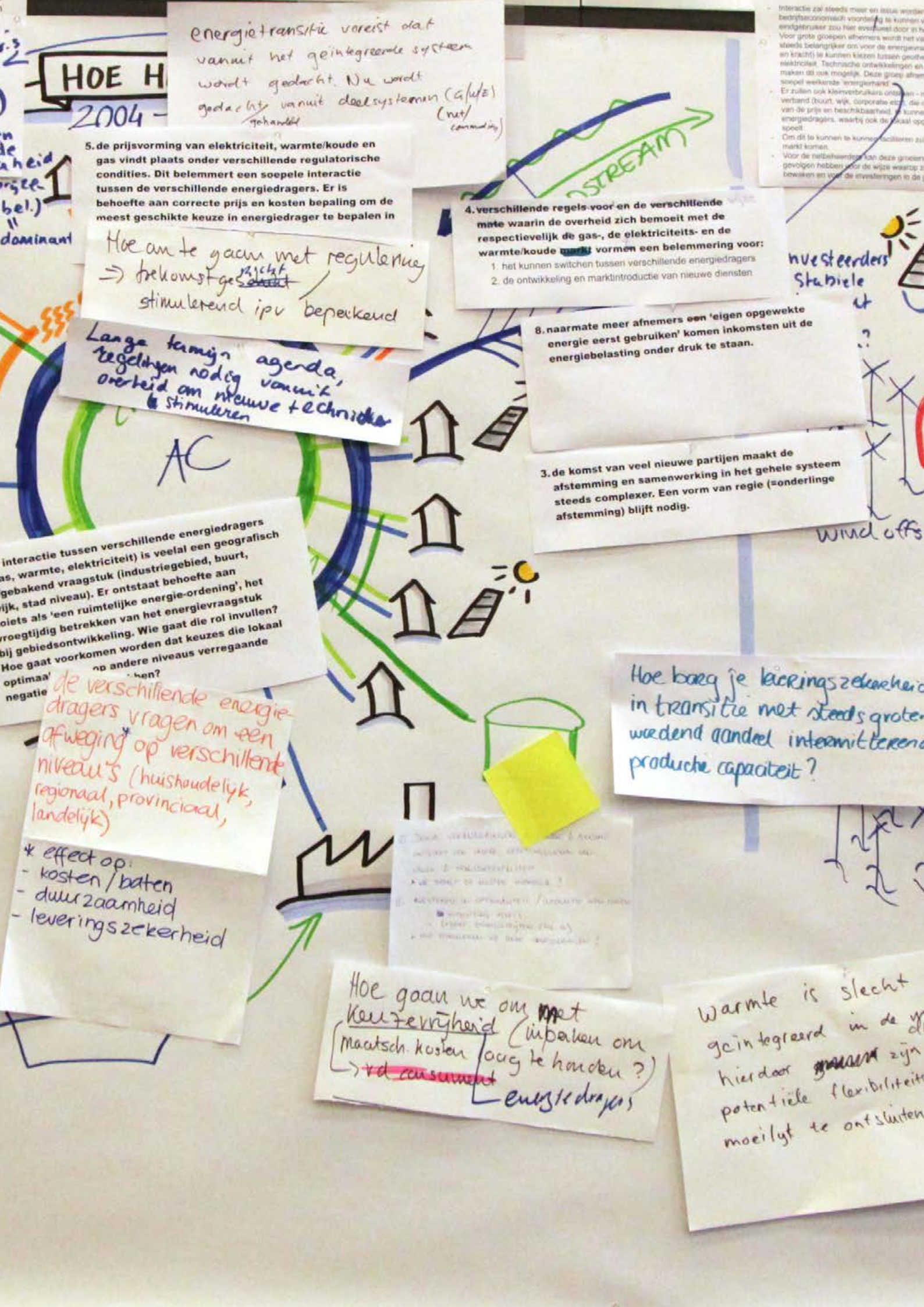
This report gives us, the participants in the Energy Supply Round Table, the shared basis for continuing the dialogue about new rules for a sustainable and stable energy system. We have gained a common picture of the potential consequences of the growth of decentralised and sustainable energy generation, of the increasing electrification of mobility and of the transition in the demand for heat in the built environment. In so doing we have noted that the existing system must be tailored to the future. We agree on the basic principles that the energy system of the future must fulfil. We have formulated concrete problem-solving approaches for a number of key issues. They provide direction - in particular for the built environment - to the new rules for a sustainable and stable energy system.

If these rules are applied, the transition to a sustainable energy supply can be accommodated effectively and efficiently, no matter the rate at which it happens. This is however conditional upon these rules being developed and introduced as soon as possible.

We want to use the problem-solving approaches in this report to contribute to the drafting of the 2015 Energy Report and the structure of future legislation and regulations.

*Teun Bokhoven*
*Han Fennema*
*Hans Grünfeld*
*André Jurjus*
*Roger Miesen*
*Peter Molengraaf*
*Sjef Peeraer*
*Tjerk Wagenaar*
*Siward Zomer*

The initiators, Netbeheer Nederland and Energie-Nederland, are fully aware that together with their members they are held responsible by politics and society for the provision of a reliable, safe, affordable and sustainable energy supply. They are therefore highly committed to the open dialogue with Round Tabele stakeholders and the development of a shared view of the problem-solving approaches to provide that energy supply.


HOE H
2004
energietransitie vereist dat vanuit het geïntegreerde systeem wordt gedacht. Nu wordt gedacht vanuit deelsystemen (G/W/E)
STREAM
5. de prijsvorming van elektriciteit, warmte/koude en gas vindt plaats onder verschillende regulatorische condities. Dit belemmert een soepele interactie tussen de verschillende energiedragers. Er is behoefte aan correcte prijs en kosten bepaling om de meest geschikte keuze in energiedrager te bepalen in
4. verschillende regels voor en de verschillende mate waarin de overheid zich bemoeit met de respectievelijk de gas-, de elektriciteits- en de warmte/koude markt vormen een belemmering voor:
1. het kunnen switchen tussen verschillende energiedragers
2. de ontwikkeling en marktintroductie van nieuwe diensten
Hoe om te gaan met regulering
⇒ toekomst gericht
stimulerend ipv beperkend
Lange termijn agenda, regelingen nodig vanuit overheid om nieuwe technieken te stimuleren
8. naarmate meer afnemers een 'eigen opgewekte energie eerst gebruiken' komen inkomsten uit de energiebelasting onder druk te staan.
3. de komst van veel nieuwe partijen maakt de afstemming en samenwerking in het gehele systeem steeds complexer. Een vorm van regie (=onderlinge afstemming) blijft nodig.
AC
interactie tussen verschillende energiedragers
as, warmte, elektriciteit) is veelal een geografisch
gebakend vraagstuk (industriegebied, buurt,
ijk, stad niveau). Er ontstaat behoefte aan
oiets als 'een ruimtelijke energie-ordening', het
roegtijdig betrekken van het energievraagstuk
bij gebiedsontwikkeling. Wie gaat die rol invullen?
Hoe gaat voorkomen worden dat keuzes die lokaal
optimaa
negatie
op andere niveaus verregaande
hen?
de verschillende energiedragers vragen om een afweging op verschillende niveau's (huishoudelijk, regionaal, provinciaal, landelijk)
* effect op:
- kosten / baten
- duurzaamheid
- leveringszekerheid
Hoe baag je leveringszekerheid in transitie met steeds groter wordend aandeel intermitterende productie capaciteit?
Hoe gaan we om met Kwetsbaarheid (inpakken om maatsch. kosten laag te houden?)
energiedragers
Warmte is slecht geïntegreerd in de
hierdoor zijn
potentiële flexibiliteit
moeilijk te ontsluiten
Wind offs

# Summary

**In the Energy Supply Round Table Energie-Nederland, Netbeheer Nederland, Duurzame Energie-Koepel, Natuur & Milieu, VEMW, ODE-Decentraal, Gasunie and the Ministry of Economic Affairs (as observer) discuss the future of the energy system. They take as their starting point the Energy Agreement for Sustainable Growth, which aims to increase the proportion of renewable energy in the Netherlands to 16% by 2023, to achieve substantial energy conservation and to strengthen the economic structure. The Energy Agreement lays the basis for the further growth of renewable energy after 2023.**

## Key question and delineation

The Round Table has focused on the question of what these developments will mean for the reliability and affordability of the energy system and what changes and innovations are needed in the system to make such developments possible, without affecting the stability and affordability of the energy supply. It began by looking at the consequences of the development of solar and wind energy production, the growth of electric transport and the transition of the demand for heat in the built environment.

This means that the Round Table has not yet considered the developments, possibilities and dilemmas that for instance come into play among the large-volume users of energy, the developments in the transport sector and high temperature heat. These topics can be considered at a later stage, depending on the way in which the Round Table pursues the dialogue.

## Developments

Heat and electricity will be made and used differently. An energy system with, from 2023, 40 - 45% electricity generated locally and sustainably from volatile sources, growth in the use of sustainable gas in the energy and mobility systems, a growing share of electric mobility, a growing share of electrified heat supply, a decline in the use of natural gas and the advent of storage systems will lead to quite different energy streams. The energy system must be prepared to accommodate these developments.

The further growth of decentralised electricity production and the development of large offshore wind farms have implications for monitoring the balance between the demand for and the supply of energy, guaranteeing the security of supply and the costs for the users.

In some places in the low voltage (LV) grid we have seen in 2015 that on a limited number of occasions more electricity is generated with solar panels than the grid can absorb locally. In such a case the transmission system operator has no other option at this point than to reinforce the grid. Since this is very time-consuming

and entails high costs, from a social perspective the question of the extent to which alternatives are available using innovative solutions by which this development can be handled faster and more efficiently is a justifiable one.

# Samenvatting

The growth in solar and wind power, largely due to the imports from Germany, is already having an effect in 2015 on the pricing in the wholesale market for electricity and therefore on the investment climate for the production capacity that is complementary to wind and solar energy.

The advent of all kinds of new players is presenting the market with new challenges. End users are going to have a more active role in the system. They are going to make a significant contribution to resolving the problems that arise as a result of the growth of (decentralised) volatile production, the rise of electric transport and the transition of the heat supply in the built environment.

The way in which the demand for heat in the built environment is met will have to change in the coming years, especially as a major gain in $CO_2$ emission reduction can be achieved here. These changes too must be made possible by changing and updating the rules.

**Challenges**

An analysis of the consequences of these developments has enabled the Round Table to identify the following four key challenges:

1. to ensure that there is sufficient energy (gas and electricity) available to meet (peak) demand even in long periods of no wind and cold and foggy weather
2. to ensure that there is sufficient flexibility in the system to absorb sudden fluctuations in supply
3. to ensure that the electricity system can accommodate the further growth of decentralised generation, electric transport and heat pumps efficiently and effectively
4. to ensure that making the demand for heat in the built environment sustainable is promoted

## Need for different rules and admission of new players

The Round Table anticipates that the challenges of a decentralised energy system with a large share of weather-dependent production can only partly be met or only at high social cost with the current system of agreements, incentives, rules and role allocations. Changes to this system and its updating are therefore necessary. New players, such as cooperatives, aggregators, service providers, ICT companies, etc, must gain low-threshold access to the system.

Steps must be taken for this soon, because these changes require a great deal of preparation and training time. New rules must also be announced in good time to prevent major market disturbances.

## Basic principles

To prevent problems and bottlenecks being tackled in isolation and to guarantee the competitive position of the energy-intensive activity, the Round Table has defined some general basic principles that the energy system must continue to meet and against which any changes can be tested. The Round Table favours a system that builds on developments of the past decades and that creates space in which the innovative strength of all parties is deployed to arrive at an updated system of mutually complementary technologies.

**The motto is:**

**More market incentives;**
**Greater flexibility;**
**More renewable;**
**At the lowest overall social cost.**

## Problem-solving approaches

On the basis of its analysis the Round Table is proposing the following problem-solving approaches:

1. **Optimising and expanding the (international) electricity market to guarantee the stability of the energy supply**
   a. actively promoting further international market integration:
      I. integration of trading platforms and expansion of interconnections
      II. enabling TSOs to optimise the collaboration needed for this
   b. expanding market for flexible power on an (inter)national scale
      I. making the flexible power accessible to the large-volume consumers (demand and supply)
      II. removing barriers (technical, financial, regulatory)
   c. monitoring:
      I. forecasts based on reliable (international) market information
      II. scenario studies into effects of a period of long-term windless, cold and foggy weather
      III. analysing the options available if the above measures prove insufficient to guarantee security of supply at all times.

2. **Improving the price signals, so that producers, consumers and prosumers are incentivised to optimum effect to modify their production/consumption behaviour and therefore to contribute to the stability of the electricity system**
   a. introducing flexible pricing of the supply of electricity (e.g. quarter-hourly or hourly pricing) in the low-volume user market (allocation to the smart meter)
   b. greater variety in connection capacity with capacity tariffs that reflect the actual costs more than now ('basic connection' and 'plus packages')
   c. investigating whether more than one provider on one connection is possible and can make an effective and efficient contribution to improving the price signal.

3. **New framework for grid reinforcement**
   a. developing a framework (technical/substantive, financial) that guarantees transparency, makes the assessment of reinforcement or purchase of flexible services possible (and therefore makes options comparable) and indicates in what way and by whom a decision will be made on this assessment
   b. amending the legislation and regulations, so that this assessment may be made at all.

4. **Extending a market for flexibility services into the medium and low voltage grids**
   a. creating a flexibility market in the medium and low voltage grids where parties (local producers/prosumers/consumers) can supply and receive flexibility (supply and demand) and be rewarded for it
   b. making it technically and administratively possible for parties to supply and receive flexibility, such as regulating decentralised production units up and down, demand response and/or storage
   c. continuing to expand and assuring the role of parties with programme responsibility: new contract forms, more flexibility agreements with customers, more control on wind farms, better forecasting, making better use of the flexibility of renewable and conventional power, making greater use of the possibilities

offered by new technology (storage, power-to-x), integrating the heat supply of the built environment, etc

d. giving new players a position: service providers who pool demand/supply of groups of users/producers (aggregators); service providers who offer flexible options; storage managers, etc.

**5. Giving space to and promoting alternatives for the heat supply in the built environment**

a. local assessment using local SCBA (social cost benefit analysis) (choosing optimum solution and timing according to the situation locally):
   I. hybrid heat pumps in less well insulated homes, combined with (sustainable) sources for peak heating
   II. full-electric heat pumps in optimally insulated buildings
   III. renovating local gas network if other options for sustainable low voltage heat supply are not possible
   IV. heat network if availability of sufficient (sustainably generated) residual heat is guaranteed to continue or other (sustainable) heat sources are available (geothermal energy, waste water purification, etc)

b. creating level playing field: removing differences in tax treatment and in charging structure of gas and electricity

c. adopting an integrated approach: including consequences for all grids (gas, heat and electricity) in SCBA

d. in the near future starting with preparation of SCBA for those areas where major investments in grids or built environment are to be expected and/or residual heat is coming available

**6. Generic measures**

a. continuing to promote energy use reduction: more efficient use, better insulation, etc

b. integrated approach to the energy system: optimisation across the entire energy system (electricity, gas, heat) offers significantly more flexibility than optimisation across one system

c. continuing to develop and implementing data storage and exchange.[1]

[1] *The availability of up-to-date and reliable data and a good data infrastructure is an absolute precondition for all problem-solving approaches. In a separate process, initiated by the Round Table, a survey is currently under way into what the data storage and data exchange that can further support these developments will have to look like. The results of this process are expected at the end of this year.*

## Customer freedom of choice

In the end it will always be the customer itself that chooses the degree of flexibility it wishes to purchase and is able to provide. It is the customer who chooses variable or fixed prices on the low-volume user market, the capacity of the connection and the way in which the potential flexibility of its solar PV (coupling/uncoupling), heat pump, home storage, electric car, etc, can be used in the flexibility market. If the customer's freedom of choice is restricted in collective systems (for example, heat networks), good checks and balances will have to be built in.

## Tax regime

The current energy system and the way in which it has been set up and operates are largely influenced by the choices made in the past with regard to the way in which the government set up the tax regime. The Round Table notes that as a result of the new developments these choices are increasingly leading to imperfections and perverse incentives. One of the most conspicuous of these is the difference in the tax treatment of gas and electricity. Changing it may increase the opportunities to bring about significant changes in heat supply in particular, for instance because (hybrid) heat pumps will be an advantageous alternative for many more users. And if these heat systems are introduced in large numbers, this will also have major consequences for the electricity system: not only will there be greater demand, there will also be more opportunities for flexibility.

The Round Table considers the way in which the tax treatment of energy carriers can be standardised, and the pros and cons thereof, to be so complex that it is currently unable to make any pronouncements about it. It will not therefore be formulating any proposals for changing the tax regime at this stage, but does urge that work be done soon on removing those elements of the tax regime that have an inhibiting effect on the energy transition.

## Consequences of these solutions

### No changes in existing allocation of roles and responsibilities

If these problem-solving approaches are followed, the existing allocation of roles and responsibilities for gas and electricity will be maintained. Since 2004 we have had a fully liberalised electricity and gas market, with a clear allocation of roles between independent transmission system operators and production and supply companies. This fundamental allocation of roles is not open to debate: the regional and the national transmission system operators remain the independent facilitator of the market, with the special position of the system operator (TSO). The parties with programme responsibility retain the important role in matching demand and supply. They will continue innovating on the basis of the market incentives to find the optimum mix of flexibility for this. New players, such as aggregators and other service providers, will acquire a clearly defined role and responsibility in the system.

To make the sustainable heat potentially available in a particular neighbourhood, district or region accessible to optimum effect, the way in which the costs of gas and gas networks and heat and heat networks are allocated, the grid tariffs are determined and the grids are managed and operated must be made comparable with each other.

### Durable system with scope and opportunities for innovation in abundance

If these problem-solving approaches are followed, the current system will evolve into a durable energy system that does not prompt a fundamental change of course with each new development and each unexpectedly successful new technology. On the contrary, there will be plenty of scope for innovation and the advent of new players, both in technology and in service provision.

## Facilitating the transition to a sustainable energy supply

The Round Table sees its own aim as facilitating the process of making the energy system sustainable, independently of the question of how fast the energy transition comes about. The Round Table takes the view that the energy system, if it is changed as proposed in this report, can fully accommodate the transition to a sustainable energy supply. If the social debate leads to the conclusion that this transition must be continued at a different rate, the energy system must be able to cope with this if it is changed in accordance with the proposals in this report.

## Sense of urgency

The problem-solving approaches proposed by the Round Table require a great deal of development and implementation time. The Round Table will if so desired invite new players to contribute towards giving shape and substance to this development. It is a good idea to start with this in the near future if we are to guarantee that the energy system will continue to operate stably after 2023. Where possible the Round Table will attend to the development itself. Where we first have to wait for political decision-making, all possible preparations will be made to attend to the development swiftly following this political decision-making. If, as a result of European or other international developments, politics takes decisions that have an impact on the reliability of the energy supply, the Round Table will be available to facilitate this adequately. The Round Table will contribute proactively to the desired problem-solving approaches and the decisions to be taken in creating a new energy policy for the period 2023-2030.
This will of course, just like the preparation of this summer report, take place in close consultation and in open dialogue with the relevant stakeholders.


NETVERZWARING
CONGESTIEMANAGEMENT
ONDUIDELIJKHEID
OVER
subsidies
STABIELE
OFF

Chapter 1

# Background and terms of reference

**A properly functioning energy system is of great social importance. The energy sector is not just one of the many sectors where products and services of particular importance are provided. Access to energy for citizen and business is therefore one of the first conditions for existence in our society. With the technological revolution we are going through the dependence on energy will only grow. In our society we must be able to assume that we can have the energy that we need.**
**In the 100 years that lie behind us we have set up an energy system that has very high reliability. The times when the gas and the heat do not flow or no electricity comes out of the socket are rare. The concerted action of transmission system operators, producers, traders and suppliers ensures a high availability of affordable energy. We want to keep it that way!**

## Sustainable, reliable and affordable

However much changes in the world of energy, one thing remains constant: citizens, institutions and businesses want access to a safe, reliable and affordable energy supply to meet their needs 365 days per year, 24 hours per day. That was important, is important and from the social perspective will simply become more important.

The growth of sustainable production has major consequences for the way in which the reliability of the energy supply can be guaranteed. Maintaining the balance (constantly matching supply and demand at any time of the day) and guaranteeing the security of supply, even when there is no wind and the sun hardly shines, if at all, for days on end, requires systems that can cope with this volatile production and a socially supported climate in which investments in the development of these systems can come about.

## Energy Supply Round Table

The Energy Agreement for Sustainable Growth brought together a large number of parties and outlined a route to 2023. The desire to continue this dialogue was expressed at a meeting about Netbeheer Nederland's Sustainable Energy Supply Action Plan in November 2013.

This was the prelude to the formation of the Energy Supply Round Table, for which Netbeheer Nederland and Energie-Nederland took the initiative in the spring of 2014. Apart from these initiators, representatives of VEMW, Gasunie, Stichting Natuur en Milieu, Duurzame Energie Koepel and ODE-Decentraal joined the Round Table. The Ministry of Economic Affairs is an observer.

### Open dialogue

In the Round Table there is open discussion of the developments having an impact on the operation of the energy system: what are the consequences of these developments, where will the stability of the energy supply be at risk if we do nothing and what are the potential problem-solving approaches that will enable us to keep guaranteeing this stability. The consequences of these problem-solving approaches were analysed: socially, financially, economically and technically. Many dozens of people from the organisations' own employees and representatives of other organisations, including knowledge institutes, were involved in different meetings.

**Frameworks and preconditions**

From the outset the Round Table applied clear frameworks within which the survey should take place:

- the Energy Agreement and the objectives and measures contained therein are not open to debate, any more than the EU energy targets for 2030 and 2050 (all but energy-neutral)
- the transition to a sustainable energy supply must therefore also be facilitated after 2023
- the financial consequences for all parties, citizens, government and businesses must remain acceptable to guarantee social acceptance.

### Focus: solar, wind, electric transport and heat in the built environment

The Round Table focused on the following question: what will the developments that are already visible mean for the reliability and affordability of the energy system and what changes are needed in the system to make these developments possible, without affecting the stability and affordability of the energy supply?

It began by looking at the consequences of the development of solar and wind energy production, the growth of electric transport and the transition of the demand for heat in the built environment. This also means that the Round Table did not at this point consider the developments, the possibilities and the dilemmas that come into play among the large-volume users of energy, the developments in the transport sector and high temperature heat. These subjects will be considered at a later stage, depending on the way in which the Round Table pursues the dialogue.

## Picture of the future

### Integrated system

In broad terms the picture of the future that the Round Table employed in the discussions is a world in which gas, electricity and heat/cold systems are more integrated. More than has previously been the case there is a choice between different energy carriers to meet the need for light, heat/cold and power. The energy system, currently with separate worlds of electricity, heat/cold and gas, has become more one system. New techniques, such as storage, electric transport, power-to-gas and techniques as yet unknown will have found their way into the energy system.

### Many more (international) parties will be contributing to the stability of the system

On the production side many more parties will be active than now, very small and very large, from local to international. Production will make far greater use of renewable

sources, with greater volatility in supply as a result. Production will take place in many more places: solar energy on roofs and in fields, biomass power stations, CHP plants and offshore wind farms. There will also still be a place for conventional, centralised production for a long time to come with, increasingly, a single European market. The market will therefore be larger and more international and consist of many more parties than is currently the case.

### Advent of sustainable alternatives for heat supply

The choice for meeting the demand for heat will fall far more than now on an alternative to natural gas. The demand for heat in the built environment will continue to fall, the demand for cold will grow. In well insulated buildings the demand for heat can be met in an alternative way. Where electric heat pumps are chosen, the result will - especially in the case of limited insulation - be an increase in the demand for electricity, unless the peak demand is met by (green) gas.
In the urban environment, especially in existing (high-rise) buildings, sustainable heat networks may start or continue to play an important role. Alternative problem-solving approaches will have to prove themselves financially and otherwise.

### Greater user influence

Much will change on the user side too. Users are going to have a more active role in the entire energy system. Because, for example, they will be electricity or biogas producers themselves or, on a cooperative basis or otherwise, largely self-sufficient. On the one hand users may cause greater imbalance in the grid through the advent of solar PV, electric transport, etc. On the other these same users may start contributing far more to the stability of the grid, for example by adjusting their use or actually producing extra when it is needed. Sometimes users will do this as individuals, sometimes their contribution will be pooled by a new player in the market, the so-called aggregator. Existing and new market players will start developing and providing services that relieve the user.

**Making developments possible**

What this world will look like precisely is impossible to say and for the Round Table not all that relevant either. The main question after all is: what has to happen to make the developments that we are now seeing heading our way possible and in so doing keep guaranteeing the reliability and affordability of the system. The rate at which these developments will affect the system is of course relevant. Reference is made to this in various places in this report, for example by referring to the need to start thinking about changes or to keep a very close eye on the developments.


DECENTRALER
DUURZAMER
MEER DATA
BELASTING TOEWIJZEN
KOSTEN
BATEN
volgende keer:
TIJDLIJN
1960
2014
WAT IS ER VERANDERD
TRENDS & ONTWIKKELINGEN
WAAR GAAT HET NAAR TOE
DUURZAAMHEID
Systeem-knop
ENERGIE
45
1990
liberalisering
Kyoto-protocol
WENDE

Chapter 2

# Solar, wind, electric transport and heat in the built environment

**The Round Table has identified a number of developments that may have a major impact on the reliability and affordability of the electricity supply, that is the growth of solar and wind energy, the growth of electric transport and the transition of the demand for heat. The main consequences of these developments are described in this chapter.**

## Sharp growth in the sustainable production of electricity and heat

In addition to bioenergy, solar and wind energy will experience sharp growth in the coming years, variable weather-dependent electricity production constituting an ever larger share of the demand (Figure 1). In the case of the demand for heat in the built environment there will be less use of natural gas and the associated gas infrastructure, with a shift towards electric and hybrid heat pumps and heat networks (Figure 2). In many cases (green) gas will continue to play an important role for the peak demand for heat.

**Figure 1:**
**Transition in the electricity supply (capacity)**
*Development of solar and wind energy capacity against the peak and off-peak demand for electricity*

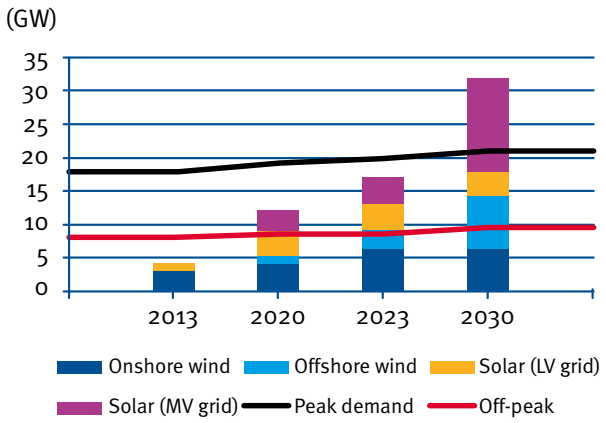
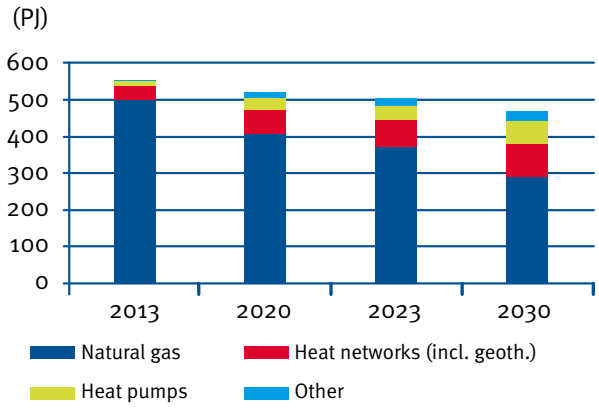



**Figure 2:**
**Transition in the heat supply (volume)**
*Development of Low Temperature Heat Consumption by source*




*(see Appendix 1 for a detailed representation of the bandwidths and an explanation of the figures used)*

**Not a forecast**
The figures above (and the explanations of them in Appendix 1) are in no way intended to be a forecast, but simply give the bandwidth within which the developments, in the eyes of the experts consulted, could pan out.
The figures relating to heat are surrounded by much greater uncertainty because the developments there depend very much on the question whether, and if so which, policy decisions are taken, e.g. with regard to the tax treatment of natural gas and electricity.

## Solar PV: local congestion and mains voltage

### Peak load

The existing grid is designed for a peak load in demand that can occur at certain times of the year. If there is an abundance of solar PV in some places in the grid, on sunny days, if demand is low, the peak supply (feed-in peak) may be greater than the capacity for which the grid is calculated. Congestion will then occur in the low voltage grid, which may lead to problems with the quality of the electricity supply or even power failure in a particular district. Problems can also occur with regard to the voltage quality if an abundance of electricity generated by solar PV is fed into the public electricity network.

### Still plenty of space, but problems locally

The existing grid is expected still to be able to accommodate a great deal of solar PV. That does not mean that problems cannot occur in the capillaries of the electricity network if the supply of solar PV is higher than the amount for which the local grid is designed. These problems are already manifesting themselves in certain places in the Netherlands.[2] The local transmission system operator currently has almost no other option than to reinforce the grid locally. The costs of this grid reinforcement are 'socialised' (divided amongst all customers). In the absence of the right incentives potential alternatives to grid reinforcement are currently not getting off the ground or insufficiently so.

When there is a high degree of penetration locally (as a result of strong growth) of solar energy, electric heat pumps or electric transport, problems will initially occur in the MV/LV transformers. As the degree of penetration continues to rise, the capacity in the MV grid will soon become limiting. In the case of solar energy the required voltage space on the transformer can be a limitation, but in many cases this can still be overcome within the current rules by increasing the voltage space. If these options have been used, according to the current rules all that remains is further reinforcement.

*[2] At the instigation of the Round Table, transmission system operator staff are currently working on an up-to-date and detailed review of the places in the LV grid where problems occur and the nature of those problems. This review is also intended to provide insight into the consequences of the different developments.*

## Solar and wind: maintaining balance between demand and supply

### Security of supply

As solar and in particular (large-scale) wind energy start accounting for a larger share of total electricity production, security of supply will become an issue requiring attention: how can we keep having sufficient power at our disposal to meet user demand 365 days per year, 24 hours per day, even if it is windless and overcast for days at a time? There must be incentives for those periods for switching on flexible production capacity and/or reducing or disconnecting electricity use.

### Handling sudden fluctuations

A further issue is the way in which unpredictable, (very) short lasting fluctuations in the supply can be handled. As the large, centralised production units (conventional or biomass), which can switch on or off very quickly, start accounting for a relatively smaller share of production as a whole, their contribution to the handling of brief fluctuations in demand and supply will also reduce. Although this will probably not be a factor until after 2023, other and additional solutions will increasingly have to be available to tackle this problem. They lie in making both the supply and the demand sides more flexible and are discussed in more detail in chapters 4 to 7.

## Electric transport: more opportunities than problems

By around 2025 there are expected to be in the region of 200,000 - 250,000 electric vehicles in use in the Netherlands. This growth in electric transport will lead to strong growth in the demand for electricity and a different pattern of consumption and may therefore result in bottlenecks in the local electricity network, especially in the absence of good incentives for drivers to spread charging across all the hours of the day. Electric transport does however mainly offer opportunities to contribute to solving local congestion, for example if it is possible to concentrate the charging time at times when there is an abundance of electricity available (for example, at times when it is sunny) or to spread it more across the day. If it becomes possible to use the batteries in the cars for maintaining the balance (for example, for the day/night rhythm) or for frequency support, electric transport may make a contribution to maintaining the stability of the energy supply.

## Heat supply in the built environment

### Major gain in $CO_2$ reduction possible

Nearly 40% of total energy use in the Netherlands consists of heat. The greatest part of the demand for heat is low temperature heat (or cold) between 20 and 60 degrees. Currently this heat requirement is met almost entirely by natural gas. The highly intricate natural gas network is designed for high peak demand in periods of cold and is therefore well able to cope with the demand for energy.

Although natural gas is still available in great abundance on a global scale, there are, apart from the international developments and the problems associated with gas extraction in Groningen, good reasons to reduce the importance of natural gas in the low temperature heat supply. Because of the relatively large share of heat in total energy use, the gain in $CO_2$ reduction will be very great if on the one hand the total

demand for heat is further reduced (insulation, more efficient use) and on the other natural gas is replaced as a fossil source by other more sustainable energy sources.

### Room for alternatives

The existing system contains all kinds of barriers to making a good choice. The obligation to connect that applies to existing natural gas networks for example is one of the obstacles to choosing an alternative when renovating the natural gas network. Another is the different tax treatment of electricity and natural gas, which is currently one of the reasons why hybrid heat pumps are not yet an alternative for the user from the financial viewpoint.

If there is greater scope to make an assessment for the heat system, other choices will start being made, choices that from the sustainability perspective may be socially more desirable than the existing dominance of the individual high efficiency boiler.

### Fundamental choices necessary with major impact on electricity system

A number of fundamental choices and decisions are needed to get the change in the heat supply going (see chapter 8 for details). These choices will determine the rate at which natural gas is replaced by other, more sustainable alternatives, such as electrification and the use of hybrid energy systems in the heat supply, either in combination with thermal storage or not. The same applies to the development and growth of collective heat systems. All this will have an impact on both the gas and electricity networks.

## The four key challenges

The developments described above present all the parties involved in the energy supply with the following four challenges.

1. to ensure that there is sufficient energy (gas and electricity) available to meet (peak) demand even in long periods of no wind and cold and foggy weather
2. to ensure that there is sufficient flexibility in the system to absorb sudden fluctuations in supply
3. to ensure that the electricity system can accommodate the further growth of decentralised generation, electric transport and heat pumps efficiently and effectively
4. to ensure that making the demand for heat in the built environment sustainable is promoted

To meet these challenges the Round Table has formulated a number of problem-solving approaches in chapters 4 to 8. In order to do this the Round Table began by formulating a number of basic principles that a sustainable, durable, reliable and affordable energy system should meet. These basic principles are described in chapter 3 below.

Chapter 3

# Basic principles

**We cannot predict the future. The (technological) developments are diverse and unpredictable and have so many interconnections that any attempt to produce a 'design' for the new system runs the risk of foundering in complexity and in its turn generating new, unintended perverse effects. The Round Table therefore advocates creating space for technological breakthroughs, without saying in advance which technology that should be. The mechanisms must be set up so that all the creativity in the system is cranked up and the barriers that are currently delaying or discouraging desired developments are removed. Within this space the freedom for the market parties will be at an optimum and all the options for potential technological developments will remain open.**

## Comprehensive assessment

These basic principles are described below. Each of them has its limits and can sometimes have contradictory effects. A comparison of these basic principles is always a necessity therefore. It will not be possible to apply any of the basic principles absolutely and generically. A solution that is highly conceivable from the 'more market' perspective may after all one-sidedly lead to one party footing the bill. Equally, a solution may be highly desirable from a technical or financial perspective, but then constitutes a barrier for the further development of sustainability. It is therefore a good idea to look for those options that as far as possible fulfil the basic principles and have as few negative consequences as possible.

## 1. More market and improving the options

The space provided will allow more market forces and greater scope for citizens and businesses to guide the huge diversity in the choices that people make. More choices can be made and to facilitate this the consequences of those choices (what are the costs and benefits) will be made more transparent. Freedom of choice for the participants is the basic principle in this case. The limit is where the choice of one individual or a particular group has major (financial) implications for many others.

This also means easier accessibility so that the potential available amongst all the users of the energy system to contribute to the system can be accessed. Access to the system must in principle be guaranteed, with a level playing field having to be created for (emerging) parties. The same applies to citizens' initiatives, which do not often have access to extensive professional support.

## 2. Acting more on the basis of the beneficiary pays principle

An important condition for broader market forces is that costs and benefits are better attributed to the beneficiary and that the user can influence the costs of and income from the use of the system more effectively. Transparency in the true costs of the entire system and throughout the chain is a condition for this.

No more than in the case of any of the other basic principles will the beneficiary pays principle be usable in all cases and in all circumstances. If the user has no opportunities to influence the costs (e.g. a connection in a rural area; in the case of heat supply through the heat network), the application of the beneficiary pays principle will lead to unacceptable consequences. The extent to which the beneficiary pays principle can be applied will therefore always have to be assessed.

## 3. Greater sustainability

The space will have to be delineated and defined so that the transition to a sustainable energy supply is effectively and efficiently facilitated and promoted. Effective incentives must be built in to promote the transition to more sustainable energy production, more efficient use of existing energy sources and further reduction of energy use.

In time sustainably produced energy must be able to compete on the market with fossil source-based production. This implies that costs of the $CO_2$ emissions of fossil production have been incorporated into the pricing.
As long as this is not the case, or insufficiently so, other measures will continue having to be taken to make the price of sustainably produced energy competitive on the market.

## 4. Acceptable balance between social benefits and costs

Seen across the entire chain and across all the energy carriers the energy supply must function as efficiently as possible. At the same time the financial consequences must be acceptable for all parties. If particular problem-solving approaches for example lead to wide fluctuations in the purchasing power of particular groups of citizens or constitute a threat to the competitive position of the industry, these measures must either be reconsidered or compensation options must be sought to neutralise these adverse effects. The same applies to the controllability of government finance.

One party must not be one-sidedly faced with meeting the costs involved in the energy transition. This is a matter of both the social effects (division of the costs and benefits across various social groups) and the economic effects (consequences for the competitive position of the industry).

## 5. Continuing to promote energy conservation and more efficient use

Sufficient incentives must be built in to accelerate further energy conservation and the more efficient use of energy. There is still a huge gain to be made in both areas and for the time being both remain necessary because the situation in which sustainably generated energy is available in abundance is only expected in the longer term (after 2030). The system must operate and be set up so that far-reaching savings on the use of (fossil) energy is rewarded.

## 6. Optimum exchange of energy carriers

It may be attractive, certainly for large-volume users, to have more opportunities to choose between different energy carriers. This may become an important aspect for low-volume users too. The main thing they want after all is the most efficient possible provision of their heat/cold, light, power/mobility need. Whichever energy source it comes from is of secondary importance to the end user.

The customer optimises across several variables at the same time. It is important to leave this choice to the customer as far as possible so that the maximum economic value can be obtained from the energy system. This means that the price of each component must as far as possible reflect the true financial and energy value (at that time), otherwise the optimisation by the customer does not contribute to the optimisation of the system. This is where the great challenge lies. Price incentives can be conducive to this.

This also means exercising restraint in influencing the behaviour of a customer from just one point of view. Giving incentives - other than the true value - may lead to a less than optimum outcome elsewhere in the system.

## 7. One European market

The transition to sustainable is taking place in tandem with far-reaching harmonisation of the European energy market. This harmonisation will make a significant contribution to keeping the energy supply affordable through better utilisation of the electricity production facilities (conventional and sustainable) and an optimum exchange of flexibility throughout the system. The latter will become increasingly valuable, mainly as a result of the increase in volatile production. It is also the case that any change within or to the Dutch energy system must be in line with the international frameworks. That does not mean that if some potential solutions come up against the limits of the European regulatory framework, joint, active attempts cannot be made to adjust these frameworks in the desired directions. At the same time certain problem-solving approaches, as set out below, are already the subject of intensive discussion in Brussels. Linking up with this and jointly exerting influence on it is therefore extremely important.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# Problem-solving approaches

The analysis in chapter 2 ends with the four key challenges:

1. to ensure that there is sufficient energy (gas and electricity) available to meet (peak) demand even in long periods of no wind and cold and foggy weather
2. to ensure that there is sufficient flexibility in the system to absorb sudden fluctuations in supply
3. to ensure that the electricity system can accommodate the further growth of decentralised generation, electric transport and heat pumps efficiently and effectively
4. to ensure that making the demand for heat in the built environment sustainable is promoted.

The Round Table sets out the problem-solving approaches for these issues that are in line with the basic principles formulated in chapter 3 below. First of all consideration is given to the problem-solving approaches that focus on the first challenges indicated: optimising the international market, improving the price signals, reinforcing the grids and developing a market for flexibility services in the medium and low voltage grids. They are followed by the problem-solving approaches focusing on making the heat supply sustainable.

The Round Table would like to stress that in seeking the right way to deal with the different challenges, the way in which the problem-solving approaches affect each other must always be part of the discussion. This is precisely where there is significant added value for the approach that the Round Table advocates.

*The current tax system plays a major role in all the problem-solving approaches. The existing tax regime in many cases determines the scope within which a solution can be found. The Round Table takes the view that barriers in this regard should be removed and that at the same time it must be remembered that energy tax is currently a stable source of income for the government. This will in many cases therefore also require adjustments to the tax regime. This will have to have a prominent place in the process when we come to the details.*


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Chapter 4

# Market solutions to guarantee energy supply stability

**With regard to electricity production, the analysis in chapter 2 shows that the share of wind and solar energy is growing all the time and that in around 2023 this sustainable variable and weather-dependent production could be sufficient to meet the demand for electricity for part of the year.**
**But even for the long periods of cold, foggy and windless weather there is a need for sufficient certain capacity to be available so that the maximum demand can be met. There must also be sufficient flexibility available for the unexpected, rapid fluctuations in the supply of sustainably generated energy. This capacity and flexibility can be provided from both the supply side and the demand side.**

## Growing urgency

For the time being the conventional capacity installed in north western Europe in 2015, whether it has been 'mothballed' or not, seems to be sufficient to meet the maximum demand in the periods in which insufficient weather-dependent electricity is produced. This would seem still to be the case up to 2023. The technical availability of sufficient installed capacity does not therefore seem to be a pressing issue.

### Uncertainty about extent of production surplus

With the promotion of renewable energy, in other countries as well as our own, the total installed production capacity in the market is growing and on an annual basis the electricity production by conventional power stations is falling. As a result the necessary investments and operating costs, such as maintenance and staff for these power stations, are not recovered, so it is not unlikely that capacity will be removed from the market earlier than currently expected for commercial reasons. This uncertain situation also means that market parties are hesitant about investing in production.

Certainty with regard to the stability of the energy supply may therefore become a pressing issue sooner than is currently assumed. In addition to sufficient certain capacity, a significant part of the flexibility currently needed to continually match demand and supply with each other would therefore also disappear.

## Promoting further (international) market integration is a no-regret measure

By and large there are two views regarding the provision of sufficient certain capacity for the security of supply. One is that the market (by improving the current model of the Energy Only Market) will arrive at good solutions by itself. The other is that these solutions will not come about by themselves or will come too late and a market must be organised in which certain capacity is explicitly priced (capacity market).

The scope for an autonomous, Dutch approach is limited. The electricity wholesale market has rapidly become a Western European market. The developments in that market determine the scope for solutions. On a European scale, in an EU context, the debate about the approach to this issue is however by no means concluded, so a great deal of scope for influencing remains possible.

### Expanding trading platforms and interconnections

In this context the Round Table in any event advocates putting everything into optimising and enlarging the (international) electricity market. This is a precondition for tackling the above challenges effectively and above all efficiently. The Round Table recommends actively continuing to promote further international market integration, integrating the trading platforms and expanding the interconnections.

### Optimising collaboration among system operators (TSOs)

It is important in this regard that the TSOs are put in a position to continue optimising the collaboration needed for this. Any barriers to this must be removed.

## Continuing to expand market for flexible power on a national and an international scale

Currently there is still sufficient flexibility in the system, in part because of the conventional capacity still available and because of what is still a low share of wind and solar in the Netherlands. The market value of flexibility is therefore low, so new applications are often not yet profitable. They are however expected to be needed for the future.

**New dynamic**

With the increase in volatile production a new dynamic is emerging in the existing (international) market for flexible power. The providers in this market are those capable of supplying the flexibility. They may be existing or new providers: CHP plants operated by market gardeners or large-volume users, providers of (yet to be developed) storage, providers with production technology at their disposal that allows them to add or shed load very fast, aggregators that make the pooled storage available from electric transport, owners of hybrid heat pumps, etc. Users are the parties with programme responsibility that in this way can balance demand and supply in their portfolio and minimise their imbalance costs.

### Making flexible power accessible[3]

To increase the freedom of movement in the (international) energy market, the Round Table advocates continuing to work on making flexible power accessible (demand and supply). The flexibility can be delivered by flexible (conventional and sustainable) production capacity, by hybrid systems, by demand-side management by the (large-volume) users and by the use of storage (e.g. batteries) or other technology, such as power-to-gas, power-to-heat, power-to-products, etc.

[3] *Making flexible power accessible has much in common with making the flexibility in the medium and low voltage grids accessible (see chapter 7).*

The large-volume users potentially have many options available for increasing the flexibility in the market, both with regard to demand (demand-side management) and supply (available capacity).

### Removing barriers

As things stand at present, the current system and the current situation are making it difficult to make this flexibility accessible. Where tariffs or taxes are creating an unlevel playing field or preventing the emergence of business cases for flexibility, they must be changed.

If this flexibility is opened up on a large scale, both in this country and in the countries around us, a market will emerge that is capable of guaranteeing the necessary short-term stability. It will also provide scope in abundance for innovations, both technological and in the area of service provision.

### Availability of flexibility in the event of brief, unexpected fluctuations

The result of the growth of volatile production in the electricity market is that the system operator, in this case Tennet, has a greater need to cope adequately with brief, unexpected fluctuations. Tennet is experiencing this as an ever greater challenge. If the above measures are taken, the market can in theory deliver the flexibility necessary for these brief fluctuations, provided that the good price signals are ignored. A relationship must then also be established with the development of a flexibility market in the regional medium and low voltage grids (see below).

**Top sector policy component**

Many large-volume users (and low-volume users when using hybrid energy systems) could in theory switch between different energy carriers for their energy need. In the case of certain electricity prices it can after all at a certain point be attractive to use electricity for the high temperature demand for heat for example and/or other products (power-to-heat, power-to-products, power-to-gas). Consequently, there is a floor price in the electricity market, that is where it is attractive for businesses to use electricity as an energy carrier.
If this flexibility could be used to optimum effect, significant possibilities arise: in the event of a surplus supply of sustainably generated electricity, it will be consumed by industry; in the event of supply being too low, they can feed into the grid (gas-to-power).
Currently the business case is often inconclusive, in part because of the existing tariff and tax rules. At the same time there are still many technical barriers to be removed.
But because this option is so promising, a great deal of attention is devoted to it in the context of the top sector policy.

## Monitoring and adequate forecasts

Since a stable energy supply is essential for our economy, whether the above proposals are sufficient to guarantee the stability of the energy supply must be monitored closely. It is after all conceivable that either the market fails to develop sufficiently or that in

times of extreme weather conditions (long-term cold throughout north western Europe, combined with windless and foggy weather) it nonetheless falls short.

The scenarios that have been developed in the context of the Energy Top Sector seem to suggest that the production capacity available in the market - provided that the flexibility available can also be made accessible - will certainly be sufficient up to 2030; other studies though appear to suggest the opposite.

### Basing forecasts on reliable (international) market information

It is therefore important that security of supply (capacity adequacy) is monitored very closely, account also being taken of the situation in the countries around us, the contribution of the interconnectors, the production that has been put on hold ('mothballed'), the effectiveness of demand management, the use of hybrid energy systems in the large-volume user and low-volume user markets and the economic developments in the market. In that context it is important to be able to guarantee that the forecasts are based on reliable (international) market information with a time horizon of approx. five years. The implementation of additional measures after all soon requires such a period.

### Bad weather scenario studies

At the same time research into 'bad weather' scenarios remains necessary, so that it is possible to say early whether and if so what additional measures must be taken.

### Research into other options

If it becomes apparent from monitoring the developments or from the scenario studies that all the measures mentioned above appear to be insufficient to be able to guarantee the security of supply at all times, alternative options must be available. Analysing these options and researching their pros and cons must therefore continue to be sure that, should they be necessary, these additional measures can be deployed early.

Chapter 5

# Improving the price signals

**An essential element of optimising the entire energy system is improving the price mechanism, so that producers, consumers and prosumers are incentivised to optimum effect to adjust their production and consumption. To bring this about the Round Table proposes changing the rules so that:**

1. **flexible pricing of the supply of electricity (quarter-hourly or hourly pricing) can be introduced in the low-volume user market (allocation to the smart meter)**
2. **a variety of connection capacity can be offered**
3. **it becomes possible to allow more than one provider on one connection.**

## Introduction of flexible pricing of the supply of electricity (allocation to the smart meter)

The use of low-volume users is currently estimated on the basis of so-called profiles; actual use does not become known and is not charged until the annual statement. As a result the behaviour of the end users is currently not or hardly affected by the current power price on the market.

The rollout of the smart meter makes it possible to reveal the current, actual use and it therefore also becomes possible to agree a flexible tariff with customers who opt for it. Providers can start making different offers to meet the different wishes of the customer: some customers will opt for the current situation ('fixed tariffs'), others will go for flexible tariffs and adjust their behaviour to them. Providers can start giving effective price signals to promote certain behaviour.

**Preventing unwanted social consequences**
The introduction of 'time-of-use' pricing in the low-volume user market will have to be accompanied by offering users a choice of using flexible prices - with the risk of great fluctuations - or stable prices, to be able to guarantee certainty for themselves.
Providers will therefore make different offers to meet the different wishes of the customer.

By working with hourly or even quarter-hourly pricing users have the chance to respond more immediately to fluctuations in the price of electricity and gas and they can therefore exert more influence over the costs of their energy use. Furthermore, the users from SMEs, hospitals, shops, etc, will initially take advantage of it. The extent to which this will also be of interest to the private low-volume user will have to become apparent in the market.

Allocation to the smart meter will therefore make some flexibility accessible in the low-volume user market: these users too can be rewarded if they adapt their use to the current situation in the market and in this way contribute to the stability of the entire system.

## Greater variety in connection capacity

To make things as easy as possible for users and to apply the beneficiary pays principle better, more connection categories can be introduced so that the connection capacity (and the associated tariff) is more in line with the actual capacity requirement of particular customers. In this way users can also be incentivised as far as possible to reduce their maximum peak in consumption (production) during the year. Retaining a guaranteed 'basic package', the costs of which are 'socialised' just as they are at present, is not a matter for debate. But in addition to this it is conceivable for example to start working with 'plus packages', in various forms and compositions, where the costs reflect the actual costs more closely.

It remains true in this regard that the connection capacity for which a system user pays is always available, but that a user refrains from using it, in return for a payment, during a period to be agreed, as part of the provision of flexible services.

## Research into more than one provider on one connection

A third option for making the price mechanism operate more effectively could consist of making it possible for two or more providers on one connection. There will then be several EAN codes behind one connection, each with a party with programme responsibility. It must of course then be entirely clear which consumption can be attributed to which provider (party with programme responsibility). This offers the market the opportunity to provide specific products or services for solar PV or the charging of electric cars, for example, or to trade with each other in locally produced electricity. This also makes it possible for cooperatives to generate renewable energy in a building that is not theirs. An issue in this regard is assuring the programme responsibility and therefore the system integrity (balance maintenance).

**Changing capacity requirement can lead to congestion**

Changing capacity requirement can lead to congestion
Until recently the use ('the load') of the networks was determined by the behaviour of the customers. This was easy to forecast.

In domestic households for example the peaks in the morning are before people go to work and in the evening when people come home. As a result of the sharp growth in electrification (because of electric transport and heat pumps, for example) and as a result of the ever increasing feed-in of self-generated power, you can no longer say that the patterns of use of the network are roughly the same for all households, in particular because these developments are not the same for every house.
Some users require greater grid capacity and/or need greater capacity at a different time from before. But this does not apply to everyone.

Because of this changing use of the networks, the costs of maintenance and management may rise. If users only need a larger connection for consumption, those costs necessary for it are currently divided 'fairly' in line with the beneficiary pays principle (a 3 x 35 A connection is far more expensive than a 3 x 25 A connection).

However, because everyone is expected to be generating electricity at the same time with their solar panels or charging their electric cars simultaneously, heavier duty networks are needed to prevent congestion in the district itself. These additional necessary costs are currently divided among all customers, including those who have no solar panels or electric cars at all or do not even live in the district. On the other hand, the owners of solar panels or electric cars do not receive any incentives to prevent this concurrency.


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Chapter 6

# Reinforcement or purchasing flexibility

**The growth of solar PV, the growth of the share of heat pumps and the further growth of electric transport may in time lead to new challenges for the transmission system operator. Under the current regime these new peaks and other forms of overloading can only be tackled with grid reinforcement. The costs of this are spread among all users (socialised). As grid reinforcement takes up a great deal of time and entails high costs, from a social perspective the question of the extent to which alternatives are available using innovative solutions by which this development can be handled faster and more efficiently is a justifiable one.**

## Social urgency growing

The transmission system operator's primary responsibility is to ensure adequate distribution of electricity and gas. For this they manage grids. They take steps to prevent the different components in the grid becoming overloaded. In some places in the Netherlands problems are already occurring in the low-voltage grid as a result of the growth of solar PV, electric transport or the advent of heat pumps; this is expected to increase in the coming years.

The existing grids are based on a low simultaneity factor in the demand for transmission capacity; this changes sharply through the growth of solar PV, heat pumps and electric transport. The problems that solar PV causes are different in nature from those of electric heat pumps. In the case of solar PV the day cycle in particular comes into play; the large-scale use of electric heat pumps can lead to a high and simultaneous peak demand, in particular in periods of severe cold.

## Dilemma: reinforcement or smart solutions or a combination of the two?

The sharp growth in electrification and the higher simultaneity mean that there may be more congestion in the regional electricity networks in the future. The challenge is to maintain the current grid reliability level at the lowest possible social cost.

The current system is based on an infrastructure that makes things easy for users and the market, where users may assume 100% availability. The transmission system operators provide all users with 'non-discriminatory' access to the infrastructure, so that users have maximum access to the energy market and have the scope to conclude the best possible contracts for them. To achieve this the transmission system operator has a responsibility to invest in the infrastructure to prevent congestion. Requirements have been laid down in law that are designed to guarantee the independence of the transmission system operator. The infrastructure is regarded as a utility function.

**Grid reinforcement remains the first option, but is sometimes far more expensive or not always possible (in the short term)**

The expected bottlenecks will, in the future too, be tackled with different forms of grid reinforcement measures. It is the responsibility of the transmission system operator to invest in infrastructure and to prevent congestion. The question however is whether, from the social perspective, reinforcement will always be the solution to be chosen in the new world, where there will more often be high peaks at some moments in time.

In some cases, where a high peak only occurs at a limited number of times and the social cost of reinforcement is demonstrably higher than other alternatives, congestion management may incidentally be more advantageous, in both the short and the long term, than actually investing in grid reinforcement measures.
In those cases the transmission system operator must be allowed to resolve the expected overload by purchasing flexibility services (see chapter 7 below).

Congestion management by a transmission system operator means that the transmission system operator resolves expected congestion by purchasing flexibility services, provided from among others the adjustment up and down of decentralised production units, demand response and/or storage or through the use of hybrid energy systems. The social assessment underlying this is the one between the costs of purchasing flexibility services by the transmission system operator or the costs of grid investments.

The costs of congestion management are costs that, just like ordinary grid expansions, must be recovered by the transmission system operator through the regulated transmission tariffs. The financial scope for the flexibility services is in principle limited by the costs of grid reinforcement.

It also seems that the bottlenecks are going to increase so fast and so massively in number and extent that there may not be the available capacity of engineers to tackle them in the short term using grid reinforcement.

## Assessment framework for transparent decision-making

The Round Table expects that the greater use of the price mechanism will certainly contribute to the prevention of this congestion, but this will probably not always prove sufficient. In those cases the transmission system operator must therefore have access to additional tools to guarantee the stability of the energy supply. In the first place this consists of the purchase of flexibility services, provided from among others the adjustment up and down of decentralised production units, demand response and/or storage.

When making the choice between when grid reinforcement is necessary and when the use of flexibility or a mixture thereof offers an attractive alternative, the transmission system operator plays an important role on the basis of its responsibility. The main responsibility resting on the transmission system operator is therefore to provide all those concerned with insight into the problem and the possible solutions.

The Round Table takes the view that a framework (technical/substantive, financial) must be developed for this that guarantees transparency (and therefore makes options comparable). Who must be involved in these decisions, to which body account must be rendered and how that must happen must be worked out in that assessment framework. It is therefore also important that a clear and accepted method is developed for comparing the costs of different options with each other. A condition for this is that the additional costs of the use of the grid must be made far more transparent than is currently the case and that this happens in a clear, transparent way.

### Modifying transmission system operator regulation

If we are to make the above assessment at all, the existing transmission system operator regulation regime requires modification. This is because the current one places the focus on socialising all the costs arising from reinforcing/expanding grids and gives no incentives to invest in the purchase of flexible services.

Chapter 7

# Expanding the market for flexibility to the MV and LV grids

**The development of a market in which parties such as local producers, prosumers, private consumers and small business consumers can supply and receive flexibility (supply and demand) and are rewarded for this is an important extension of the current set of rules that the Round Table advocates.**

**If such a market continues to develop, it will prove to be an important tool for maintaining the stability of the energy supply, not only because the transmission system operator can use this market to purchase flexible services, but above all because of the behaviour that the players in this market can display.**

## Ample scope of its own for the Netherlands

There is great scope for seeking solutions in the Netherlands, but it is constrained by the existing regulatory framework. If a market can develop in the Netherlands in which the smarter use of the networks of the entire energy system (electricity, gas and heat) can be chosen as a solution in addition to reinforcement, this can expand into a promising, innovative market. It is for good reason that this also counts as one of the main aims in top sector policy: it has the potential to be a huge impulse for all kinds of innovations, both in the technical field and in the area of service provision.

Making it technically and administratively possible for parties to supply and receive flexibility, such as regulating decentralised production units up and down, hybrid systems, demand response and/or storage, is therefore one of the specific courses of action that the Round Table recommends taking up as soon as possible.

The connection with the proposals in the chapters above is evident: without better price incentives throughout the system the further development of a flexibility market in the medium and low-voltage grids is hard to imagine.

**Customer's freedom of choice**
It will always have to be the case that in the end the customer itself chooses what degree of flexibility it wishes to provide. It is the customer who chooses variable or fixed commodity tariffs, the type of connection and the way in which the flexibility of its solar panels (switching off or not), electric transport, home storage, heat pump, etc, is used. Customers conclude contracts for this with their providers (with programme responsibility) or with another service provider, such as an aggregator.

## Players in the flexible market

If, following an assessment of the different options (see chapter 6) it is decided that congestion management is an option for preventing grid overload, the transmission system operator resolves the expected congestion by purchasing flexibility services. This can for instance consist of the adjustment up and down of decentralised production units, hybrid systems, demand response and/or storage from the market. The transmission system operator can for example submit a tender for this or purchase standard products.

Other parties on the 'demand side' of this market include the parties with programme responsibility and the system operator (Tennet). Parties acting for or on behalf of individual users (aggregators), control technology providers or other service providers can build up a business model in this flexible market.

The providers in this market can be very many parties which, depending on demand, can actually start producing or supplying a little more or consuming a little less. It may be consumers and probably above all the small business consumers who adjust their use, either collectively or through aggregators, and are therefore rewarded for it. They may be parties that have stored energy, in whatever form, and that can feed in at a time that the price makes it attractive. All these providers provide their flexible services in competition with each other.

Aggregators are one of the new parties that may develop in the flexible market. They are service providers who for example enter the market on behalf of a group of prosumers. Possible behaviour is as follows.
An aggregator provides services to the group of individual owners of solar PV plants. These services consist for example of optimising their own use, trading with each other and finally purchasing excess solar energy produced. This can then be offered by the aggregator to parties that only purchase electricity if it falls below a given price, for example industry (power-to-product).

In this way the aggregator's behaviour contributes to the stability of the system. Because aggregators, just like the party with programme responsibility, operate in the supply market ('kWhs'), network companies cannot fulfil the role of aggregator.

The introduction of an aggregator role in the market model raises the question of how this role relates to the role of the party with programme responsibility. Different scenarios can be imagined for this. To continue the way in which system stability is regulated in the Netherlands between the parties with programme responsibility and the system operator (Tennet), it is important that whichever model is chosen it is clearly laid down under which programme responsibility the aggregator's actions fall or that the aggregator itself must also be a party with programme responsibility.

If the transition of the heat supply develops in a way that the Round Table advocates (see chapter 8), the (full-electric and hybrid) heat systems and heat storage systems will also be an important factor in this market. Finally, links will undoubtedly also be made with the development of flexible power, as described in chapter 4.

## Options for the transmission system operator

In this model the transmission system operator has certainty that the flexibility will be delivered because the risk is explicitly placed with the flexible provider (e.g. the aggregator). If it fails to deliver to the transmission system operator as per agreement, it risks a contractual penalty. As a result there is greater certainty that a solution will actually be delivered.

In this way the transmission system operator will be able to access/contract precisely the amount of flexibility it needs and will do so with those network users who voluntarily wish to adopt a flexible attitude at the lowest cost. These network users then receive a payment for this from the aggregator. In this model the principle of a certain available network with which we are currently familiar therefore remains intact, because a consumer/prosumer/producer is prepared to change its behaviour on a voluntary basis for the benefit of the stability of the network. This model of flexibility services also leads to the most effective solution at the lowest possible social cost.

## Alternative to current form of netting

The development of such a market is also necessary to give the prosumers the opportunity to offer the solar energy that they do not use themselves to, for example, an aggregator.

The netting scheme has proven to be a effective stimulus for solar energy among final consumers, but is increasingly leading to a disproportionate increase in costs for other users as a result of necessary grid reinforcement and other system costs.
If the price mechanism acquires greater influence as a result of the Round Table's proposals, the solar PV owner will be encouraged actually to start using the electricity it has generated itself (momentary use) more than is currently the case. It can then offer any surpluses, at a favourable price, on the flexible market, where either an aggregator or another party will purchase it.

In the event of an unfavourable price, the solar PV owner will perhaps choose storage, conversion to heat or temporary disconnection, depending on what the optimum solution is and/or which technology is available. Service providers are expected to emerge and/or develop further that will take this concern off the hands of the individual solar PV owner.

In this way the flexibility market and the prosumer behaviour resulting from it will contribute to efficient maintenance of the stability of the grid.

## Assuring the role of party with programme responsibility

The parties with programme responsibility ensure that demand and supply are constantly in balance in the current system. As they have more energy in their portfolio that is generated with sustainable (volatile) production capacity, they will therefore have greater need for alternatives for those times when the sustainable producer is unable to supply. This can also be supplied through the flexible market, for example

by conventional electricity production, from storage, by concluding contracts with customers in which some of the demand is disconnected (demand management) or by enabling the user to switch to other energy carriers (e.g. gas at times of peak demand for heat).

The formal role of the party with programme responsibility in the system does not therefore change with the advent of a market for flexible services in the medium and low voltage grids, but it does have to contend with (far) greater dynamism, greater flexibility, other players and other techniques. It will therefore have to show itself to be innovative: introducing new contract forms, making different flexible agreements with customers, using better forecasts, controlling more on wind farms, making different use of flexibility with conventional power, etc.

Since the programme responsibility for every connection to the network must be placed with a recognised party, there is a market party for all demand and supply that has a financial interest in assessing and valuing volatility and maintaining sufficient flexibility to incorporate it.

## Finally

The Round Table takes the view that the above measures, certainly if they are applied in combination with each other, will most probably be sufficient to cope with the potential overloading of the network as a result of the development of volatile production and the electrification of the demand for heat and transport. Society however rightly sets high standards of the stability of the energy supply. And, just as with guaranteeing sufficient capacity and flexibility (see chapter 4), it is also a good idea here to monitor closely whether all these measures do indeed provide the security that may be expected.

The transmission system operator must have access to tools that can, if all other options fail, be used to guarantee the stability of the energy supply. In that context the possibilities of time-dependent capacity tariffs will also be researched further. The flexibility market must of course first be given time to develop before the use of time-dependent capacity tariffs can be considered.

Chapter 8

# Making the heat supply sustainable in the built environment

**The way in which the demand for heat in the built environment is met will have to change in the coming years, especially as a major gain in CO2 emission reduction can be achieved here. Since its discovery in Groningen natural gas has been the dominant energy carrier for meeting the need for heat of the built environment. In many places alternatives such as heat networks and heat pumps could in principle also meet the need for heat. The same applies to existing and new technology: solar energy for the demand for heat, geothermal energy, bioenergy, infrared heating and heat storage systems. The challenge is to offer greater scope to these sustainable alternatives to natural gas.**

## Urgent need for more options

In numerous places transmission system operator and (local) authorities are facing the choice of how they can meet the need of the built environment for heat and cold. New build projects are increasingly turning away from installing a local gas infrastructure; when renovating existing gas networks the question is regularly asked: should we be continuing to invest in renovating the local gas networks (gas supply to the door) or should we be offering a local alternative (electricity, mixed or heat network). In many cases however this choice cannot yet be made, because (national) legislation and regulations stipulate that the local gas infrastructure must be renovated. Therefore the choice is fixed for the next 30 to 40 years.

Dutch heat supply policy can largely be implemented autonomously, as long as it is in line with European regulations. There is great social desirability for more options for the heat supply in the built environment, not only because of the international situation and the problems with regard to natural gas extraction in Groningen, but also and above all because of the gain in CO2 emission reduction that can be achieved here.

## Local consideration (SCBA): choosing the optimum solution according to the situation

The Round Table takes the view that to meet the CO2 and renewable energy targets, apart from energy conservation, the future heat supply in the built environment will increasingly have to come from renewable sources. What they will be depends on the local situation. In general terms the following can be said about this.

In existing build heat pumps (heat from the air, largely based on electricity), supplemented at peak times by natural gas, sustainable gas or thermal storage, are often a good option. If an additional source (natural gas, sustainable gas, thermal

storage) is available for peak demand (period of extreme cold), this solution may be the best in many cases from the social cost perspective. The consequences for the expansion of the (regional and national) electricity networks will then be manageable.

In metropolitan areas, and where a great deal of sustainable residual heat, bioheat and/or geothermal heat is and remains available, (open) heat networks will be able to play a greater role. In the old inner cities and in other places where no other sustainable alternative is available for commercial reasons, natural gas and/or sustainable gas, sometimes individually, sometimes in a form of collective heating, may remain the principal source.

A recent report by CE ('Towards a climate-neutral built environment 2050') from June 2015 produced a breakdown for 15 typical neighbourhoods, such as historical inner cities, reconstruction areas and village centres, of the overall costs of production, distribution, consumption and conservation of heat, to arrive at a built environment in which eventually no further CO2 emissions occur. In so doing consideration was given to energy conservation in combination with facilities with green gas, collective heat supply, all electric and solid biomass. The research shows that the cheapest option for heating buildings differs from one type of neighbourhood to another. A mixed picture emerges: there are neighbourhoods where natural gas is gradually being replaced by green gas in combination with energy conservation and high efficiency gas applications (gas heat pump, hybrid heat pump/high efficiency boiler). In many high to moderate density neighbourhoods heat supply from different sources will replace the current supply of natural gas. In the lightly built areas electric heat pumps will be a logical successor to natural gas heating. Nothing will happen overnight and there will be many intermediate steps, but a final picture for each neighbourhood will help the decision-makers in the field of infrastructure and renovation of buildings to take decisions that prevent lock-ins.

A local SCBA (social cost-benefit analysis) would therefore have to underlie the choice of heat supply. The ultimate responsibility for this choice would have to rest with a public body, such as the municipal council.

Given the urgency (in many places in the Netherlands a decision will have to be taken in the near future about whether or not to renovate the existing gas infrastructure), the Round Table recommends starting as soon as possible with the preparation of an SCBA in those areas where major investments in networks or built environment are to be expected and/or residual heat is becoming available. In this way experience is gained over time of preparing an SCBA and questions such as 'who is the client, who carries out, who decides, who tests, etc' are considered and answered as we go along.

### Incorporating consequences for electricity network

If the large-scale use of heat pumps is chosen following this overall assessment, this will have consequences for the electricity networks locally, especially if full-electric heat

pumps are chosen. The choice of full-electric or hybrid heat pumps therefore forms part of the assessment in the local SCBA.

## Creating a level playing field

This local assessment will only be possible if there is a level playing field between the various energy carriers so that a good comparison of different alternatives is possible. In this way we can guarantee that the heat potential available in a given situation (from neighbourhood to regional level) can always be made accessible.

To create this level playing field the way in which the costs of gas and gas networks and heat and heat networks are allocated, the network tariffs are determined and the networks are managed and operated must be made comparable with each other. Removing the differences in tax treatment between the different energy carriers is one aspect of creating a level playing field.

### Consequences

Depending on the local situation, the choice will fall on an optimum solution from the social perspective on the basis of an SCBA. In those cases the freedom of choice for an individual user may therefore become more limited.

# What next

**Over the past year the Round Table has found that the open atmosphere in which the top of the energy sector has discussed the developments and associated dilemmas with each other in the Round Table and in the many sub-fora has contributed greatly to improving mutual understanding. The Round Table is keen that this should continue. But whether this means that the Round Table continues in its present form, composition and way of working is yet to be decided.**

As a follow-up to this report the Round Table in any event proposes the following:

1. development and ultimate implementation of the problem-solving approaches
2. monitoring of implementation of data storage and exchange research
3. starting discussion of new topics
4. coordination with other fora (Denktank, EnergieDialoog Nederland Bergingscommissie, etc)

## Development and ultimate implementation of the problem-solving approaches

The Round Table is going to survey where, by which organisations and in what way work is currently already being done on (one of) the problem-solving approaches formulated. At European level for example there is frequent consultation about broadening the flexibility market, certain themes from this report have already been the subject of research in a Top Consortium for Knowledge and Innovation (TKI) context and the development of the heat issue is taking place in various places.

On the basis of this survey the Round Table will see whether the topic is therefore covered sufficiently and what could yet be a responsibility of the Round Table with regard to that specific problem-solving approach. This can range from monitoring the development to actively placing an order to develop a given problem-solving approach further. The Round Table will also ask for certain topics that lend themselves to it to be assessed.

In any event steps must be taken to ensure that the integral nature of the development and the way in which different problem-solving approaches affect each other is assured. There is also a need for new technological and social developments to be recognised early and for the consequences of this for the different problem-solving approaches to be discussed. There is a further need for a regular review of the assumptions used in the report, for example about the bandwidth within which the developments are taking place or about the present situation in the market.

The implementation of the problem-solving approaches is a long-term process. Liaising and coordinating, in whatever form, remains desirable to respond to new developments early.

## Data storage and exchange

In February the Round Table commissioned a study to provide a common picture of the current situation regarding data in the energy sector. The quantity of data, the exchange of the data and data storage throughout the sector are increasing exponentially. It is clear that all the problem-solving approaches in this report are only possible if the IT infrastructure, with all it entails, is in good order. The initial report resulting from this study suggests that improvements are needed in certain areas. This is why the relevant developments, needs and wishes are currently being analysed with committed experts from inside and outside the sector. A number of options will be developed on the basis of this analysis, which in their turn will be developed into a future picture for the (open) data in the energy sector.
All parties are involved in the research, the development of the options and the choice of the future picture. The final report of this study is expected to be available in December.

## Starting discussion of new topics

At this stage the Round Table has focused on the developments of solar and wind energy, electric transport and the development of the demand for heat in the built environment. Topics such as the reduction of the energy use of large-volume users and the developments in high temperature heat and in mobility have either not been covered or only indirectly. In a follow-up process explicit attention will be given to the developments that are important for industry, such as making the demand for heat sustainable, the development of a revenue model for flexibility services and expanding the opportunities for sustainable gas in the energy system.

## Coordination with other fora

The Round Table notes that meetings are organised in many places and by many organisations, sometimes incidental in nature, sometimes on a more permanent basis. The future of the energy supply is debated and considered in many places in the Netherlands. The Round Table participants need to apply greater consistency to it and therefore to reduce the number of meetings.

At the same time a need appears to be emerging for one central point where solicited and unsolicited advice can be given about everything associated with the energy transition and where, just as is the case with the Round Table, reasoning and reflection is based on a complete picture. This body could also itself initiate research, start pilots, etc.

Over the coming months an assessment will be made of the extent to which the Round Table (or a successor to it) can fulfil such a role and if so what the consequences for it are with regard to the way of working and the composition of the Round Table.

# Appendices

"ZORGEN"

- ER ZIJN AL VEEL gremia
- HOE KOM JE TOT doen!
- ZOEKEN WE EEN OPTIMAAL SYSTEEM OF EEN TOTAAL NIEUW SYSTEEM

LANDJEPIK

heilige HUISJES

RESPECT & VERTROUWEN

CEN TRA AL of DE CEN TRAAL

HET KAN NOG STEEDS VERSUS HET KAN NIET

ENERGIE SYSTEEM

RSONEN

SSEN

GEBRUIKERS

LENTEN

INCIES

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## Appendix 1

# Bandwidth of the developments

The following figures have been assembled from different sources (SER Agreement, Trend Reports, CE Scenarios and interviews with experts). They are emphatically not forecasts or targets to be pursued. The figures simply indicate a bandwidth within which the developments could take place, based on the knowledge and understandings in the first half of 2015.

### Electric Transport

| | 2015 | 2020 | 2025 |
|---|---|---|---|
| **Vehicle fleet** | 9,6 million | 9,6 million | 9,6 million |
| **Electric number** | 40.000 | 200.000 | 1 million |
| **Electric share** | 0,40% | 2% | 10% |

*Source: http://www.rvo.nl/onderwerpen/duurzaam-ondernemen/energie-en-milieu-innovaties/elektrisch-rijden*

More recent estimates of the growth of electric transport are based on lower growth.

# Estimate of Bandwidth of Developments

| | | 2013 | 2020 | | | 2023 | | | 2030 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | min | **exp.** | max | min | **exp.** | max | min | **exp.** | max |
| The development of the final energy use | PJ | 2185 | 2100 | **2150** | 2200 | 2164 | **2179** | 2194 | 2150 | **2175** | 2200 |
| The development of the final demand for electricity | PJ | 424 | 425 | **428** | 431 | 427 | **431** | 435 | 432 | **491** | 550 |
| **Solar PV annual production** | PJ | 2 | 13 | **19** | 26 | 13 | **23** | 32 | 16 | **57** | 97 |
| % of the final demand for electricity | % | 0,5% | 3,0% | **4,5%** | 6,0% | 3,0% | **5,3%** | 7,5% | 3,7% | **11,5%** | 17,5% |
| installed capacity | GW | 1,0 | 4,0 | **6,0** | 8,0 | 4,0 | **7,0** | 10,0 | 5,0 | **18,0** | 30,0 |
| **Wind annual production** | PJ | 20 | 44 | **47** | 50 | 50 | **70** | 91 | 81 | **115** | 188 |
| % of the final demand for electricity | % | 5% | 10% | **11%** | 12% | 12% | **16%** | 21% | 19% | **12%** | 34% |
| installed capacity onshore | GW | 3,0 | 4,0 | **4,0** | 5,0 | 5,0 | **6,0** | 7,0 | 5,0 | **6,0** | 7,0 |
| installed capacity offshore | GW | 0,0 | 1,0 | **1,0** | 2,0 | 2,0 | **3,0** | 5,0 | 5,0 | **8,0** | 15,0 |
| Solar and wind together | | 5,5% | 13,0% | **15,5%** | 18,0% | 15,0% | **21,3%** | 28,5% | 22,7% | **23,5%** | 51,5% |
| **LT heat**<br>**The development of the demand for LT heat** | PJ | 550 | 459 | **515** | 571 | 421 | **500** | 579 | 330 | **465** | 600 |
| relative demand for heat | % | 100% | 90% | **94%** | 98% | 85% | **91%** | 97% | 75% | **85%** | 95% |
| relative share of natural gas supply | % | 90% | 67% | **79%** | 82% | 58% | **74%** | 78% | 35% | **62%** | 70% |
| relative share of heat networks incl. geothermal heat | % | 7% | 10% | **12%** | 14% | 12% | **15%** | 18% | 15% | **20%** | 25% |
| relative share of heat pumps | % | 2% | 3% | **6%** | 9% | 4% | **8%** | 13% | 5% | **13%** | 20% |
| relative share of other | % | 1% | 1% | **3%** | 4% | 1% | **3%** | 6% | 1% | **6%** | 10% |

**Notes to the figures:**

- in the case of the development of solar PV it is important to have local data available because problems and bottlenecks first come to light at this level
- in the case of solar PV it is important to have insight into the workable hours and into the hours when solar PV is not available
- concrete figures about the development of the demand for heat are scarce; the advent of new technology (e.g. infrared panels) is still very uncertain, but may have great influence on the developments in the demand for heat
- the rate at which the existing buildings continue to be insulated will to a high degree determine the development of the demand for heat
- the rate at which sources other than natural gas are used for the demand for heat in the built environment will depend on fundamental choices that are made with regard to the use of natural gas

## Appendix 2

# Some examples of perverse characteristics of the present tax system

It is noted in different places in the report that the current tax system contains perverse incentives. Some striking examples are set out below.

- assuming a standard energy unit (e.g. Gigajoule) a household pays €5.43 converted in energy tax in the case of natural gas and €33.22 in the case of electricity. In relation to the emissions per tonne of CO2 the tax in the case of natural gas is €96 and electricity €245[4]

- a household is compensated for the tax on electricity (currently: €318). This does not happen for natural gas

- the (high) energy tax rate on electricity becomes 60% lower above 10,000 kWh; 90% lower above 50,000 kWh. Such an exemption does not apply for natural gas

- electric heat pumps are increasingly a sustainable alternative for heating using natural gas. However, because the energy tax is mainly levied on electricity use, the costs of starting to use heat pumps are relatively higher. The user reduces the primary energy use, but pays more tax

- the business case for power-to-heat or power-to-product (if large-volume users want to use electricity as an alternative energy source) is not at this point, in part because of the energy tax, established

- the energy tax is such a large proportion of the customer's bill that the price has insufficient effect as an incentive for electricity to influence the user's behaviour

- to avoid adversely affecting the international competitive position of large-volume users, they pay far less energy tax than the low-volume users. The large-volume users that face no international competition (government institutions, hospitals, large office complexes, universities, large retail companies, etc) also benefit from this

[4] *Energy tax shift: exploring effects, CE-Delft, June 2015*

## Appendix 3

# Some examples of perverse incentives in the present regulatory framework

- allocation on the basis of standard profiles instead of actual use provides insufficient insight into the actual use of electricity

- users with many solar panels benefit from netting; users who are unable to own or install panels themselves are however faced with the costs for the network that the installation of solar panels causes (‘the homeless pay for the energy transition’)

- from the legal perspective transmission system operator must always go for grid reinforcement in the event of problems

- existing legislation and regulations stipulate renovation of the existing local gas network, even if more sustainable alternatives are available. Therefore the choice is fixed for 30 to 40 years.

- in the case of investments in new large-scale production for example, sustainable and conventional, the costs the transmission system operator must incur to connect these fields are not part of the investment decision

- tariff agreements are one of the reasons why the business case for power-to-gas/power-to-heat/power-to-x is difficult to make balanced because a larger connection with a higher tariff is necessary, even if that maximum capacity is only wanted a few days a year

- netting (solar PV feed-in payment) impedes the advent of other flexibility options. Home storage (in batteries or in heat) is already economic for many prosumers in Germany, for example, but not in the Netherlands because feed-in is more attractive.

## Appendix 4

# Participating organisations

Participants in the different sub-fora came among others from the following organisations:

Alliander
APX

Berenschot

CE
Cogas
Cofely GDF SUEZ

Duurzame Energie Koepel
Delta
Delta-Netwerkgroep
DNV GL
Duurzame Energie Unie

ECN
Ecofys
EDSN
ennatuurlijk
Endinet
Energie-Nederland
Enexis
Eneco
E.ON Benelux
E.ON Gas Storage
Essent

Gasunie Transport Services
GasTerra
Gasunie
GDF SUEZ
Greenchoice
Groenpand

Hanzehogeschool Groningen
Holland Solar

Mijnwater

Natuur en Milieu
Nederland ICT
Nederland Krijgt Nieuwe Energie
Netbeheer Nederland
Nuon
Nuts Groep

ODE-Decentraal

Qurrent

RENDO

Siemens
Stadsverwarming Purmerend
Stedin

TenneT
Thermo Bello
TNO
TU/e
Topsector Energie

VEDEK

VEMW

Westland Infra


ENJOY 12


ZORGEN
KOSTEN
BATEN
KOSTEN
ENERGIE
INDUSTRIE
MAAK alle KOSTEN ZICHTBAAR
DUS OOK NET-AANPASSINGEN
OLD BOYS