Chapter 20
Energy and Plastics: The Slow Transition

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Abstract This chapter, exploring fossil subsoil resources, focuses on two domains: energy and plastics. The energy section analyses the difficult transition to renewable energy sources. The focus here is on electricity because promising renewable energy sources like biomass, windmills and solar panels contribute above all to the supply of electricity. There is, moreover, a close relationship among oil, natural gas and electricity.

Dutch electricity supply was long trapped in tensions among the policy of the provincial electricity suppliers, the energy policy of the national government (in particular the Ministry of Economic Affairs) and the environmental movement, with as main issues decentralised electricity generation, the inclusion of nuclear power, the role of domestic natural gas and energy-saving. Privatisation and liberalisation are setting the electricity sector completely on its head. There is now more room for other forms of electricity generation, in particular decentralised generation and heat-power coupling. Opportunities for renewable energy sources have increased,

This chapter is written by Harry Lintsen with contributions by Rick Hölsgens and Ben Gales.

H. Lintsen et al., *Well-being, Sustainability and Social Development*,
https://doi.org/10.1007/978-3-319-76696-6_20

among other things thanks to international agreements ('Paris') in connection with climate change.

The plastics sector too has undergone dramatic changes in this period. The *production* of bulk plastics and artificial fibres still takes place in the Netherlands, but hardly at all by *Dutch* firms. The plastics *processing* industry, that consists above all of small and medium-sized firms (up to 50 employees) has developed into the Netherlands' most innovative sector. The attitude toward plastics has become ambivalent. They have shaped a life of comfort, ease, luxury, sport, and games. At the same time they are a source of litter, waste, 'plastic soup' and micro plastics.

Keywords Energy · Oil · Gas · Coal · Electricity · Nuclear energy · Environment · Decentralised generation · Heat-power coupling · Wind · Solar cells · Plastics · Plastic soup · Microplastics

20.1 The Trial

On June 24th, 2016 the court of The Hague issued a remarkable ruling: 'The [Dutch] State has to ensure that in 2020 the emission [of greenhouse gases] in the Netherlands is at least 25% lower than in 1990.'[1] The ruling was world news. Foreign newspapers, radio stations and websites like the Guardian, El Pais, the BBC and ABC Australian Radio covered the story. The BBC noted that

> the judgement was unprecedented in Europe, and unexpected. It pushes the Dutch government to honour its commitment to cut emissions.[2]

A foundation called Urgenda, directed by Marjan Minnesma, and almost 900 private co-plaintiffs wanted to use a court decision to force the state to do more about the emission of greenhouse gases. But the question was whether a judge was competent to pass such a judgment. In a democracy, was it not parliament that was responsible for dealing with issues like this?

An essential characteristic of the rule of law – so argued the court – was that an independent judge could (and sometimes had to) judge the actions of political organs like the government on the point of legal protection. That, it considered, was the case here. The state was legally obligated to take measures against climate change. After all, in all probability climate change has serious and life-threatening consequences for people and the environment:

> … the Netherlands will be confronted with higher average temperatures, changing precipitation patterns and rising sea levels … [with] heat waves and extremes of precipitation …

[1] Rechtbank Den Haag, zaaknummer C/09/456689/HA ZA 13-1396, uitspraak 24-06-2015, *ECLI:NL:RBDHA:2015:7145*.

[2] 'Netherlands ordered to cut greenhouse gas emissions' in *BBC News*, 24 June 2015.

> dangerous situations on the lower reaches of the rivers … increasing salinity in the coastal zones and less available water for agriculture …[3]

In addition there are the global consequences of melting ice, desertification, a decline of biodiversity, threats to food production, and other big problems. In both national and international law, the precautionary principle then prevails: measures have to be taken, despite the fact that complete scientific certainty is lacking. The possible consequences are simply too serious. This has led to international treaties to combat climate change, signed, among others, by the Netherlands.

The court further pointed to the agreements made within the European Union. These have encumbered the state with the obligation to reduce greenhouse gas emissions in 2020 by 25–40% of 1990 levels. Present government policy will lead to at most a 20% reduction. According to the court this is unacceptable.

Meanwhile, the State has filed an appeal. Urgenda did not expect otherwise. Its strategy is ultimately to plead its case before the European Court. If Urgenda wins there, it will have consequences not only for the Netherlands, but also for the other member states. That could mean a breakthrough in the difficult energy transition. All the member states can then be compelled to take far-reaching measures.[4]

It is easy to see why Urgenda speaks of a difficult energy transition. At the moment, climate change is the most important argument for drastic cutbacks in the use of fossil fuels (coal, oil and gas). But controversy about the problems of fossil raw materials has been around for much longer. In the 1960s, air pollution, particularly due to coal combustion, was the main issue. The Club of Rome report in 1972 put the issue of depletion of fossil fuels squarely on the agenda. The oil crisis of 1973 fueled fears of foreign dependency, particularly on the Middle East. These issues continued to reappear in various guises and with shifting urgency in subsequent debates. The climate issue became dominant during the 1990s.

Suggestions for alternatives to fossil raw materials also go back a long way. Research into windmills, solar panels, biomass and other renewable energy sources goes back to the 1970s. But the harvest of a half-century of innovation, debate and policy seems rather meagre: around 4–5% of the total energy demand is supplied by ‘sustainable,’ ‘green,’ or ‘renewable’ energy. With respect to the implementation of renewable energy sources, the Netherlands is suspended somewhere near the bottom of the list of European Union member states.

Fossil energy sources have played an extremely important role in history. They contributed greatly to the fight against poverty. But since 1970 other issues are at stake and the Netherlands is searching for alternative ways to produce its energy. History reveals that radical changes often require a long gestation period. After that, things can nonetheless move quickly. Is the Netherlands now on the threshold of such a pivotal moment? It may also be possible that the process will grind to a halt and that the transition stagnates. This chapter will summarise the history of fossil and renewable sources of energy in the Netherlands over the past decades and make

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[3] Rechtbank Den Haag, zaaknummer C/09/456689/HA ZA 13-1396, uitspraak 24-06-2015, *ECLI:NL:RBDHA:2015:7145*.

[4] Cox, H. (2011), *Revolutie met recht.*(pp 288) Maastricht: Stichting Planet Prosperity Foundation.

an effort to characterise the present phase in the transition. We set off with an overview of the supply of and demand for fossil energy sources.

20.2 The Energy Balance and the Energy Mix

A large stock of fossil raw materials is available in the Netherlands. In terms of the unit of energy 'joule,' the amount is about 10,000 PJ (petajoule or 10^5 joule, 2011). Two raw materials dominate: oil and natural gas. Oil is mainly imported, though 83% of it is exported again, immediately or after refining. Seventy-five percent of the natural gas is domestically produced and more than half is exported. The actual domestic consumption of fossil fuels is therefore significantly lower. Of the available 10,000 PJ the Netherlands itself consumes roughly 2500 PJ. Not all fossil raw materials are destined for energy production. Fifteen percent is used to produce plastics and other chemical products. In discussions on sustainability these substances are a distinct topic. In this chapter, we shall deal with plastics in a separate section.

Energy production thus relies on a remaining 2100–2200 PJ. Part of the energy flow (about 30%) undergoes an important intermediate transformation before it reaches the end-user, namely the conversion of almost all the coal and part of the natural gas into electricity. Ultimately, the flow of energy (including the electricity) is delivered to four important categories of end-users. The industry is the biggest consumer of energy, followed by transport, services (and agriculture) and households (Graph 20.1). Within the industry, chemicals, metals and foods are the most important energy consumers. In transport, road traffic claims the biggest share.[5]

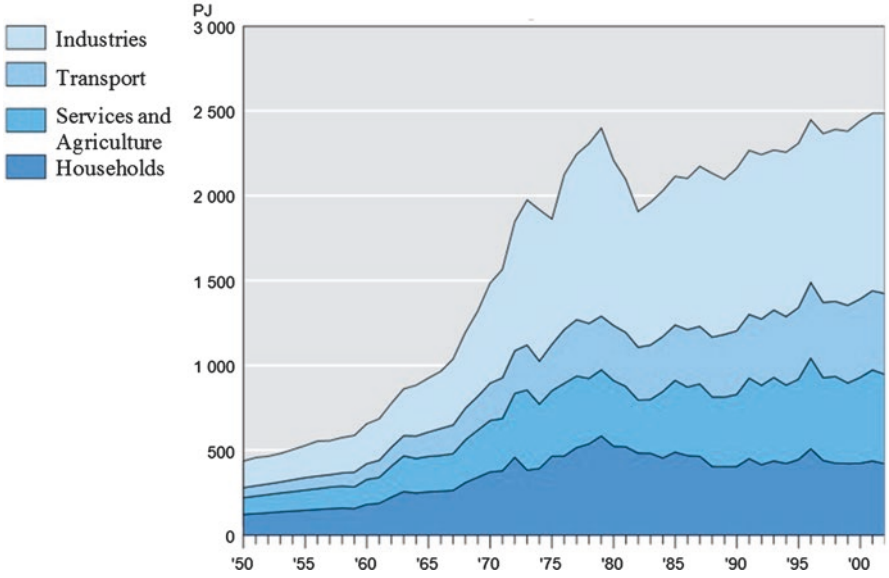
Since the 1970s, energy supply in the Netherlands has been composed of a mix of chiefly oil and natural gas. While coal has a smaller share, it has still not entirely disappeared (Graph 20.2). Over this period, the transformation of fossil fuels into electricity steadily increased. The flow of energy from oil is chiefly consumed in transportation, while natural gas, coal and electricity find their way mainly to households, industry and services.

Other raw materials and energy sources are only a small part of this story. Renewable energy sources (including biomass, water power and geothermal energy) appear as extremely thin lines in the graphs. They are clearly overshadowed by their big competitors. On the other hand, their share is growing steadily – if slowly. Let us look more closely at the dominant energy sources. We focus on electricity, because promising, renewable sources of energy like biomass, windmills and solar panels contribute above all to the electricity supply. Moreover, there is a close relationship between oil, natural gas and electricity.

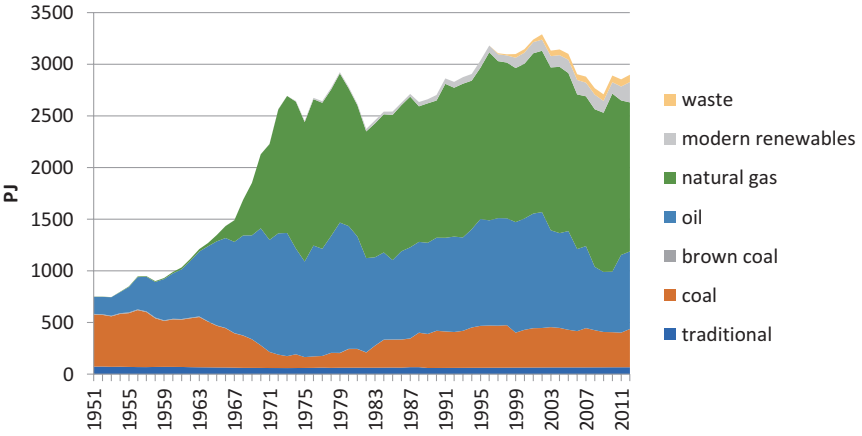
[5] An interactive overview of the energy balance and final consumption of the Netherlands 1975–2015 can be found at the website of the International Energy Agency (IEA):

Energy balance 1975–2015 at http://www.iea.org/Sankey/#?c=Netherlands&s=Balance

Energy final consumption 1975–2015 at http://www.iea.org/Sankey/#?c=Netherlands&s=Final%20consumption



Graph 20.1 Energy consumers, 1950–2002
Source: *Statistisch Jaarboek 2004, 295*



Graph 20.2 Energy consumption by sources of energy, 1951–2012
Source: B. Gales and H. Hölsgens, *Energy transitions in the Netherlands: Sustainability challenges in a historical and comparative perspective* (Groningen, 2016) 11 and appendix 1

20.3 Fossil

20.3.1 Oil

Around 1960 oil overtook coal in the Netherlands and 10 years later it became a dominant source of energy. Worldwide, five big American oil companies (Chevron, Exxon, Gulf Oil, Mobil and Texaco) and two European (Shell and BP) controlled oil production.[6] Shell was the largest in the Netherlands.

The 1973 oil crisis was a game changer. The oil companies surrendered a good deal of their control to the oil producing countries, partly organised in the Organisation of Petroleum Exporting Countries (OPEC). They were still privileged purchasers of raw OPEC oil, but that status too succumbed to the second oil crisis of 1979.

The price of oil had meanwhile risen sharply. Vacillating oil prices would thereafter exert a strong influence on energy policy and economic growth. In the 1990s Shell adroitly managed the new situation and became the world's most profitable company. But the company's position would weaken again around 2000 due to declining oil prices and the lack of takeovers. Growth in production stagnated. It appeared increasingly difficult and more expensive to develop new oil and gas fields. At the outset of the century, shale gas and shale oil occasioned a revolution in the energy supply.[7] They turned the world of oil, dominated by the OPEC cartel, on its head once again. Oil prices, that had meanwhile increased again, were once again under pressure and declined from 2014 on.

The Netherlands – even with such a powerful player as Shell – has no influence on the supply and the price of oil. And that holds to a great extent for the demand as well. Most of the oil is destined for motorised traffic. At the end of the 1950s and the beginning of the 1960s the demand for mobility increased explosively.[8] Initially it concerned mostly the increasing use of mopeds and only later the automobile. In the course of the 1970s, the government attempted to curb the explosion and saw an ally in the economic recession of the 1980s. But the number of passenger cars continued to increase exponentially, as did the number of kilometres driven per year and the average commuting time per week. Controversies about fuel for automobiles had no effect. Problems with the emission of carbon monoxide and other polluting gases were solved in the 1970s with the introduction of the catalyser. Threats to public health from lead in gasoline were eliminated by the development of lead-free gasoline in the 1980s.[9] Since the 1990s, fine dust from, among other sources, diesel

[6] See for the following: K. Sluyterman, 'Concurreren in turbulente markten 1973–2007' *in Geschiedenis van Koninklijke Shell, deel 3*, (Amsterdam, 2007: Boom) pp. 5–9; 93; 239.

[7] Shale gas and shale oil are mined from shale rock formations, consisting primarily of clay minerals.

[8] G. Mom, R. Filarski, *Van transport naar mobiliteit. De mobiliteitsexplosie [1895–2005],* (Zutphen, 2008: Walburg Pers), pp. 265, 374.

[9] H. Lintsen, T. Van Helvoort,. and R. Van Veen. *De kracht van de katalysator. De magie van het onderzoek*, (Eindhoven, 2014: Stichting Historie der Techniek) pp. 17–29.

engines, has become an issue. Such debates have little influence on the oil market. But the production of natural gas in the Netherlands is another matter.

20.3.2 Natural Gas

As little influence as the Dutch government had on the supply of oil, so strongly did it determine the supply and demand of natural gas. Intervention in sources of energy by the government was not new. It had decisively intervened in coal mining at the beginning of the twentieth century. Now it was the turn of the natural gas located in the subsoil of the province of Groningen. The concession for extracting natural gas in Groningen had been granted in the early 1960s to the Netherlands Oil Company (NAM) in which Shell and Esso (later Exxon) cooperated.[10] But the government retained a firm hold of developments in the field. The costs of production as well as the income were managed by the *Maatschap Groningen* in which the state participated for 40% via the State Mines (DSM). Initially 75% of the profits were claimed by the state. In the 1970s this would increase to 95%. The *Maatschap Groningen* sold the gas to the *Gasunie,* in which the government had a share of 50%, both directly and via DSM. As we saw, the *Gasunie* built an elaborate natural gas network. Households switched from coal, fuel oil and municipal gas to natural gas for heating and cooking. Low prices stimulated firms to use natural gas and to invest in energy-intensive production processes, for example the aluminium smelter at Delfzijl. Energy-intensive branches like the greenhouse garden-farming industry began to use gas instead of fuel oil. Electricity companies switched from coal to natural gas. In 1970, the Netherlands supplied 92% of the internationally traded gas in Europe.

The oil crisis was a watershed for natural gas as well. The Netherlands restricted production of natural gas and acquired new competitors on the European market in the form of the Soviet Union, Norway and Algeria. The government lowered the rate of extraction in the Groningen field and encouraged the exploitation of smaller gas fields. Government policy aimed on the one hand at a leading role for natural gas in the Dutch energy supply, and on the other hand at maximization of the proceeds from gas sales in the short and long term. This made the government dependent on the oil price, from which the gas price was derived.

The European discussion over increased leeway for market forces in the European gas market made it necessary to restructure the natural gas supply system. The consequence was that the *Gasunie* was split up in 2005. In its new embodiment, the *Gasunie* has become the owner of the gas network with the state as sole stockholder. Selling gas – the *Gasunie's* other activity – has now devolved to Gas Terra, in which Shell and Exxon each participate for 25% and the state for 50%. In this way an

[10] See chapter 15 and also: Sluyterman, *Concurreren in turbulente markten*, pp. 225–229; Correljé, A. C. van der Linde en Th. Westerwoudt, *Natural Gas in the Netherlands. From Cooperation to Competition?* (Amsterdam, 2003: Oranje-Nassau Groep).

independent gas transport network has come into being which every supplier can use to bring its gas to market. Gas Terra is only one of the suppliers and the gas comes not only from the Groningen field, but also from smaller fields and from foreign sources. The transformation meant further limits to governmental influence on the energy supply.

Of the original quantity of Groningen gas – amounting to about 2600 billion m^3 – less than 800 billion m^3 of retrievable gas remains in the subsoil (2013).[11] Production has vacillated over recent decades and for several years hovered around 50 billion m^3.[12] Since then, production has declined significantly. In 2017 the government decided to reduce gas extraction to about 22 billion m^3 (or 770 PJ). That was in part a response to the growing protest in Groningen against the increasing number of earthquakes in the gas fields and dissatisfaction about the way the earthquake damage was being compensated.

In several instances over the past decades, gas extraction in the Netherlands has become controversial. A long struggle ensued over plans to extend gas mining into the Waddenzee. Only after gas mining was combined with nature development, did the government see fit to condone the development in 2004.[13] At present, gas mining is the scene of an ongoing struggle between residential and environmental interests on the one hand and economic interests and those of energy policy on the other.

20.4 Electricity, Natural Gas and Coal[14]

The introduction of renewable energy sources seemed to have the greatest chance of success in the field of electricity supply, but it turned out to require a major effort to acquire a toehold in this sector.

Until the early 1970s the electricity sector had a relatively stable organisation. Provincial (and a few municipal) companies produced electricity. They worked together in the Cooperating Electricity Production Companies (SEP). Together they had complete control over the facilities and wished for as little governmental interference as possible. With the coming of natural gas, the sector became involved in the industrial and energy policy of the government. The transition in electricity production from coal to gas went reasonably smoothly. By the mid-1970s, 80% of the electricity would be generated with natural gas. Conflicts emerged above all around

[11] *Aardgas in Nederkand*. http://aardgas-in-nederland.nl/de-toekomst-van-aardgas/aardgasreserves-en-verbruik/ consulted 19 April 2017.

[12] NAM, *Bron van onze energie*. http://www.nam.nl/feiten-en-cijfers/gaswinning.html consulted 19 April 2017.

[13] J.J. De Jong, E.O. Weeda, E.O., Th. Westerwoudt, A.F. Correljé, *Dertig Jaar Nederlands Energiebeleid. Van bonzen, polders en markten naar Brussel zonder koolstof,* (Den Haag, 2005: Clingendael International Energy Programme), pp. 153–155.

[14] This section based on: G. Verbong and F. Geels. 'The ongoing energy transition: lessons from a socio-technical, multi-level analysis of the Dutch electricity system (1960–2004)'. *Energy Policy* 35 (2007) pp. 1025–1037.

the introduction of nuclear energy, a darling of the Ministry of Economic Affairs. The Ministry was convinced that the future belonged to nuclear energy. It was essential to build up a new industrial sector in the Netherlands around this new technology. In this context, the construction of a nuclear power plant in the Netherlands itself would be very welcome. But the SEP charted its own course. One of the associated companies bought such a power plant in Germany to be built in Borssele, in the province of Zeeland.

In this period, the electricity sector experienced next to no trouble from the emerging environmental movement. Resistance to nuclear power was still modest. Air pollution was a hornets' nest, but this was mitigated by technical measures and the declining use of coal. The sector was totally disinterested in small-scale experiments with sun and wind energy, let alone in the utopian dream of 'small is beautiful.'

Once again, the oil crisis of 1973 initiated fundamental shifts. A year later the first *Energy Memorandum* appeared. This circumscribed the autonomy of the electricity producing companies. The Ministry of Economic Affairs acquired a decisive voice in the construction of nuclear power plants and the use of fuels in conventional power plants. The wide-ranging memorandum was inspired by two basic principles: reliability of the supply and the cheapest possible energy for big industry. To be sure it also took note of the environmental problems of electricity generation and addressed the depletion of raw materials, but these were clearly subsidiary issues. Only marginal attention was paid to renewable energy sources.

The electricity supply companies were also faced with a new phenomenon: the deployment of gas turbines and consequently the growth of decentralised energy production. Big industry already generated its own local electricity in order to partly provide for its own needs. With the advent of natural gas it began to install gas turbines to handle peak loads and thanks to a new type of gas turbines, gas became dominant in decentralised energy production.[15] This also generated waste heat (that the firms recycled into their production processes) and hence so-called 'heat-power coupling' was born.

The second oil crisis of 1979 led to the second *Energy Memorandum*. Saving energy became a top priority in addition to reliability and cheap energy. In this respect, heat-power coupling offered excellent opportunities. Surplus heat could be employed in the neighbourhood of the industrial plant and surplus electricity (on the basis of power) could be returned to the electricity grid. The government decided to provide extra natural gas for decentralised electricity production. But the electricity companies were far from happy with the 'uncontrolled' delivery of electricity by big industry. They were ill-prepared and paid only a low rate. The government had to intervene in order to enable local producers to connect up with the electricity grid on realistic terms.

In this period the government also began to champion nuclear power. It was, however, faced with a broad protest movement. Nuclear power would go on to

[15] It should be noted that the electricity companies too installed gas turbines in order to accommodate peak loads. Gas turbines are easier to start up than conventional power plants.

dominate the debate on energy supply for years to come, in the process overshadowing other crucial issues like the scarcity of raw materials and the introduction of renewable energy sources. Resistance to nuclear power also contributed to a certain hesitancy within the environmental movement to address the climate issue. Fighting climate change would only strengthen the hand of the proponents of nuclear power, who framed this technology as the ultimate solution to global warming.[16]

The further diffusion of nuclear power was thwarted due to massive protests and the accident with the Chernobyl nuclear power plant in 1986. Expensive oil was, however, quickly replaced as fuel for power plants by cheaper coal. That in turn demanded extra measures to deal with the environmental effects.

The electricity-producing sector was hard pressed. During the recession of the 1980s, privatisation and efficiency were the key concepts; de-regulation and liberalisation those of the 1990s. The European Union supported the latter policy and was able to enforce it after the Treaty of Maastricht in 1992. The electricity sector tried to retain a grip on developments by advancing proposals for restructuring. But to no avail. The government was already working on a new Electricity Law. This came into force in 1989 and after modifications was superseded by the Electricity Law of 1998.

The Electricity Laws led to a reshuffling and splitting up of the grids of the old electricity companies. The high tension grid has become state property and is managed by a new organisation, Tennet. The grids for medium and intermediate tension have become the property of public grid managers in the hands of municipalities and provinces. They deliver electricity to users who can in turn remit electricity from proprietary windmills and solar panels to the grid. At the moment, there are a limited number of regional grid managers in the Netherlands, like Endiner, Liander, and Stedin, all of which also deliver gas.

In addition, the laws have created a new set of actors. The old provincial and municipal companies have been privatised and transformed into commercial electricity companies. These buy electricity as well as produce it themselves. The biggest companies are Nuon, Essent, Eneco and EPZ. They are the owners of the power plants. In addition, the commercial electricity companies initiate joint ventures, make deals with firms that generate electricity locally and own windmill parks. End-users are free to choose from among these suppliers. Market mechanisms have come to replace the internal planning mechanisms of the original electricity sector.

The new structure provided opportunities for decentralised electricity generation. The Ministry of Economic Affairs especially supported heat-power coupling schemes by means of subsidies and tax breaks. These schemes either focused on power (and hence electricity) with heat as a by-product, or focused on heat for the heating of office buildings, hospitals and agricultural greenhouses with electricity as a by-product. However, the rapid increase in the number of such schemes occasioned a crisis in the planning and monitoring of electricity production. This was exacerbated by the development of electricity production on the basis of wind and

[16] Duyvendak, W. *Het groene optimisme. Het drama van 25 jaar klimaatpolitiek*, (Amsterdam, 2011: Uitgeverij Bert Bakker), pp. 65.

solar power. Coordinating supply and demand has become much more complicated with the advent of decentralised electricity production. 'Smart grids' are currently among the 'trending topics' in the sector.

20.5 Environment, Depletion and Climate[17]

The driving force behind the changes in the electricity sector was initially the Ministry of Economic Affairs, seeking to get a grip on the national electricity supply in connection with its interests in natural gas and nuclear power. Privatisation and liberalisation would only later begin to play a role and the European Union would also become a new actor in the background. The Ministry pursued low energy costs for industry, reliability of the supply, and decentralized generation. Environmental problems, depletion of fossil fuels and climate change were secondary considerations. The introduction of renewable sources of energy was a marginal aspect of energy policy. The societal debate on sustainability barely made a dent, at least not in the energy policy of the Ministry of Economic Affairs.

The debate came in waves.[18] At the beginning of the 1970s, protest groups, environmental organisations and political parties were up in arms above all around the issues of air pollution, the depletion of raw materials and nuclear power. The debate on nuclear power polarised the country and dragged on interminably. Air pollution was a quite different matter. The focus here was on sulphur dioxide (SO_2) and its effects on public health. The ministry of Public Health, Spatial Planning and Environmental Management (VROM) took the lead on this issue. The reduction of SO_2 emissions in those years was a success. That was partly the outcome of legislation and the implementation of technologies like gas scrubbers to remove sulphur, but above all a beneficent side-effect of the transition from coal to natural gas. Concern about the depletion of fossil fuels moved the government to pay ongoing attention to energy conservation. The Ministry of Economic Affairs adopted energy conservation as one of the cornerstones of its energy policy. Subsidies and so-called 'multi-annual agreements' were mobilised to enrol private industry. Regulation, permits and energy taxes comprised the stick in the event these carrots failed to produce adequate results.[19] The recurring high energy prices formed a favourable backdrop. This story too turned out a success.

The debate ebbed away but resurfaced with renewed force in the course of the 1980s. Nuclear power and acidification and their connection with fossil raw

[17] See for this section the elegant overview of the history of sustainable energy in the Netherlands: G. Verbong. G, et al. *Een kwestie van lange adem. De geschiedenis van duurzame energie in Nederland*. (Boxtel, 2001: Aeneas uitgeverij).

[18] See also: J. Cramer, *Milieu*. (Amsterdam, 2014: Amsterdam University Press).

[19] J.J. De Jong, E.O. Weeda, E.O., Th. Westerwoudt, A.F. Correljé, A.F. *Dertig Jaar Nederlands Energiebeleid. Van bonzen, polders en markten naar Brussel zonder koolstof,* (Den Haag, 2005: Clingendael International Energy Programme), pp. 106.

materials were the key issues. The accident at Chernobyl put an end to the nuclear dream of Economic Affairs and the nuclear power lobby. The debate on acidification shifted attention from public health to the environment and from sulphur dioxide to ammonia emissions (SO_2 and NH_3). In this case too, it proved possible to take measures to keep emissions within legally defined norms.

From the 1990s on fine dust and greenhouse gas emissions were the most important issues. The problem of fine dust (airborne particles smaller than 10 micrometers) re-oriented the discussion once again to public health. With greenhouse gas emissions the debate about fossil raw materials acquired a new aspect: climate change. The biggest concern was CO_2 emissions but these proved far more resistant to legal and technical measures than the other emissions. Moreover, the concern was global, leading to international agreements about reduction that the Netherlands could hardly ignore. In the short term – up to the year 2020 – it seems likely that the government can satisfy the norms with 'classic' policy measures (energy conservation, energy covenants and so on). For the long term, however, more ambitious measures will have to be taken.

At certain moments it could seem that there was broad support for taking measures in energy production. At other times support has proven to be quite limited and riddled with weak spots. One of the weak spots is that the debate is constantly plagued by uncertainties. In each period there has been fundamental debate about the reserves of fossil raw materials and about the effects of air pollution on public health and the environment.

The situation with respect to climate change and CO_2 emissions is no different. Some question the analyses that predict global warming, consider the severity of the problem grossly exaggerated and find political support for their views.[20] Others argue that the influence of CO_2 emissions on global temperatures is still imperceptible and that humans do not have the power to fiddle with the 'climate dials.'[21] The court of law that ordered the Dutch state to reduce CO_2 emissions acknowledged that there is scientific uncertainty about '…the question when and to what degree, which specific effects will become manifest, and also about the effectiveness and possible negative consequences of certain precautionary measures.'[22] The court, however, considered the fact that there is consensus among climate scientists and within the international policy field about the serious consequences of CO_2 emissions. The precautionary principle thus justified the ruling that appropriate measures be taken.

[20] In this spirit the PVV (Party for Freedom) – the biggest but one party in the Second Chamber in 2018 – submitted a motion in which the government '… in view of the fact that the climate treaty is bad for the Dutch economy … is requested to dump the climate treaty in the wastebasket' Motion by parliamentarian Madlener (19 May 2016) *Kamerstuk 31,793 nr. 150, Tweede Kamer der Staten-Generaal.* Vergaderjaar 2015–2016.

[21] A prominent representative of this line of thought in the Netherlands is S. Kroonenberg, emeritus professor at the Technical University Delft. See among other publications his book: S. Kroonenberg, S. *De menselijke maat: de aarde over tienduizend jaar*. (Amsterdam, 2006, (revised edition in 2008): Uitgeverij Atlas).

[22] Rechtbank Den Haag, zaaknummer C/09/456689/HA ZA 13-1396, uitspraak 24-06-2015, *ECLI:NL:RBDHA:2015:7145.*

20.6 Renewable Energy Sources[23]

CO_2 emissions can be reduced by, among other things, saving energy or closing coal-fired power plants. Renewable energy sources play a special role. They provide an alternative for fossil raw materials, but their practical implementation has long left much to be desired. This is hardly surprising because these are new technologies that have to buck up against the prevailing mature energy technologies. Their future depends on investments in research and development, practical experiments, anchorage in laws and regulations and the building of networks. All these activities take much time and face numerous obstacles. Two examples – wind energy and solar panels – make this clear.

20.6.1 Wind

The wind energy story goes back to the 1970s. For a long time the technology was regarded with great sympathy. The ministry of Economic Affairs invested tens of millions of euros in research and development. A first National Research Program on Wind Energy was initiated (1976). This was followed up by a second National Development Program on Wind Energy (1981), an Integral Program on Wind Energy (1986), a Wind Plan (1989) and the Implementation of Wind Energy in the Netherlands (1992). The Energy Research Centre Netherlands (ECN) became the core of a national research network. The institute opted for large wind turbines. The small wind turbines championed by the environmental movement were pretty much ignored by the ECN and in the end lost the race against their bigger brothers.

But things went anything but smoothly with the big wind turbines. Researchers and designers struggled with technical shortcomings like broken blades and with what turned out to be a dead-end strategy. They invested in two-bladed turbines, while three-bladed turbines eventually became the dominant design. The most important obstacles, however, were the relations with the electricity sector on which the wind-energy developers were dependent for their practical trials. The creation of a wind-energy park at the beginning of the eighties gave rise to a host of conflicts with the electricity companies. The latter wanted complete control of the wind-park and managed to disengage the project from the national research program. It suffices to note that one of the turbine manufacturers abandoned the project and the other nearly went bankrupt.

One of the issues was the coupling of wind energy to the electrical power network. According to ECN, the electricity sector grossly underestimated the wind turbine capacity that could be coupled to its network without endangering the stability of the electricity supply. Moreover, the sector was willing to pay only modest amounts for supplying electricity to the network. That created problems for local

[23] This section is based on: Verbong and Geels, 'The ongoing energy transition', pp. 1033–1035.

wind turbine initiatives. And the costs of coupling a turbine to the network also played a role. The actual installation of windmills therefore lagged far behind the goals that had been set. And due to these problems a wind turbine industry also failed to develop. Manufacturers had too little experience with wind turbines and got too little feedback from actual practice.[24] The obstacles disappeared after the privatisation and liberalisation of the sector and the founding of public network managers and private electricity companies. However, dependence on subsidies did not disappear. In terms of price, wind energy was no match for fossil energy sources.

Furthermore, after 2000, wind energy began to lose its societal base. According to critics, the actual implementation of wind energy was too much of a top-down affair managed by researchers and policy-makers or by individual farmers seeking to earn extra income. That created a backlash. Local residents increasingly agitated against the noise, shadow flicker and the ugly aspect of the high wind turbines, while nature conservationists protested against turbines as 'bird choppers' and 'landscape polluters.' Politicians viewed windmills as a hardly cost-effective means to reduce CO_2 emissions. In a study the introduction of wind energy at the start of the new century was characterised as:

> … possibly the most painful policy domain… Despite the best of intentions and ambitious policy aims, this domain is characterised by a continual process of 'pushing and shoving' leading in the end to laborious outcomes. And then once again to ambitious new resolutions.[25]

Recently, the tide has turned. In 2013 the government, employers, the unions and nature and environmental organisations signed the Energy Agreement for Sustainable Growth.[26] By 2023, 16% of all energy would have to be generated in sustainable ways. One of the strategies to achieve this aim was the installation of large wind turbine parks at sea.

In 2023 minimally 4450 MW of generating capacity will have to be installed at sea, of which around 35–40% will produce electricity due to wind fluctuations. (By comparison: the capacity of many gas-powered electricity plants runs between 300 and 700 MW).[27] And the government has even bigger ambitions for the period to follow: up to 2030 an additional 1000 MW per year.[28] And the number of land-based windmills will also have to be increased substantially. The strategy requires signifi-

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[24] Davids, M., Lintsen, H., Van Rooij, A., *Innovatie en kennisinfrastructuur. Vele wegen naar vernieuwing.* (Amsterdam, 2013: Boom),. pp. 179–183.

[25] J.J. De Jong, E.O. Weeda, Th. Westerwoudt, A.F. Correljé, *Dertig Jaar Nederlands Energiebeleid. Van bonzen, polders en markten naar Brussel zonder koolstof,* (Den Haag, 2005: Clingendael International Energy Programme), pp.226.

[26] *Energieakkoord voor duurzame groei* (2013) Den Haag: SER.

[27] The biggest gas-fired power plant has an output of 1275 MW and the biggest coal-fired plant of 1560 MW. See: https://nl.wikipedia.org/wiki/Lijst_van_elektriciteitscentrales_in_Nederland consulted 22 mei 2017

[28] M. Niekoop 'Tweede Kamer opent deuren voor meer offshore wind in 2023', *Linkin,* 1 maart 2017. https://nl.linkedin.com/pulse/tweede-kamer-opent-deuren-voor-meer-offshore-wind-2023-mike-niekoop

cant subsidies, but thanks to, among other things, economies of scale and the learning curve these turn out to be lower than estimated.[29] While wind energy is still not uncontroversial, it seems that a tipping point has been reached: wind energy will be implemented at a large scale.[30]

20.6.2 Sun

Every new source of energy follows a different trajectory. With solar cells, for example, the ambitions were completely the inverse of those for wind. Initially the government and policy makers saw little potential in solar cells, while nowadays they are the promise of the future in electricity supply. The solar cell (photovoltaic cell or PV cell) was considered ill-suited to the Netherlands. The country had too little sunshine due to its geographical location and frequent cloud cover. Nonetheless, academic researchers used their freedom to investigate solar cells. They also formed a lobby group that aimed to convince politicians, policy makers, industrialists and the environmental movement of the future of PV on the basis of demonstration projects.

The about-face in perception occurred at the beginning of the 1990s. PV acquired substantial support and became a serious option. Shell, for example, integrated solar cells into its future scenarios and the multinational predicted that PV would become an important energy source by the middle of the twenty-first century. Other parties like the ministry of Economic Affairs, Greenpeace and Nuon encouraged the adoption of solar cells by households, among others. The budget for PV increased substantially in these years.

However, PV was definitely more expensive, certainly in comparison with fossil energy sources, but also in comparison with other renewable energy sources. Despite the improvement of the solar cell, the gap remained. PV scored poorly in an evaluation by the government at the end of the 1990s. It barely contributed to CO_2 reduction and the costs were high. Implementation of PV stagnated.

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[29] J. van den Berg, 'Buitengaats pionieren met miljarden', *De Volkskrant* 8 mei 2017, 6. Zie ook: C. Grol and B. van Dijk 'Shell gaat tweede grote Borssele-windpark aanleggen' in het *Financieel Dagblad*, 12 december 2016, https://fd.nl/ondernemen/1179351/shell-gaat-tweede-grote-borssele-windpark-aanleggen. For five wind parks at sea (two off Borssele and three off the Holland shore) a maximum of € 18 billion in subsidies had been estimated. The estimate in 2016 was € 6 billion. The decrease is also the result of low interest rates, cheap steel prices and the availability of cheap offshore material due to the malaise in the oil and gas sector.

[30] See for example the debate between minister H. Kamp of Economic Affairs and Dercksen (PVV) in the Second Chamber on Dec. 19, 2016. Handelingen TK 2016–2017, 2, 19 December 2016. Or the reactions in response to an article by C. Grol and B. van Dijk 'Shell gaat tweede grote Borssele-windpark aanleggen' in het *Financieel Dagblad*, 12 december 2016, https://fd.nl/ondernemen/1179351/shell-gaat-tweede-grote-borssele-windpark-aanleggen

Recently PV is once again on the rise thanks to technological developments, subsidies,[31] and so-called *salderen* (charging private consumers on the basis of delivered energy *minus* energy returned to the network by local PV or wind sources). The contribution to the electricity supply is growing, but the technology has not yet reached the stage of large-scale implementation that wind power has achieved.

The two examples exhibit uneven and unpredictable trajectories.[32] Future promises were often too ambitious. Technical problems were too easily made light of. Implementation took longer than expected. Factors largely beyond the control of the parties concerned also played a role: the oil price, an economic recession, concern for the environment, liberalisation, etc.

The development of renewable sources was often stimulated by technology. Researchers focused on technical designs and technical challenges and paid less attention to the political process and social acceptance. They failed to adequately anticipate resistance by the environmental movement and local groups.

The building of well-functioning networks among research institutes, industry, societal organisation and the government proved to be essential.[33] Those networks were necessary to protect the new and vulnerable technologies against their harsh environments. Within these networks, the proponents of wind energy and solar cells had to organise subsidies, create favourable preconditions for innovations, organise practical experiments in sheltered environments, exchange knowledge and above all create optimistic images of advantages and disadvantages, costs, and profits. If a critical party became obstructive, as was the case with wind energy and the former electricity sector, the process could stagnate for years. The lack of stability of the networks and the changing role of the actors was remarkable. Policy makers had a tendency to change their strategies when results were disappointing and learning processes became more laborious than hoped for. The government often provided meagre guarantees for the longer term. Investors were uncertain and careful. Societal organisations tended to jump ship if the technology stimulated too much social protest.

In the short term investments in fossil energy sources will remain dominant. Low energy costs, market forces, reliability and diversification still have a high priority in the energy supply; climate, public health and environment take a back seat. To be sure there are clear EU norms for reducing CO_2 emissions and those of other greenhouse gases, but the solution will partly be sought within existing technologies and institutional structures. CO_2 storage is an option. Possibilities for energy saving, heat-power coupling and decentralised electricity generation are not yet exhausted. There are new chances for fossil fuels, in particular for gas. ‘If coal was the fuel of

[31] In particular the subsidy measure ‘Stimulering Duurzame Energie (SDE+)’, Rijksdienst voor Ondernemend Nederland, 2017: http://www.rvo.nl/subsidies-regelingen/stimulering-duurzame-energieproductie-sde

[32] Verbong and Geels, ‘The ongoing energy transition’, pp. 1035.

[33] Also see: B. Verhees, R. Raven, F. Veraart, A. Smith and F. Kern, ‘The development of solar PV in the Netherlands: a case of survival in unfriendly contexts’, *Renewable and Sustainable Energy Reviews* 19 (2013), 275–289.

the nineteenth century and oil the fuel of the twentieth, then natural gas is predestined to become the fuel of the twenty-first century' as Jeroen van der Veer, president of Shell, predicted in 2002.[34]

Still, it remains to be seen whether this prediction is correct. Wind energy has acquired momentum and will experience significant growth in the coming decade. Work will continue on the expansion of other renewable energy sources. Societal support is clearly not lacking. The Second Chamber aims to have sustainable energy account for 30% of the energy supply by 2030.[35] This will only be the beginning, because the norms for CO_2 reduction for 2050 are stringent.

We shall return to this point in the conclusion. First we investigate another function of 'fossil.' Fossil raw materials are not only sources of energy, but also raw materials for chemical products. We focus on plastics, because they are an important example of this use of fossil resources.

20.7 Fossil and Plastics: Prelude to a Second Revolution[36]

After the Second World War, plastics became a revolutionary force. They rapidly penetrated into the capillaries of society with plastic products in the living room, the kitchen, the playroom, the bathroom and the bedroom, with fibres in textiles, films in packaging, laminates in construction, coatings in the paint industry and with plastic parts in machines and plastic applications in medicine, agriculture, transportation and the office. The Netherlands emerged as one of the international leaders in the production, processing and use of plastics.

The oil crisis of 1973 initially led to panicked reactions in the plastics sector. Companies began to hoard, fearing a scarcity of raw materials for plastics. Demand increased enormously but subsequently took a nosedive with 1975 as a low point. Economic stagnation, rising prices for plastics and more efficient use were the causes of the hectic movements. 'It will be clear…' noted the trade journal *Plastica* summarizing the mood, '…that the entire complex of events during and after the oil crisis has thoroughly unsettled the plastics industry of the fatherland.'[37] In retrospect, the oil crisis caused little more than a ripple in the ongoing increase of plastics production and the use of plastics. It happened once again during the credit crisis of 2008. Up to the present day, production and use of plastics have continued to increase in the Netherlands, although the spectacular growth of the 1960s has never since been achieved.

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[34] Citation in: Sluyterman, *Concurreren in turbulente markten*, pp. 235.

[35] Passed motion submitted by parliamentarians Jan Vos (PvdA) en Van Veldhoven (D'66), nr. 511 (30196). Handelingen TK 2016–2017, 49, 7 February 2017.

[36] See for this section: Lintsen H., Hollestelle M., Hölsgens R. (2017) *The plastics revolution. How the Netherlands became a global player in plastics.*

[37] W. Bongers. 'De Nederlandse kunststofindustrie in 1975', *Plastica* 29 (1976), 239.

20.7.1 The Heterogeneous Sector

Still, much has changed in the plastics sector. The production of bulk plastics and artificial fibres still takes place in the Netherlands, but not or rarely by *Dutch* companies. The 'classic' big plastics producers, Shell, DSM and AkzoNobel, have withdrawn from the fray. Shell still supplies raw materials for plastics. DSM has oriented itself to technical polymers and AkzoNobel to coatings. In the 1980s and 1990s the strategy was no longer oriented to diversification and the creation of broad conglomerates, but to core activities and the attainment of leadership positions in specialised markets. Profit margins on bulk plastics were too small and production suffered from extreme ups and downs. Currently, foreign companies have stepped into the breach as active bulk producers. Companies like General Electric, Dow Chemical and DuPont pioneered this strategy in the 1960s. Other big firms like the Saoudi SABIC, the Japanese Shin-Etsu and the international LyondellBasell are newcomers to the Netherlands.

The plastics *processing* industry consists above all of small and medium-sized firms (up to 50 employees) and has developed into the most innovative sector in the Netherlands. It is extremely heterogeneous. Many firms in the plastics processing sector are specialised in one way or another, for example in products like sliding roof systems, in materials (among others PVC), in technologies (for example injection moulding), or in market sectors like automobiles and construction. There is variety in age (many firms are not older than 40 years), in ownership forms (many are a BV, a private limited liability company, among which a number of family companies, some are an NV – a public company – or are part of a conglomerate) and variety in origins (founded as a plastics processing company or the continuation of a metalworking firm, a tool and die firm etc.).

The heterogeneity of the plastics sector has its positive and negative aspects. The advantage is that the sector can operate flexibly in national and international markets. The disadvantage is that the sector is hard to organise and that policy makers have difficulty getting a handle on it. Among other things, this plays a role in the many public controversies around plastics. In the field of energy problems the lay of the land is reasonably evident and it is possible to call large actors like the Ministry of Economic Affairs and the big electricity companies to account for their policies. In the plastics sector this is much more difficult.

20.7.2 Controversies

In the 1950s and 1960s, plastics had an ambivalent image. The material had an aura of progress and modernity, but was also associated with low quality, litter and waste. These negative associations continued to rear their ugly heads in subsequent years. Other issues also surfaced with the emergence of the environmental movement. PVC became the bogeyman of the 1980s. According to critics, PVC production

released carcinogenic substances. As packaging material, this plastic threatened food safety. When burned in waste incinerators, dangerous quantities of poisonous dioxin escaped. In the same period a debate emerged on the dangers of additives in plastics to health and the environment. Later on this debate broadened to include sustainability, which also included energy production and the exhaustibility of fossil raw materials.

Recently plastics waste is once again high on the agenda due to problems with litter, 'plastic soup' and micro-plastics. Unimaginable quantities of plastics end up globally in rivers, along the coasts, and at sea. Birds and other animals perceive floating bits of plastic as food, consume it, are weakened and die. Plastics waste is concentrated in so-called *gyres*, large circular movements fed by multiple ocean currents. These result in enormous garbage dumps, many times larger than the Netherlands.

A portion of the marine plastics degrades into miniscule particles, providing a substrate for the growth of organic material and attracting poisonous substances like dioxin. They cover the ocean floor and enter the food chain via fish. Micro-plastics also end up in the water and sediments of sewage treatment plants because they are for example constituents of toothpaste, shampoos and cosmetics. The modern human body contains minimal but measurable quantities of plastics. As the *Washington Post* announced as long ago as 1972, 'Every human is a little bit 'plastic.'[38] What are the implications for health and behaviour? We do not yet know. 'Under the 10 micro-meters they penetrate through your cell membranes, enter into your bloodstream and travel through your body…' according to Heather Leslie, a researcher in the field of micro-plastics at the Free University of Amsterdam.

> …we still have to investigate how many of these particles you have to take in before you begin to experience severe discomfort, but laboratory tests already show that very fine plastic particles can damage cells and tissue and that they can lead to all kinds of infections.[39]

The problems have an international dimension. Plastics are produced, exported, imported, used and disposed of worldwide. Within the Netherlands and the European Union this attracts some attention. Internationally there are hardly any organisations that articulate the problem. This is why a solution for one of the most pressing issues – marine pollution and the 'plastic soup' – still remains far distant. *The Ocean Cleanup*, founded by the Delft student Boyan Slat, is one of the few organisations that is preparing for one of the biggest clean-up operations in history.[40]

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[38] Quoted in: S. Freinkel, *Plastic. A Toxic Love Story* (Boston, 2011: Houghton Mifflin Harcourt), 89.

[39] D. Cohen, 'Geplastificeerde maatschappij. Er wordt te veel van de burger verwacht', *De Volkskrant* 24 september 2016, bijlage Vonk, 2.

[40] In 2013 Boyan Slat started a project to capture floating plastic trash in the oceans with the aid of inflatable barrier arms. The project generates much enthusiasm and receives financial support from all over the world. Slat works together with students, engineers, oceanographers and industry experts. Feasibility studies are underway. The first pilot project was launched in 2016. See: www.theoceancleanup.com/ (Geraadpleegd op 8 maart 2017.)

The problems with the ‘plastic soup’ and the micro-plastics can be traced back to the linear nature of the plastics supply chain. A large proportion of the plastics ends up in garbage dumps, leaks into the environment or is burned. In Europe that percentage is 74%, of which garbage dumbs and the environment accounts for 38% and burning for 36% (2012).[41] In the Netherlands the percentage is 67% but a much smaller proportion ends up in garbage dumps and in the environment – 7% – and 60% is burned. The advantage of burning is in any case that the plastics don’t end up in the environment and that they produce useful energy. The disadvantage is that finite resources are depleted.

The problems could be partly solved if degradable bio-plastics were to replace the current ones, so that the waste products could be taken up in the environment. Wageningen University and Research are investigating this, but an important contribution from ‘green’ plastics should not be expected anytime soon. Degradable bio-plastics cannot compete with the majority of plastics and are used only in niches.

The solution for the time being would have to be sought in the closing of the supply chain, that is to say in the nearly complete recycling of plastics. In the Netherlands some 33% is recycled. Increasing this percentage will be a big challenge in view of the heterogeneous nature of the plastics sector and the absence of influential organisations prepared to assume responsibility for the problem. It could be the prelude to a second plastics revolution.

20.8 Fossil as a Janus-Head

Fossil raw material is the Janus-head of well-being. It has two faces like the head of the Roman god Janus. As an energy source it was an important factor in modern economic growth, the elimination of poverty and the achievement of welfare. As raw material for plastics it shaped a life of comfort, ease, luxury, sport and games. At the same time it was a source of uncertainties and controversies. In the field of energy supply, dependence on foreign suppliers was an issue as early as the end of the nineteenth century. In recent decades this has been augmented by air pollution, depletion of raw materials and climate change. In the new domain of plastics litter became an issue from the 1950s on, now augmented by concerns over ‘plastic soup’ and micro-plastics.

Will the dark side of fossil lead to a transition? This is highly unlikely in the short term for issues like ‘plastic soup’ and micro-plastics. Little urgency is felt, nationally or internationally, to undertake action on these points. Nonetheless there is a possibility for a slow but radical change in the domain of plastics if the tendency to recycling can be sustained.

The energy situation is another story. Climate change is currently the crowbar for the energy transition. Will this transition continue at a slow pace in the coming

[41] *Plastics – The facts 2013. An analysis of European latest plastics production, demand and waste data* (z.pl 2013). The text is published by Plastics Europe, Association of Plastics Manufacturers.

decades with 'fossil' continuing to remain dominant? Or will there be a radical breakthrough in which renewable energy sources rapidly become the major suppliers? Renewable energy sources now have a long gestation period behind them of some four decades. That is not unusual for a transition. It was no different with the rise of coal and steam and it was also the case with the transition to oil.

Much happens in the course of such a gestation period. In the fields of science and technology research is undertaken and elaborate experiments carried out. A base of support is organised among societal organisations. The government is wooed with expectations and solicited for favourable conditions. Niches are identified in the economy, so that the new options can come to fruition in a somewhat protected environment. The creation of social networks is essential to achieve synergy among all these efforts and to enable the creation of new institutions.

The question is whether wind energy, solar cells and other renewable sources of energy have reached the stage where they can compete with oil, gas and coal under equal, but newly formed, circumstances. That stage seems to have been reached for wind energy, although the technology is still dependent on subsidies. For solar cells this is not yet the case, but there is still hope.[42] The new technologies are not only in competition with the classic energy sources. There is also a struggle among the alternative options, for example with biomass, heat-power coupling and geothermal energy. It is still unclear what kind of mix will surface in the end.

The conditions for a sustainable energy transition seem favourable at the moment, especially because important actors are lending their support. Business leaders like the chairman of the Employers' Association, the director of the National Railways and even the director of the *Gasunie* have spoken out in favour of the transition.[43] The ABP, the Netherlands' biggest pension fund, recently announced that it wants to commit itself seriously to sustainability. Chairman of the board, C. Wortmann-Kool, is pushing for a climate law and in this she is not alone: 'We have to provide our clients with long-term security and be able to offer gains, so we are not going to sit back waiting on fickle subsidy policies. The cabinet has to provide clarity for a period of ten to twenty years.'[44] The Netherlands Bank calls on the government to

[42] See for example the analysis by the Rabo Bank: 'Zonne-energie (fotovoltaïsche zonnepanelen', *Rabobank Cijfers & Trends* 40(2016/2017), 23 May 2017. https://www.rabobankcijfersentrends.nl/index.cfm?action=branche&branche=Zonne-energie_fotovoltaische_zonnepanelen

[43] See, for example: 'Top Nederlands bedrijfsleven op excursie naar Noordpool', *Financieel Dagblad* 2 mei 2017, https://fd.nl/ondernemen/1200342/top-nederlands-bedrijfsleven-op-excursie-naar-noordpool. For example also: 'Uniek paar: Marjan Minnesma en Hans de Boer', *Vroege Vogels Radio* 12 februari 2017, https://vroegevogels.vara.nl/nieuws/uniek-paar-marjan-minnesma-en-hans-de-boer

[44] See: C. Wortmann-Kool, 'Nieuw beleggingsbeleid van het ABP is breuk met verleden', https://www.apg.nl/pdfs/abp-pensioendoc_2016.pdf. The chairman of the board of the General Citizens' Pension Fund (ABP) indicates that it is difficult for the ABP to invest in sustainable projects because it often concerns projects that are too small for the ABP and because too many projects still return too little profit. See: N. Trappenburg and J. Groot, 'Pensioenfonds zoekt grote groene projecten', *Financieel Dagblad* 8 mei 2017, https://fd.nl/economie-politiek/1200685/abp-duurzaam-beleggen-in-nederland-is-lastig. Typical of the situation is that in 2016 the ABP invested €2 billion extra in fossil energy: 'ABP belegde € 2 mrd extra in fossiele energie', *Financieel Dagblad* 15 mei 2017, https://fd.nl/beurs/1201824/abp-belegde-2-mrd-extra-in-fossiele-energie

'commit itself in a timely manner to a credible and feasible path toward a CO_2-neutral economy'[45] For this moment in time, it is hard to image a more powerful statement from one of the most influential organisations in the Netherlands.

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Internationally, important investors are pulling out of 'fossil.' That will doubtless set other (smaller) investors to thinking. Examples: the Rockefeller family. http://www.cbsnews.com/news/rockefeller-family-is-exiting-the-oil-business/; https://www.theguardian.com/environment/2014/sep/22/rockefeller-heirs-divest-fossil-fuels-climate-change; http://www.telegraph.co.uk/finance/newsbysector/energy/oilandgas/11114591/Rockefeller-family-sells-out-of-fossil-fuels-and-into-clean-energy.html

Influential investment advisor Bloomberg has long been crystal clear: A single example: https://www.bloomberg.com/company/new-energy-outlook/en; https://www.bloomberg.com/professional/blog/sustainable-investing-strategy-reality/

[45] G. Schotten, S. van Ewijk, M. Regelink, D. Dicou en J. Kakes, *Tijd voor Transitie. Een verkenning van de overgang naar een klimaatneutrale economie* (Amsterdam, 2016: de Nederlandsche Bank).

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