Practical wisdom in Risk Society. Methods and practice of interpretive analysis on questions of sustainable development
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Chapter 5
A process to ‘illustrate’ sustainable technology development: the case for Novel Protein Foods

The developments towards ‘de-compartmentalisation’ and ‘integration’ in the Dutch eutrophication control, described in the previous chapter, heralded an approach to environmental policymaking that came to be considered internationally as unique and innovative (Weale 1992; Beder 1996). Weale regards the Dutch approach to environmental policy of the late 1980s and early 1990s as a text-book example of what he calls the “new politics of pollution” (1992:122-153). The main innovative element in the Dutch approach, which was elaborated for the first time in the first National Environmental Policy Plan (NEPP) of 1989, was its ambition to integrate environmental considerations “with the full range of public policies” (Weale 1992:148). The ultimate objective was to have environmental considerations incorporated in personal morals as well as in economic activities. It is against this background, that the TA project, which is central in this chapter, was designed.

The interdepartmental organisation that initiated the TA project, the National Interministerial Programme for Sustainable Technology Development (STD), took the philosophy underlying the NEPP one step further. It propagated the full integration of environmental notions into technological innovation. Established in 1992 as a temporary research programme, STD sought to systematically investigate and demonstrate the possibilities for developing sustainable technologies and for attaining the conditions under which these could be successfully diffused in the long term. The programme entailed research and support activities to strengthen the innovation capacities in the Netherlands in order to foster the development and dissemination of technologies that meet future societal and environmental needs.

STD’s first major project to be implemented was a TA-study on novel protein foods (NPFs). In order to contribute to a reduction of the high environmental burden associated with meat production, the project set out to analyse the possibilities for developing food products on the basis of non-animal protein. The project, which was dubbed an “illustrative process”, ran from 1993 to 1996 and involved research into the technical and the environmental as well as the economic and societal aspects of novel, non-meat protein foods. Its main objective was to illustrate the technical and business-economic feasibility of NPFs, in such a way that various relevant parties (industry, research institutes, policymak-

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1 The empirical material presented in this chapter was published previously as a STD working document (Loeber 1997) and was presented in the context of the EUROP TA project (Loeber 2000).
ers, consumers and environmental organisations) would be willing to invest and cooperate in their development after the project had come to an end.

This chapter describes the NPF project against the backdrop of the Dutch environmental policy. Below, first, the complex relation between the dynamics in environmental policy and in technology policy in the Netherlands in the 1980s and 1990s is discussed. The STD programme was set up on the interface between the two. Thereupon, the programme’s installation (moment t0 in figure 3.1) and the selection of NPFs as a topic of research will be described, as well as the Dutch protein research activities that formed the innovation context within which the NPF project took shape.

The story continues with a description of the project’s institutional setting and objectives at the time of the “kick-off” meeting of the actual analytic process (moment t1). Subsequently, the NPF analysis and its outcome (moment t2) are discussed, as well as the activities to disseminate the project’s findings. Interestingly, in this case, dissemination activities were not postponed until after the analysis was finalised. The NPF project team actively sought to disseminate the findings on a continual basis throughout the entire project, and intensified its efforts in that respect towards its conclusion. The project’s impact (both in terms of learning and of action) is assessed in 1997 (moment t3, the time of my evaluation), upon which the impact is placed in the context of the developments in policymaking and protein-focused research. The final section discusses the interrelations between the NPF project, its impact, and the developments in relevant policy domains and research areas. Furthermore, the dynamics in the NPF project are elaborated, and related to its impact, from the perspective of the interplay between the project’s innovative ambition, its methodical sophistication and its institutional conditions. Thus, we may understand how and why the project, which was intended to “initiate a dialogue between potential innovators of novel protein foods and stakeholders” (Weaver et al. 2000:120) from the perspective of sustainable development evolved into a technology-focused TA that in spite of its ambitions was only moderately interpretive in its elaboration.

The policy context: integration of environmental responsibility in economic activities

As came to the fore in the description of the 1970s’ approach to eutrophication control, the early attempts at environmental protection in the Netherlands were, like elsewhere (Weale, 1992), characterised by the conviction that environmental policy formed a separate policy area. Environmental issues were “simply to be added to the other concerns of government” (1992:20) and to be solved by building on the existing range of policy instruments. Pollution issues were approached in isolation from one another, and were dealt with mainly by means of direct regulation and though the development of end-of-pipe technologies.
This approach, it was found by the mid nineteen eighties, proved unsatisfactory. The use of traditional administrative regulatory strategies in pollution control amounted to a disproportionate increase in government tasks and to continual difficulties in the implementation of environmental legislation. Furthermore, the approach was found to allow for problem solution via a displacement across political and administrative boundaries (1992:22).

In order to meet the various shortcomings, in the years that followed, efforts at environmental management in the Netherlands show an increasing tendency towards ‘integration’ in various ways and meanings. The ‘sector-oriented’ approach in policymaking, which focused on distinct pollutants and their contexts such as water, air or soil as separate policy issues gave way to an ‘integral’ approach, in which issues were addressed thematically and abatement efforts focused on the pollutants’ source. Correspondingly, legislative innovation led to an integration of the patchwork of acts and regulations on environmental issues. The focus on integration of environmental notions into the motives for economic activities of environmental policy target groups was of a more fundamental nature.

The latter notion was elaborated firstly by the Minister of the Environment, Winsemius, who was in office between 1982 and 1986. He spoke of the need to stimulate verinnerlijking (internalisation) of environmental responsibility (Winsemius 1986). In that way, actors would be inclined to change their conduct themselves in line with moral standards vis-à-vis the environment. Such an approach fitted the tendency towards ‘deregulation’ which was current in policymaking in general at the time, urging the government to limit its role in societal developments in favour of market dynamics. (1986).

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1 The developments in environmental policymaking towards integration were reflected in the naming of the various policy documents in the field. The Indicative Multi-Years Programmes (Indicatieve Meerjaren Programma’s, IMPs; see chapter 4) that were originally organised on the basis of the various sectors, such as water, were later accompanied by an Indicative Environmental Multi-Year Programme by which the environmental policy as such was coordinated. After the IMP for the 1987-1991 period, these IMPs were replaced by the annual Environmental Programme - Progress Reports, and by issue-oriented strategic policy documents such as the Nature Policy Plan. The more generic, long-term aspects of the Dutch environmental policy were covered in the National Environmental Policy Plans (the NEPPS).

2 The 1977 general act that coordinated the licensing procedures on the basis of the various sector-oriented acts (the Wet algemene bepalingen milieuhygiëne) was gradually rebuilt into a comprehensive Environmental Management Act (Wet Milieubeheer), which was enacted in 1993. With its enactment, legal instruments were untied from their original sectorial context and were integrated to allow for a more efficient environmental protection, to prevent cross-media transfers of pollutants, and to increase the transparency of environmental control to industry and citizens. The genuine innovation in the 1993 Act was that it took the idea of prevention as its point of departure: it posited that anyone who could reasonably expect his or her behaviour to be detrimental to the environment was obliged to either not proceed, or to take precautions that would limit or undo the detrimental effects.
A new approach to environmental policymaking

The notion of verinnerlijking was one of the major concepts on the basis of which the Dutch environmental policy of the late 1980s and 1990s was formulated. The basic assumption underlying the new approach was that a change in human activity, which was pinpointed as the primary source of pollution, formed the key to a solution of environmental problems. This assumption implied the need to directly interfere in human economic activity from the perspective of environmental concern. Whereas, for instance, in the early days of environmental policymaking, eutrophication control required agricultural practice to be sensitive to environmental considerations, now it was understood that environmental notions were to co-determine agricultural activities as a matter of principle.

This understanding of environmental policymaking, outlined in the first NEPP (1989), was made operational in a number of concepts and principles as well as in various concrete pollution-reduction targets. In addition to the ‘standstill’ principle, which marked the current state of environmental degradation as the absolute bottom line of pollution levels, the ‘polluter pays-principle’ and the principle of ‘abatement at the source’, the new environmental policy was built around the notion of the ‘closing of substance cycles’.

With respect to the instrumental elaboration of its ambitions, the NEPP was innovative too. Rather than relying solely on the traditional legal instruments, it proposed a direct involvement of target groups in the formulation and selection of policy measures. The NEPP envisaged a partnership between government, industry and consumers so as to jointly set environmental standards, and to create the circumstances for compliance with these norms in close consultation. In this way, the paper postulated, the significant changes in human activities that are required for realising the Plan’s ambitions could be induced. Such a ‘target group approach’ would be contributory to realising a certain level of internalisation of ecological responsibility for the target group’s own actions.

Thus, the nature of pollution problems as it was understood in the NEPP implied an approach to environmental management that aspired an integration of ecological considerations in personal morals (of consumers, for instance) and in corporate policy. One of the areas in which environmental notions were to be incorporated in the decision making processes was the field of technological development.

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4 The follow-ups to the NEPP further elaborated the various quintessential concepts and principles. The NEPP II (1993) focused notably on the notion of ‘target-group policy’, distinguishing between easily reachable target groups, and those that are too diffuse to address directly. The NEPP III (1998) extended the principle of ‘self-regulation within limits’, which intended to broaden the principle of consultation between government and target groups from discussing the means by which to implement a policy, to also discussing the formulation of goals and objectives.
Traditionally, in the Netherlands, there is a sharp distinction between the policy field of technological innovation and development which is the responsibility of the Ministry of Economic Affairs, and the policy area of preventing and reducing the negative effects of these developments, which was and is predominantly the responsibility of the Ministry of the Environment. Although the Ministry of Economic Affairs (which is the industry ministry in the Netherlands) together with the Ministries of Transport, Agriculture and the Environment respectively, had co-signed the NEPP, it had never been the first to express environmental concerns. Of old, the emphasis in the Ministry's policy approach had been on stimulating economic growth. Since the early 1980s, it had pinpointed technological innovation as a key element in achieving that objective.

The Ministry of Economic Affairs had actively encouraged technological innovation ever since in various ways. Between 1980 and 1985, an emphasis was put on the stimulation of knowledge generation in business firms and research institutes. Policy instruments were designed that aimed at stimulating R&D through economic measures. It was anticipated that such a 'technology-push' would induce economic growth (Van Dijk 1993, 1996). In the subsequent period, from 1986 to 1990, the emphasis shifted to stimulating the diffusion of knowledge. Rather than strengthening the innovative capacities of individual firms, the technology policy aimed at the dissemination and application of the R&D knowledge that was available within the country and focused on the development and strengthening of human capital. The establishment of a network of regional innovation centres was one of the instruments to achieve these goals.

In the 1990s, the emphasis shifted again. In correspondence to the national government's changing perception of its own role vis-à-vis society, the focus was now on strengthening and intensifying the interactions between business firms and research institutes on the one hand, and the state and society at large on the other. Reformulating its role as one of a 'party among peers', the central government intended to stimulate public-private partnerships and joint efforts to identify opportunities for innovation. In addition, more emphasis was put on the role of the state in helping to articulate social and economic demands, and to translate these into technological development paths. The perspective on the integration of technology in society gradually changed from promoting acceptance for a 'given' technology to promoting the societal embedding of technology development processes, which take place in close interaction with future users (Van Boxsel 1992; Ministries of Economic Affairs and of Housing, Spatial Planning and Environment 1991).

Against this background, the preparatory discussions for a national environmental policy plan took place. As was the case with the Environmental Department, the Ministry of Economic Affairs felt a need of strengthening the communication between policy
actors and policy area actors, in order to attune technological innovation to social needs. Still, negotiations over the envisaged NEPP were intricate, as the intentions to increase co-operation between the various Ministries from an environmental perspective were, in practice, at odds with the traditional distribution of ministerial authority and the prevailing policymaking routines (Weale 1992:139-142).

A focal point in the slow and complicated discussions between the Ministries, and between these and industry, was the role of technology in the ‘greening’ of society. In 1988, the prestigious National Institute of Public Health and Environmental Protection (RIVM) had published a report on the state of the environment and on possible improvements, reaching some alarming conclusions. The RIVM (1988) argued that even if all of the environmental technology known at the time were to be deployed to its full potential, the net result would not entail a significant improvement of the situation.

The policy implications of the RIVM results were clear. Since the application of end-of-pipe technologies would not suffice to reach the emission reduction targets that the Ministry of the Environment aimed at, more structural changes in economic behaviour and technological innovation were called for. This conclusion put the objective of environmental protection, as Weale puts it, “on a collision course” with economic development: “It was at this point”, Weale adds, “that the influence of the Brundtland report was felt” (1992:135).

The ‘sustainable development’ philosophy that was outlined in the report (WCED 1987, see chapter 1) appeared to offer an opening to actually integrate the ecological dimension into economic policy. The practice of co-operative policymaking, however, still proved difficult. The preparatory talks on the NEPP had intensified consultation between the Ministry of Economic Affairs and the Ministry of the Environment. While both agreed upon the NEPP’s general assumption that actors who are active in the field of technology, as in agriculture and transport, should incorporate environmental considerations in their core business, no concrete measures to that end were formulated. In a subsequent white paper by both Ministries, long abided by societal organisations and opinion leaders in the realm of environmental protection, again little innovative thought on the subject was brought to the fore. Although the document, aptly called ‘Technology and Environment’, postulated in its subtitle that technology could form the “linking pin between ecology and economy” (EZ VROM 1991), it merely discussed ways for “greening” the existing policy instruments. To technology, it accorded the traditional ‘end-of-pipe’ role of cleansing and removing pollution from affected areas.

The white paper’s argument was more or less in line with the findings of a study by the Netherlands’ Commission for the Long-Term Environmental Policy (CLTM) of the

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1 The phrase ‘environmental technology’ encompasses all techniques, procedures and artefacts that can be of relevance in order to prevent or reduce the negative impact of production and consumption on the environment (cf. Cramer 1995:127).
previous year, into the role of technology in achieving a sustainable development. The study's main conclusion was that technological innovation offered no prospect for sustainable development (CTLM, 1990). As a specific elaboration of the role and potential of technology vis-à-vis environmental policy was lacking in the NEPP, this conclusion appeared to mark the beginning of a period of standstill with respect to the integration of the environmental challenge into technological development. It probably would have done so, had it not been for a couple of visionaries at the top of the Ministry of the Environment.

Events leading up to the TA initiative

The limited role ascribed to technology in reducing environmental problems met with considerable opposition among a small group of senior civil servants within the Environmental Department. The CTLM's conclusion that "technology will not save us" was later dismissed as "both unethical and immoral" by one of them in an interview (DTO 1997a:29). With a background in the academic world, as well as in politics, this critic found himself in a position to investigate, low profile at first, the possibilities of a long-term programme on technology and sustainability. Discussions with civil servants from a range of departments, captains of industry and scientists gradually fuelled the idea that technology could play a key role in sustainable change.

The idea that technology, rather than being peripheral to an environmental policy, could and should play a pivotal role in a sustainable development in circles of academics, technologists and opinion leaders fell in fertile ground. The question was how technology could respond to the challenges posed by the environmental degradation. In the ensuing discussions, various concepts and notions converged into a rough outline for a programme on sustainable technology development.

Among the core concepts around which the later programme was designed was the idea of stimulating leap frog ("jump-like") innovations by taking a forty-year horizon in thinking about technological change, instead of the usual three to five years. Furthermore, it was acknowledged that technology, while a pivotal lever, could never be more than a tool in stimulating change towards a more sustainable future (Vergragt & Jansen 1993:136). Therefore, technological innovation in the programme was to be perceived as being embedded in process of cultural and structural change. The triad of culture-structure-technology was to form a conceptual core element in the design of specific projects on sustainable technology.6 For the concrete elaboration of projects, the needs of the future society were to serve as a starting point. To that end, these needs should be analysed, quantified and described as concretely as possible in a so-called need area

6 Because of the linkage between technology, culture and structure, the STD Programme addressed the issue of what 'we' as a society want and how to achieve that (hence, the question of phronēsis).
Finally, the concept of backcasting was outlined, be it rudimentarily at the time, indicating a way to identify the cultural, structural and technological changes that must be made ‘now’ in order to arrive at a long-term vision of a sustainable future.

The backcasting idea came to serve more or less as a connecting principle between the other concepts. Together with the notion of leap frog innovations, it appeared promising in the light of the need, implied by the sustainability concept, to by-pass incremental technological change. The idea was that by starting to “reason backwards” from an imaginary future, the limitations that are inherent in extrapolating from the present situation supposedly could be surmounted. More in particular, the underlying rationale for this approach was to make specific the highly abstract discussion on what ‘we’ as a society want:

Viewing culture (‘what do we really want?’), structure (‘how can we organise what we want and make it happen?’) and technology (‘which means will we employ to that end?) as a hierarchy [of issues], the STD programmes started bottom-up.... In so doing, we employ a [participatory TA] approach. The difference with traditional TA studies is that in our research not the present-day needs present the demand pull but those of over 40 years. On the basis of those needs, we formulate questions to science and technology. ... Once on the market, [the products that are thus developed] result in a technology push [stimulating the desired development] (STD programme director Jansen, interview conducted by W. Aarts, 21-Oct-’96; my translation).

The agglomerate of concepts and ideas on sustainable technological development was tentatively substantiated with a rough calculation. If the North desires to keep up the present level of prosperity, the initiators of the discussions argued, and the global population growth continues unchanged while the level of prosperity in the South will increase, technology has to improve its “environmental efficiency” by a factor of 20 in the next 50 years. The problem at hand was thus structured as the challenge to explore the opportunities for technological developments that meet this requirement.

The initiators commissioned the Advisory Council for Research on Nature and the Environment (RMNO) to systematically explore this line of reasoning. The Council then set out to quantify the concept of sustainability as much as possible, in terms of depletion of raw materials and of pollution and deterioration of resources. It concluded that for a sustainable development, the per capita emissions of pollutants and the consumption of resources must be reduced in fifty years to a level of less than 10% of those currently common in the industrialised world. In the resulting report (RMNO 1992).

7 A line of reasoning indebted to Commoner’s equation by which to express an entity’s environmental strain as the product of population size, prosperity and the environmental burden of production and consumption (see chapter 1 nt. 7).
the general idea of the limitations to the eco-capacity was endorsed by numerical data from which the ‘factor 20’ could be inferred.

Confirmed in their views by the RMNO-report, the initiators (who, in the meantime, had found an institutional basis in the form of an interdepartmental project group that consisted of representatives of the Ministry of Science and Education and of the four Ministries that had co-signed the NEPP: the Ministries of the Environment, of Public Transport and Water Management, of Agriculture, Nature and Fisheries and of Economic Affairs) reported positively on the possibilities for a programme to address the environmental challenges to technological innovation. A number of opinion leaders from the world of technological research institutes and industry were asked to comment on a draft version of the programme, and on twenty-some suggestions for technological innovation. The workshop organised to that effect resulted in a positive advice as to the contents of the proposal and affirmed the project group’s expected appropriateness. In addition, some suggestions for technological development paths were added that appeared promising from an environmental perspective.

Thus, through discussions with leading persons from government, industrial and scientific circles, the programme’s philosophy as well as its working method and objectives gradually took shape. A subsequent step was to outline and elaborate the technical processes and artefacts by which the requirements of a sustainable development could be met. The projects to elaborate specific innovative ideas were dubbed “illustrative processes”. These projects were to form the heart of the STD programme’s activities.

**Institutional setting**

In order to facilitate the implementation of the programme, in 1993, a Programme Bureau was set up as a five-year inter-ministerial organisation, sponsored by the five Ministries that had been involved with its preparation. The Ministry of the Environment was the largest contributor, financially. Both this Ministry and that of Agriculture were willing to guarantee their support for the total five year period. The other Ministries adopted a more hesitant attitude and granted their support on a year to year basis. The Ministry of Education and Science was mainly interested in the methodology of STD and merely supported the organisational set-up. The Ministry of Economic Affairs was the most reluctant to participate. Yet, the initiating group was persistent in gaining the Ministry’s support, because it was felt that this was the only way the programme would actually integrate ecological and economic considerations in technology-focused decision making.\(^8\)

\(^8\) The top of the Ministry of Economic Affairs was heavily pressurised into co-operation as its involvement was considered a *condition sine qua non* for continuation of the plans. The Programme’s hidden agenda was ultimately to convince the Ministry of Economic Affairs of the need to reform the existing technology policy. Therefore, the initiators of the STD Programme had opted from the start for an *inter-ministerial* programme organisation, rather than for an institutional arrangement within the Ministry of the Environment. Eventually, the
STD’s offices were located on the premises of the Netherlands’ Organisation for Applied Scientific Research (TNO) in Delft. Its staff, which was small in the beginning, included scientists from various academic disciplines and senior civil servants from some of the supporting Ministries, who were seconded to the STD Research Bureau for the duration of the programme. The Programme was supervised by a steering committee on which the participating Ministries were represented. In addition, a consultative forum was established in which the Programme’s target groups (industry, universities and scientific institutes) were represented.

Selection of research topics for the respective “illustrative projects” was done in consultation with the steering committee and the consultative forum. Because of its relatively independent position and temporary status, the STD staff’s discretion in selecting topics and methods for research was quite large. The staff had no formal role in the political decision making process on science and technology. Yet, the overall criterion for the selection of projects was that these had to fit in the Dutch governmental policy in general, and that they were acceptable to all the contributing Ministries.9

Selection of NPFs as a research topic

The topic of novel protein foods as a research field was not pinpointed in the analysis concerning the “need area” of food that was conducted some time after the STD programme had begun. It was brought up during the aforementioned workshop in the preparatory phase of the programme.10

As it turned out, most of the innovation suggestions that were made during the workshop were not suitable to meet the programme’s ambitious objectives (DTO 1994b). By and large, these involved amendments to the technological procedures and artefacts available at the time, which might improve the “environmental efficiency” of technology by a mere factor of two or three. The notion of non-meat protein foods, however, formed an exception in the eyes of the STD staff.

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9 Ministry conceded and entrusted a civil servant of the lowest possible rank with the tasks that resulted from participation in the Programme.

10 An overall selection criterion for research topics was the importance for the Netherlands’ economy of both the problem that was to be addressed in a project and the proposed technical solution(s): “[a]lthough directly applicable technologies or products are not immediately envisaged, the latter implies that the perspective of getting support from important economic sectors who see market advantages ahead will positively influence the choice of the illustrative processes” (STD 1994:10; my translation).

11 The analyses of ‘need areas’ that were commissioned to various research institutes, on food, transport, water, chemistry, and housing respectively, did not necessarily result in a more systematic or scientifically sounder selection procedure of research topics. The topics for ‘illustrative processes’ (15 in total) were selected “in a pragmatic, rather intuitive way” (Aarts 1997b:9). The selection was made in close consultation with various experts and potentially involved representatives of industry, on the basis of the expected technical and economic feasibility of suggested innovations, their potential contribution to the Dutch economy, and the availability of a project leader. The latter was someone with name and standing in a particular sector who was prepared to be at the forefront of the project to boost its image.
Apparently, the concept had been a topic of discussion in the Netherlands Council for Agricultural Research (NRLO), whose members were closely involved in the preliminary talks on STD (Letter of the NRLO to VROM, 18-12-1992). The initial idea was to produce meat-like proteins on the basis of some sort of broth. A rough, common sense assessment by the initiators of the STD Programme appeared to indicate the suitability of this ‘meat-in-vitro’ concept as a topic for an illustrative process. After all, meat production involves high amounts of energy, space and raw materials and contributes largely to the emissions of plant nutrients in the environment. Even without detailed calculations, it seemed plausible that a substitution of meat products therefore could contribute substantially to a reduction in environmental pollution and degradation.

Another reason why protein foods made an attractive topic to the initiators of the STD Programme was that it seemed promising to some major producers in the food industry, who appeared eager to participate in a study on the issue. For the STD Programme, this enthusiasm on the part of industry cleared the way for support from the Ministry of Economics, which insisted on financial involvement by the private sector before contributing to the Programme (a standard financing criterion with the Ministry).

It was decided to organise an illustrative process on the issue of NPFs (not so called yet, at the time), regardless of the outcome of the need area analysis on food. It promised to be an eye-catching first project which, given the enthusiasm of actors in the field, was likely to be successful.

The innovation context: protein research and the food industry

While the project addressed the topic of substituting meat proteins from an unusual angle, namely from an environmental and long term perspective, the idea itself was not new. In the 1970s, several firms had invested heavily in the development of meat substitutes on the basis of soy and milk proteins. At the time, R&D efforts in the Netherlands were directed predominantly at developing techniques for ‘building’ the required structure in these proteins.

Incentives to invest in this product development had been twofold. Firstly, addition of non-animal proteins to processed meat, such as hamburgers, appeared to increase the product’s quality. Soy components, for instance, retained moist better than the meat components during frying. Secondly, in correspondence to the increasingly stringent regulations on environmental aspects of industrial activity, there was a growing desire to put industrial waste (“by-products”) to good use and profit. A very attractive option economically was to render waste-products, such as the soy pulp that remained after extracting soy oil, suitable for human consumption.
It turned out, however, that the market prospects for non-animal proteins were bleak. According to Dutch law, the adding of "meat-alien" proteins to meat was prohibited." Moreover, consumers proved not very eager to try out the new meat substitutes. Market opportunities for non-animal protein products were virtually reduced to zero, eventually, when imitation meat (so-called TVP products) from the United States was introduced in the Netherlands. These meat substitutes were made of soy-protein that was processed in a 'quick and dirty' manner, that is, without removing the sugars. As a result, their consumption caused flatulence.

In the early 1990s, at the time of the start of the NPF project, there were hardly any dynamics in the field of vegetarian protein-containing meat alternatives in the Netherlands. A limited number of companies produced meat substitutes for a niche market. Research on proteins in several research institutes at the time focused on various aspects of protein application in industry, medicine and food. Yet, unlike some 20 years before, the subject of meat substitution was no longer a relevant research topic.

Factors co-determining the dynamics in the field

With companies such as Unilever, Nutreco (formerly Nutricia), Heineken and the Delft based producer of enzymes and yeast, Gist-brocades (now Gist-DSM), the food industry has a relatively strong foothold in the Netherlands. Within the food processing sector, the meat industry is well represented. The internationally operating firms dominate the market, among which Unilever and its subsidiary companies such as Unilever Research Laboratories at Vlaardingen and the meat producer UVG in Oss. In various niche markets, however, small meat processing companies, such as Boekos in Boekel, put up serious competition.

The (international) food industry is characterised by a fierce competition and by relatively frequent acquisitions and amalgamations between firms. Innovation in the sector is market driven. In product innovation, a short 'lead time' (the time lapse between the conception of a new product and its marketing) is essential in retaining a company's competitive position.

Since the markets of Europe and the United States are both saturated, an increase in market share can be obtained mainly by product differentiation. The trend in product

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"The quality, composition and labelling of meat and meat products is legally organised on the basis of the Commodities Act (Warenwet) by means of the so-called Meat Decrees (Vlees- en vleeswarenbesluit). The ruling regulation at the time of the NPF project included stipulations on the contents of a product in relation to the labels 'meat', 'minced meat' and 'meat product'. These labels were not allowed to be used, if "meat-alien proteins" were added. In that case, use of the label "product with x% meat and y% meat-alien protein" was compulsory, which was little attractive to meat producers. As of 1998, the Meat Decrees were reformulated to comply with EC directives. The stipulations concerning product labels were not fundamentally altered, although at least until then in some other European countries, the adding of non-animal proteins to minced meat and meat products was allowed."
differentiation at the time of the outset of the NPF project was the emphasis on ‘high tech’ foodstuffs in which the nutrition value is artificially increased (for instance, by adding calcium to milk and extra vitamins to fruit juices). Furthermore, there was a trend in developing new functional foods, such as ‘medi-food’ (for instance yakult and energising drinks), low-fat products and ready-made, convenience food. In addition, and seemingly in contrast, there was a tendency to emphasise the ‘natural’ quality of foodstuffs.

Among the most relevant parameters influencing the developments in the food sector in general, and the meat processing sector in particular, are the (inter)national rules and regulations concerning safety and health aspects of foodstuffs, relevant technological developments, the dynamics in the international commodity market and (local) consumers preferences. Firms attempt to influence these parameters; their ability to do so depends largely on their scale and geographical position. While powerful lobby-networks such as the soy-lobby or the dairy-lobby are known to influence national and international regulations on relevant issues, in general, legislation is a limiting condition for the dynamics in the food development and processing sector beyond the companies’ direct control.

In the Netherlands, direct governmental involvement with food is largely limited to the sphere of health and safety regulations. Dutch law does not include regulations concerning the environmental aspects of foodstuffs as such, next to the stipulations and laws concerning their production, packaging and dissemination. The national government does not actively seek to influence the development of specific food products for reasons pertaining to the environment.

Another major influence on the dynamics in the field, and one that is within the reach of the food industry, are the developments in relevant technical research. Business firms generally have their own R&D divisions, but also finance research in formally independent knowledge institutes and universities. The amounts spent on fundamental research and on product-oriented research vary among companies. In general, there is a tendency to contract out fundamental research to universities and other knowledge institutes as much as possible, in order to limit the expenditure on corpo-

\[12\] Health and safety aspects of novel protein foods for instance are regulated via the Statutory Regulation Protein Products that is drawn up on the basis of the Commodities Act.

\[13\] Even among the environmental organisations, at the time of the STD Programme, there was little attention for the relation between the environment and food. Because of the specific genesis of the environmental movement in the Netherlands (which came forth from the nature conservation movement), the emphasis of old lay on environmental care concerning the primary production of agricultural goods. The movement had, according to a spokesperson, a “blind spot” for the environmental aspects of processing and marketing food products. In the late 1990s, this was gradually changing as far as labelling (notably with regard to products produced with the aid of modern biotechnology) and packaging is concerned. At that time, the attitude of the environmental movement towards industry (among them the food industry) started to change as well. While the actions were traditionally directed ‘anti’ any particular activities of other actors, the organisations increasing adopted a more pro-active and co-operative approach, focusing on the inducement and stimulation of certain developments instead.
rate research. At the time of the NPF project, this tendency was getting stronger." As a result, the (food) industry increasingly determines the research agenda of universities and other knowledge institutes. The central government’s economising on general funds spent on university research enforced this development.

Protein-related research in the Netherlands in general is considered relevant for two reasons. First, as mentioned above, stringent environmental regulations induce the industrial sector to look for ways to extract proteins from waste flows, and preferably put them to profitable use in one way or another. Secondly, industrial (particularly non-food) applications of proteins offer an alternative market to producers of agrarian products. Proteins produced in the Netherlands are used, for instance, in the production of TV-screens. The Ministries of Agriculture and of Economic Affairs actively promote protein-related research by means of a so-called Innovation-oriented Research Programme (IOP) on Industrial Proteins.

The IOP-Protein intended to strengthen the empirical knowledge on protein application available in the Netherlands by enhancing the scientific insight in the relation between the structure of proteins and their functional properties such as taste, smell and solvability. In 1996, it commenced its second phase of four years. Research topics in the context of this and other protein-related programmes were selected on the basis of scientific and business economic criteria. As is the case with most research stimulation programmes supported by the national government, environmental aspects did not play a role in initiating new protein-related research in the Netherlands at the time.

The developments in the food (processing) industry’s R&D activities are predominantly determined by consumers’ preferences. These tend to fluctuate in accordance with such factors as inflation and purchasing power, but also in response to campaigns by the environmental movement. In general, at the time of the NPF project, the ‘average’ consumer was becoming more and more scrupulous where food was concerned. Because of the increasingly critical consumers, producers tended to strengthen their grip on the production conditions of raw materials and semi-manufactured ingredients. In order to guarantee certain quality standards, raw materials were increasingly produced on the basis of contracts. As a result, producers of raw materials and semi-manufactured products too were increasingly confronted with end-users’ demands.

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14 In the Netherlands, investments in R&D in the private sector in general decreased from 1.33% of the GNP in 1987 to 0.96% in 1994 (data CBS 1995). With these figures, Dutch private enterprise lags behind such countries as Sweden, Finland, France, Germany, Denmark and Great-Britain in which the business community spends a much higher percentage on R&D. Reasons for the Dutch ‘frugality’ are believed to be the small amount of large firms operating in this country, the relatively small internal market, and the maturity of the technologies in which Dutch firms trade (Van Grinsven 1998). These numbers caused some worry with the central government. Policy measures were formulated to increase the ‘knowledge intensity’ of Dutch industrial activity, for instance in the 1996 white paper by the Ministry of Economics, ‘Knowledge on the move’ (Kennis in beweging).
Because the market opportunities for non-animal protein foods were unsure at the time of the NPF project, the general mechanisms that drive developments in the sector were hardly likely to induce R&D on NPFs in the Netherlands. Only a small percentage of the consumers took to a vegetarian diet (about 5%) and it was unclear what constituted the surplus-value of non-animal protein products for non-vegetarians. Most food manufacturers held the view that the consumer’s choice for meat alternatives is not motivated by arguments concerning the environment. Therefore, as was obvious from the very start of STD’s project on the issue, future NPFs had to perform well with respect to taste, texture and nutrition value in order to be a match in the competition with meat products. The project therefore focused on the design of NPFs as a promising development towards a sustainable future from an environmental perspective as well as a consumer’s and business-economic perspective.

The illustrative process on NPFs: a ‘multi-dimensional’ analysis

The project was organised on the basis of the central presumption that if NPFs were to play a role in reducing the environmental burden of meat production, they should be able to actually replace meat products in the general consumer’s diet. The extent to which NPFs could contribute to a sustainable development, it was argued, therefore was not only dependent on their environmental performance and their technical feasibility, but also on the prospects for their market penetration. Consequently, information on “consumers’ aspects”, that is, on the NPFs’ taste, texture and image, had to be included in the analysis.

Another inference of this line of reasoning was that if the NPFs were to yield the desired environmental effect, it was absolutely necessary that the food industry would be willing and able to provide a sufficient supply of NPF-products. Therefore, the attractiveness of NPFs to potential investors from a business-economic perspective was to be included in the analysis as well. In addition, given the expected scale on which NPFs were supposed to substitute meat to have an environmental impact, the impact on the Dutch economy and notably on the food and livestock sector were considered sufficiently significant to be included. As a result, the STD Programme’s general philosophy on the need and possibility of integrating ecological and economic notions on the project level was elaborated into a ‘multi-dimensional’ analytic design that covered five fields of research.

The project’s set-up as a cluster of five simultaneously conducted analyses, with a project team to co-ordinate the various research activities, was designed at the preparatory stage of the project, at which time the initial selection of promising protein sources was made as well.
Preparatory stage of the illustrative project

The meat-in-vitro suggestion was extensively discussed with a small group of actors with expertise on the subject (managers of research divisions of leading food companies, a scientist from the Agricultural University and members of the NRLO). The resulting discussion paper (Jansen 1993) advised positively on the elaboration of a project on "meat-like products." The general objective of the project was, at this stage, formulated as "producing a communicable design of a meat-like product which can be produced in a way that is 20 times more environmentally efficient than the production of meat." The paper also contained a rough sketch for the design of an illustrative process to achieve that objective.

The suggested first step was to commission a "definition study" on the subject. This study was conducted by the consulting firm A.D. Little, and was financed by the Ministries of Agriculture and of the Environment. The study focused on the feasibility of developing protein products that were attractive to both producers and consumers, of which the nutrition value compared to that of meat, yet which could be produced in a more environmentally efficient way. The study was based on desk research and approximately 20 interviews with experts on the subject, in the Netherlands and the USA. It resulted in an overview of some twenty combinations of protein sources and technological procedures that appeared promising. Its main conclusion was that, depending on the specific protein source, the expected environmental efficiency of NPFs would be significantly higher than that of meat production, yet that the technologies required for producing an edible and attractive product were largely embryonic (A.D. Little 1993). In addition, the report outlined a detailed project plan for carrying out an illustrative process on NPFs.

The ensuing project, which was launched in February 1994, not only adopted A.D. Little's phrase of "NPFs" to indicate the project's topic but also its suggested organisational structure. Five research fields were to be covered, of which the interplay between the consumers' analysis and the technological research was considered of crucial importance. The interaction between (representatives of) consumers and technologists, it was argued, could "direct the development of technology on the one hand, and influence the acceptance of a new protein product and the required production process on the other" (DTO 1994b:8).

Selection of participants

At this stage, the practical, strategic elaboration of the project was already considered at least as relevant as its contents. In order to ensure that "third parties" (research institutes, business and industry) would continue the development of the envisaged protein products after the project had come to an end, the social embedding of the analytic
process in a perceptive context was seen as essential. A stakeholder analysis was conducted to identify potentially interested discussion partners, and to assess “potential risks” for the project. These risks included non-co-operation (NPFs might not be regarded a business-case by industry, since the STD Programme might be considered a pot-shot, or because consumers’ behaviour is unpredictable) and non-adoption (the meat sector might protest as NPFs may pose a threat to employment opportunities; uncertainty with respect to public health aspects might cause resistance).

The stakeholder analysis included a wide range of parties, ranging from the five Ministries that were involved in the STD Programme to the major trade unions and environmental organisations. Interestingly, the selected parties within this broad range of stakeholders were, at least as far as the food companies and technological institutes were concerned, limited largely to the initial discussion partners (Unilever, Gist-brocaades and to the Agricultural University in Wageningen, the Institute for Agrotechnological Research (ATO), at the time closely related to the Ministry of Agriculture, and TNO). In addition, talks were held with some biotechnologists in other universities and the National Institute of Public Health and Environmental Protection, and with a company that dealt in pharmaceutics, agrochemicals and seeds, and two major feed producing companies. These talks did not have any follow-up.

Organisational focus

Both contents-related and strategic considerations converged in the criteria that were applied to the selection of protein sources. In order to make the project fit in the context in which the most relevant actors operate, the protein sources were selected according to the preferences of the discussion partners in industry and the technological research institutes.

The selection was based on the tender of the three institutes that were to implement the technological research. The involved technologists did not attach much value to the technical aspects of the definition study. The protein source selection that they proposed was made “in mutual consultation” (Jongen, personal communication, October 18, 1996) between the three envisioned implementing research groups, in relation to a rough initial selection of technical procedures by which to process the protein sources.

The protein sources that the technologists proposed were selected on the basis of the expected success in the relative short term (the newest technologies “are in such an embryonic state that in the short term no break-through can be expected”; Proposal NPF research LUW, ATO and TNO to STD, June 1994:2.), of the energy conversion factor (on the basis of which animal proteins were dropped), of the expected energy use during the processing of protein sources (on the basis of which certain technologies were dropped) and of the origin of the protein sources (which had to be producible in the Netherlands). Proteins from existing waste-products were not incorporated in the
initial selection, as other programmes already dealt with these. Ultimately, the proposed selection was based on the wish to spread the assignment for research equally between the three co-operating institutes. After subsequent deliberations with the project team and each other, algae were added to the initial selection. The “environmental criteria” that were mentioned in later documents as guiding the initial selection merely consisted of the “common sense insight” (Jongen, personal communication, October 18, 1996) into the expected environmental burden of animal protein as opposed to other protein sources.

Structuring the problem: from designing a synthetic steak to outlining research opportunities

Since A.D. Little’s findings did not form the basis of the subsequent research, in the preparatory phase, there was little substantial basis on which to organise the analytic process. In fact, at this stage, the project went ahead on the basis of the rather ill-defined idea that the development of food products on the basis of non-animal protein could contribute to a reduction of the environmental burden associated with meat production. The idea was found sufficiently challenging and promising to get the project going, yet the STD steering group that initiated the organisational and research activities during this stage did not itself pay much attention to elaborating the topic substantially.

As a result, by the time that the various research institutes had been contracted, their proposals approved and their research assignments granted, there was little coherence or consensus as to what exactly the illustrative process was to yield, and how it could contribute to instigating a sustainable development. At that moment, the NPF ‘project team’ was installed. In line with A.D. Little’s recommendations to attract a senior manager with a robust reputation in circles of science and business, the project team was chaired by a former captain of industry. In addition to the ex-Unilever chair-

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9 The initial inclusion of algae as protein source was considered to be of interest to the participating food companies, for which the possibility to have fundamental research conducted within the context of the NPF project was part of the motivation to co-operate. However, in a subsequent phase, on the basis of information from the non-technological analyses, algae were discarded again. Production of algae on a commercial scale was considered not feasible in business-economic terms. Furthermore, among the various non-technologically oriented researchers, there was a strong preference for plant(parts) and mushrooms as protein source. This rather conservative selection was supplemented with the more “adventurous” and risky choice for single cell proteins (SCP). This choice was motivated by the consideration that “with the present knowledge and state of the art of the technology, it must be possible to strongly improve the results with SCP as achieved in the 1960s”. Eventually, in the NPF project, single cell proteins, plants, and – at a later stage – fungi were selected as protein sources.

10 The technical research was to be implemented by the Food Institute of the Netherlands’ Organisation for Applied Scientific Research (TNO-Nutrition), the Institute for Agrotechnological Research (ATO-DLO), and the Department of Integrated Technology of Food and Physics of the Agricultural University Wageningen. The Centre for Environment Studies Leyden (in Dutch: CML) and the Environmental Division of TNO investigated the environmental aspects. The two economy-oriented research clusters were implemented by the Agricultural Economic Institute (LEI-DLO). The research on consumers’ aspects of NPFs was contracted out to SWOKA, an institute for strategic consumer research.
man, the team included a Wageningen University-based scientist, a process coordinator, a secretary and a communication advisor. The team’s tasks included controlling the quality and internal communication between the several research groups, a timely integration of their outputs, and general public relations. The team was assisted in its tasks by an advisory board with a consultative task (klankbordgroep).

The newly installed team did not approve of the direction that the project appeared to be taking. In particular, it did not endorse the choice to design NPF ‘test products’ which were to be judged subsequently by a specially trained consumers’ panel. The project team’s criticism stemmed from a fundamental difference in view with the STD steering group regarding the end-product of the project. According to the steering group, the project was to result in a ready-to-eat protein food, that would occupy a stand-alone position in the available food range. Notably the technically trained members of the project team doubted the feasibility as well as the desirability of designing an end product within the NPF project, given the developmental stage of interesting and relevant technologies.

The implementers of the technological research shared the project team’s standpoint regarding the project’s end product. They held, however, a more inclusive view of the problem at stake. The technologists disapproved, initially, of the project’s exclusive emphasis on proteins. As was outlined in their research proposal, according to the technologists, preferably the entire protein source had to be taken into account, including its oils and carbohydrates. Furthermore, the technologists insisted that the project should focus on the entire food production chain. In their eyes, in addition to the processing of proteins, in a project that meant to contribute to a reduction of the environmental stress in food production, also the cultivation of protein sources deserved attention.

As a consequence, at the time the “preparation phase” was rounded off, and the actual project (the “programming phase”) was to begin, in June 1994, the objectives and potential of the NPF project were vehemently debated. A “Manual” to guide the prospective research activities in the NPF project, drafted by the project team, put an end to the discussions. It was decided that the NPF project was to result in an overview (a “sketch”) of promising novel protein food options that were assessed in the light of the five involved research perspectives. The project was still expected to result in a product description of a specific NPF end-product “together with an outline of its production procedure and the R&D programme necessary for developing it” (DTO 1994c:3). The novel protein foods were to be described in such a convincing manner, that relevant stakeholders were triggered to act upon this information and to actually start producing and marketing them.
The analytic process: to “convince by illustration”

The idea of describing end-products fitted the STD Programme’s general philosophy. The basic objective of the STD Programme was not to influence technology development as such, but to “set examples ... to illustrate both the possibility and the direction of technology development for sustainability” (Vergragt & Jansen 1993). The Programme aspired to produce such illustrations in the form of “communicable designs” of technical options, which in a sustainable way provide in future societal needs. These options could entail innovations on the system level, on the artefact level or on the component level. Furthermore, the Programme was expected to result in recommendations for scientists and R&D divisions of firms about the directions to take in research in order to contribute to a sustainable development.

In addition to these contents-related objectives, STD also formulated aims with regard to creating a “societal support base” so as to generate a climate and context that were favourable to the Programme’s mission and actions as well as to the development of the envisioned technologies. Thirdly, by way of a learning-by-doing approach, the various projects (the illustrative processes) were meant to provide insight into the methodology of designing and instigating sustainable technology development, in line with the various notions that together constituted the Programme’s conceptual basis. Called a “research programme”, STD not only instigated research, but also formed itself the object of research that eventually had to result in an overview of experiences with ways to induce long-term, environmentally benign innovation processes.

Corresponding to STD’s overall goals, three types of objectives were formulated for the NPF project. As regards the contents, the project was to result in a description of a research and development trajectory for NPF-products for the mid-term (5-20 years) and the long-term (20-40 years). The NPF-products to be developed had to entail an eco-efficiency improvement over meat production by a factor of twenty, they had to be acceptable to consumers and society, attractive to producers and distributors and technologically feasible, and they were not to have unacceptable effects on the economy. As regarded the support base for the actual development of environmentally sound NPFs, by the end of the project, its mission had to be reflected in initiatives of companies, governmental institutions, consumers’ organisations and environmental organisations to contribute to the development of NPFs. The existence of such a supportive base was to be expressed in the R&D-programmes of companies and research institutes, through the creation of a research consortium to carry out the required R&D, and in a general acknowledgement among relevant parties that novel protein foods may contribute to a sustainable development. The objective regarding the methodology was formulated as developing methods for stimulating processes of sustainable technological development for protein substitution.
These objectives were translated in the Manual into sets of research questions to direct the five fields of research. This operational elaboration of the project’s objectives shows that the NPF project team defined the project’s challenge as a technical problem to substitute the nutrition value of meat by means of a newly developed protein food which could be produced by the Dutch food processing industry, for which the Dutch agricultural sector could supply the raw material, and of which the environmental gain (as compared to meat) was to be won in the processing techniques of the protein sources. On the basis of this problem definition, the various research groups set to work.

Combining qualitative and quantitative research methods

The novelty character of the NPF project posed numerous methodical challenges to the respective research groups, as well as to the project team that was to integrate the various findings. The methods which were employed to answer the research questions differed according to the characteristics of the topic and the working tradition of the responsible research institute. In practice, in accordance with the emphasis that the STD steering group had originally put on the integration of technical and consumer-related information, the technological research and, to a lesser extent, the research on consumers’ issues took the lead in the NPF project. The environmental research as well as the macro-economic and the business-economic research followed the track that was outlined by these.

The technology research cluster’s contribution to the project was based on desk-research and some interviewing with experts; no laboratory work was done. To the involved technologists, the project’s focus was “odd yet challenging”. The idea to organise the research on the basis of more or less clear-cut notions about its end-products was a relatively new and “enlightening experience” (Eggink, personal communication, October 18, 1996). In addition, the multi-disciplinary approach in the project posed challenges to the usual modes of thinking about a technical problem. The attuning of the various research activities to one another therefore entailed not only a practical but

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7 The environmental research consisted of a Life Cycle Analysis (LCA) of the various NPF options that were outlined by the technology research cluster. The business-economic analytic activities focused on the marketing aspects of those options. The macro-economic research analysed the impact of the development of NPFs as compared to that of meat production and consumption on the Dutch economy. The scenarios elaborated to that end provided the framework by which the various NPF research activities were integrated in the second stage of the analytic process.

8 One of the three participating research groups already organised part of its work by identifying technical research and development issues on the basis of consumers’ perceptions of future end products and the corresponding product specific design demands.

9 Notably the request to provide an indication of the production costs of the selected NPF options, which was required for the business-economic analysis, was met with considerable scepticism by the technologists, as was the condition that the resulting NPF options should be favourable to employment opportunities in the Netherlands.
also a substantive challenge. Notably the interplay between the technological research and the research on consumers' aspects proved intricate.

In their contribution to the NPF project, the analysts of the consumers' research employed a procedure that they had recently developed, dubbed Future Visions of Consumers (henceforth referred to by its Dutch abbreviation, TvC; cf. Fonk 1994). This method is participatory in character and focuses on integrating notions about future consumers and their perspectives into the decision making on technological development paths. The objective is to thus co-direct technological development on the basis of expected future users' claims, concerns and issues regarding the technology that is to be developed, in order to contribute to “socially acceptable developments” (Fonk & Hamstra 1996:3).

The NPF project offered the first opportunity for the TvC procedure to be carried out. The procedure consisted of various research activities. The initial research activities were intended to provide information on the present-day consumer and his or her perceptions of meat and novel protein products. This information formed an input in the activities to develop “future visions of consumers”. The latter activities were interactive in character, and involved, in this project, three meetings of a heterogeneous group of actors who were (potentially) involved in NPF development. The three interactive sessions should result in a commonly shared perception (“future vision”) of future consumers (called a “common TvC”) on the basis of individual perceptions of consumers and their considerations about NPFs (the “initial TvC”), and on the basis of such perceptions as per selected category of professionals (“actor-group dependent TvC”).

The meetings, which were organised as a stay-over arrangement of an evening and the following day, were each attended by about 25 participants. The participants were representatives of technological research institutes (the “technologists”), professionals working in the R&D or marketing divisions of companies (the “marketing group”) and representatives of societal organisations, among them various consumer organisations and environmental organisations. During the sessions, the specific NPF-related research questions formulated by the project team were combined with the assignments to develop future visions of consumers. For each session, the findings from the other research clusters, notably from the technological research, were incorporated as well. Thus, the assignments focused on an assessment of (future) consumers’ aspects of the NPF options that were proposed by the technologists. The resulting tasks for the TvC participants pre-structured the direction of the discussions during the meetings to

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*In the case of the NPF project, the TvC research activities included exploratory desk research to assess relevant consumers' aspects of meat and meat substitutes and in-depth interviews (about twenty) to the same end. In these, descriptions of vegetarian meat substitutes served as a starting point for discussion. The results of these interviews were processed to form the input for a survey (N=1000) on the consumption of meat and meat replacements. By using the findings from the in-depth interviews as a starting point for setting up the survey, the survey intended to yield information on the motives, associations, norms and values that bear on the consumers' decision to buy and eat meat substitutes.*
some extent, yet they left ample room for interpretation and debate. The discussions were chaired by an independent “facilitator”.

In spite of the conscientious efforts to consistently incorporate the output from the technological research in the TvC assignments, the data of the two analytic tracks were not easily integrated. Many of the TvC-participants without a technical training indicated that they found it difficult to deal with the technical information and technology-focused questions (cf. Fonk & Hamstra 1996:7; Van Wieringen, personal communication, September 20, 1996) and reported a reduction in enthusiasm and creativity as a result. Furthermore, the TvC results were hardly quantifiable, whereas the data processing procedure on the project level required quantitative data (the findings of the five research clusters were integrated by means of a so-called portfolio analysis). As a result, the normative aspects of meat production, meat substitution and NPF development, which came up for discussion during the TvC meetings (see below), were not incorporated in the end results of the NPF project as such.

To the project team, the multidisciplinary approach to analysing NPF development presented unforeseen difficulties. The anticipated cross-fertilisation between the disciplines was slow to materialise, as genuine interaction and communication between the involved research groups proved hard to establish in the early stages of the analysis. At first, communication between the researchers took place at the project’s workshops that were organised every three to four months. In between these meetings, information was to be exchanged via the project team, to which end the team had designed so-called “interaction sheets”. On these, each research group could indicate which kind of information from which research cluster it required. The sheets soon proved insufficient to allow for a proper mutual understanding.

It also turned out that the workshops did not initially provide the appropriate platform and context for the anticipated exchange of ideas. Among the barriers was a lack of mutual understanding due to differences in professional jargon, as well as a general feeling among the researchers that the results presented by the others were “not relevant for one’s own research”. In addition, the consumers’ researchers as well as the economic analysts found it hard to comment on the propositions made by the technologists, since in their own eyes, they lacked the know-how to do so adequately: “It was an enormous amount of technical information on which one did not dare to comment for fear of showing that one did not understand what it all meant.”

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4 The output of the TvC procedure was taken into account in the technological analysis more in spirit than in letter. In the reports produced by the technologists, merely the thrust of the consumers’ research findings was acknowledged. In the final study by the technologists, the findings from the initial (desk) research phase in the TvC procedure were used. The NPF product examples, which were drawn up initially by the technologists on request of the NPF project team to serve as a basis for the preliminary (non-participatory) consumers’ research, did not play a role in the subsequent analytic activities by the technologists. The amount of exchanged and mutually employed information that is documented, however, obviously does not fully cover the extent to which a ‘cross-fertilisation’ between the research clusters took place within the project’s context.
The communication and translation problems could not be solved by the planned intermediary activities of the project team. Gradually, it became apparent that the need for more face to face contacts, in between the workshops was commonly felt. In the second phase of the analytic process, such meetings were eventually organised every two weeks. The atmosphere of these plenary sessions was less formal than at the workshops. In addition, the project team came to play a different role in enabling a communication between the researchers. At these meetings, in general, the team's role was one of a mediator rather than intermediary, and of a facilitator rather than process controller. These roles, in hindsight, fitted better the originally intended 'interactive' character of the NPF project.

Organisational focus -continued-

The NPF project was described by the project team as an “interactive” analysis, in which the analytic focus was jointly decided upon by the various involved stakeholders in consultation with the project team. In retrospect (Weaver et al. 2000), the project was typified as an example of Constructive Technology Assessment (CTA; see chapter 1 this book), of which the analysts’ “neutral role” was considered a characteristic methodological trait: “Values come from stakeholders directly and not from the analyst. The role of the analyst is therefore (...) to facilitate a discussion among innovators and stakeholders through which relevant design and evaluation criteria as well as the positions of stakeholders can both emerge and be formed (...) in a constructive and ‘power-neutral’ context (Weaver et al. 2000:135).

Weaver et al. continue the description of CTA in their account of the NPF project as follows, and I quote at length12:

CTA is particularly useful in the context of complex and unstructured problems, which are typical of sustainable technology development. ... New technologies are, by definition, characterised by uncertainty. This means that new technologies need to be introduced via a process that involves open and frank discussion about concerns, risks and contexts, which seeks to integrate concerns into technology designs and which builds consensus around agreed courses of action to reduce uncertainty. ... CTA is an inclusive, interactive and iterative process ... [A] key objective is to ascertain all stakeholders’ concerns either directly from them or from their representatives. ...[A] specific objective of CTA is to develop a possible synthesis. This does not necessarily imply a compromise but rather a search for entirely new positions to which the many different parties can all subscribe. ... The process tends to move between rounds of discussion and rounds of research. The research is driven by the questions raised during the workshops and is designed to feed new information back into subsequent workshops (2000:135-6; italics in the original).

12 Weaver et al.’s description of the TA concept that underlay the NPF project makes clear that the project, which is by these authors typified as a CTA, in its intentions fitted the characteristics of what in this book is called ‘interpretive TA’.
In practice, in the NPF project, there were two types of interactions with interested parties. On the one hand, there were the frequent and intensive contacts between the project team and the researchers of the five research groups. More than in the usual, "non-interactive" multidisciplinary projects, in which various types of scientists obviously also interact, in the NPF project, the contacts between the involved researchers qualify the project as "interactive" in the above sense. In this case, after all, the researchers not only were the implementers of the research assignments as commissioned by the project team, but were also stakeholders with respect to the (future) development of the NPF options that were being analysed. The project team notably viewed the involved technological research institutes as relevant stakeholders in the light of future NPF development.

On the other hand, there were the interactions with the actors outside the project's organisation ("third parties") whose views were solicited in various ways. Most systematically, stakeholders were involved through the TvC procedure. In addition, the advisory board provided an opportunity to involve interested parties, as did, obviously, the informal discussions with the financial supporters of the project. Moreover, stakeholders' views were solicited through the two stakeholder-analyses, which amounted, in the words of the project's chairman, to "talking, talking and talking again". Finally, with an increasing frequency towards the end of the project, all sorts of actors were approached by the project team with the request to discuss NPF development and to adopt activities in their professional context that might contribute to that development.

Of these divergent platforms for exchanging information on NPF development, the TvC procedure provided, as far as methodology is concerned, the most structured opportunity for discussion to a wide range of stakeholders. As was mentioned above, the participants were recruited to represent three categories of actors involved in technology (NPF) development: technologists, marketeers and societal actors (among which the central government, consumers' representatives, and environmental organisations). The individuals to actually partake in the TvC meetings were selected more or less at random. Technologists and actors working in the R&D or marketing divisions of companies were approached through the existing STD/NRLO contacts. All three technological research institutes involved in the NPF project as implementers also had representatives participating in the TvC procedure. Representatives of societal organisations were recruited in the network of the implementing research institute, SWOKA.

The selection of topics to be discussed at the TvC meetings, as well as the way in which their results were to be processed, were co-determined by the TvC procedure's embedding in the framework of the NPF project. Thus, the claims and concerns of the

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2 The NRLO (the Netherlands Council for Agricultural Research) had been closely involved in the brainstorming sessions on installing an STD Programme (from which stemmed the original suggestion to organise a project on 'meat-in-vitro') and remained a sparring partner in later stages.
NPF project team that were formulated in consultation with the five groups of researchers formed the main ‘organisational foci’ of the interactive sessions. Still, the participants had some influence on the agenda. For instance, the second TvC meeting (on March 2 and 3, 1995) included, on request of the participants, ample room for a brainstorming session on the relation between consumers, food and NPFs in the future. In general, the discussions that were structured on the basis of various assignments did not cover solely the mere technical aspects of NPFs in relation to expected consumer behaviour. Time and again, TvC-participants addressed normative aspects of sustainable food production and of NPFs as a solution strategy, including questions concerning the relevance of developing NPFs from the perspective of sustainable development (see below). The results of the three meetings were compiled in a “final statement”, which included an overview of the issues upon which the participants had not reached an agreement.

The advisory board met four times during the course of the NPF project. Both companies that were financially supporting the NPF project were represented on the board, as well as the main consumers’ organisation in the Netherlands (Consumentenbond), two research departments of the Agricultural University Wageningen, the Ministry of Economic Affairs, the NRLO and the main farmers’ organisation, LTO-Nederland. Small and medium-sized enterprises were not represented. Furthermore, no environmental organisations were found willing to sit on the board. A commercial environmental advisory consultant was asked to join instead.

44 For the first TvC meeting (of December 6 and 7, 1994), participants were asked in advance to detail their personal “future visions” of consumers and their wishes and demands with regard to meat and NPF options. The results from the preliminary desk-research and in-depth interviews were sent to the participants, in addition to the technical information from A.D. Little’s inventory of promising NPFs. At the meeting, on the basis of the personal views, a future vision of consumers was jointly drawn up per actor-group. A list was made of the aspects of NPF that the actors expected consumers to consider the most relevant. On the basis of these aspects, the NPF-options as described by A.D. Little were assessed per actor-group, upon which the commonly shared issues were sorted out, and the differences were discussed. The results were not considered a sufficient basis to continue the assessment procedure at the second TvC meeting (on March 2 and 3, 1995), “for lack of technical know-how on the part of most of the non-technologically trained TvC participants” (Fonk & Hamstra 1996:7). Instead, at this meeting, the expected consumption pattern of the future was discussed. Product examples to suit different “meal moments” were constructed by the participants, as most of the product suggestions that were made by the technologists in the NPF project were considered not suitable or attractive. Finally, the participants estimated to which extent the semi-manufactured NPF products that the technologists had designed might fit the end-products and meal times as defined by the TvC participants. The third and final TvC-meeting (November 9 and 10, 1995) focused on a further, more precise selection of NPF products, consumer target groups and “meal moments”. The target of 40% meat substitution in 2035, which was formulated by the NPF project team in consultation with the involved technological researchers, formed the starting point for selecting target groups and meal moments per NPF product, and for discussing the criteria that these products will have to comply with in order to reach the intended consumer target groups. Thereupon, the results of all three TvC meetings were discussed, and commonly endorsed inferences about consumers’ aspects of NPFs in the future were drawn. In addition, an inventory of issues that were not agreed upon was made. Subsequently, the analysts drew up a final statement on the basis of these inferences and findings (Fonk & Hamstra 1996:4-9), which was sent to the participants for comments.

45 The major motive to turn down the invitation was the reluctance to commit oneself (as an organisation) to a project of which the outcome was unsure, and of which the environmental benignity was not at all clear or considered dubious. In the latter case, parties were concerned that their involvement could be conceived of as an approval of developments that they might eventually not support. Other reservations concerned the sheer
The advisory board’s discussions focused on the developments in the NPF project and the decisions taken by the project team. The discussions were structured on the basis of a brief memorandum that was drafted by the project team, and which was sent to the board’s members in advance of the meeting. Discussions were vivid, and a wide range of topics was covered. Still, members of the advisory board recall not to have had a decisive influence on the contents of the NPF project: “It was as if everything had been planned beforehand, and the project team subsequently was trying to find support for their ideas. I don’t think that [the advisory board] has had any real influence on the direction of the project.”

From the very beginning, the STD steering group and later the project team had discussed the topic of NPFs and the project itself with a large number of stakeholders, among whom the two companies\(^\text{6}\) that eventually decided to support the project financially. The two stakeholder analyses that were carried out in the project’s context were the formal, systematised reflection of this informal practice. In the first analysis, stakeholders were considered “all those persons who can influence the development of the Illustrative Process in a positive or negative way” (DTO 1994e:1). At that occasion, 18 stakeholders were identified as potentially interesting sparring partners, among which 5 companies. The second stakeholder analysis, towards the end of the analytic process, defined stakeholders as those actors that could positively or negatively influence the development of NPFs (DTO 1995b:1). At that time, 115 actors, among them 40 companies, were included in the analysis.

In addition, at the final stage of the project, which focused on the “embedding” of the projects’ results within the relevant networks, numerous informal meetings with potentially relevant and interested parties were organised on a bilateral basis. In these bilateral discussions, the ideas and concerns of the sparring partner were discussed and related to the NPF project’s objectives and mission.

It was notably through the informal discussions, as well as via the interactions with the implementing research institutes, that the claims, concerns and issues of NPF stakeholders had a bearing on the contents and direction of the NPF project. Especially in second phase of the analytic process, the interactions between the various research groups, and between them and the project team came to co-determine the agenda of the analytic activities. The first research period had been largely “pre-cooked”, in the words of an involved researcher, by the project team. Now, the research agenda was set in close consultation with everyone involved. As was the case in the first phase, a

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\(^{6}\) The NPF project’s main supporters were Gist-brocades, producer of baker’s yeast, enzymes and penicillin, and Unilever’s corporate research division, Unilever Research Vlaardingen. For the second stage of the analytic process, additional support was gained from Avebe, world leading producer of potato starch and derivatives. Furthermore, the participating research institutes were each asked to partly finance their own research contribution. The supporting Ministries carried the remaining expenses.
"Manual" was drawn up in order to tune the various activities to one another. Still, it was decided that the researchers might depart from the research goals and methods that were outlined in the manual, provided that such adjustments would come about in close consultation with the project team. As a result, at this stage, the project's central problem was redefined to some extent, that is to say, the operational research challenges which were formulated on the basis of the problem definition were reformulated.

Closure

The above account of the various interactions with stakeholders shows that the initial responsiveness to the claims, concerns and issues of (some of) the involved parties in the preparatory stage subsequently was translated into a rather rigid project design. The project's format precluded, to some extent, the incorporation of newly gained insights and an integration of inputs of 'new' stakeholders that were involved in a later phase. Many considered the project's rigid set-up at odds with the STD Programme's underlying philosophy. At times, it annoyed researchers and other participants ("third parties") alike.

The project team itself was aware of the need to adopt a flexible approach, given the project's topic and experimental project design. In the Manual, the possibility of reformulating research questions and of readjusting methodological procedures on the basis of newly developed insights was explicitly acknowledged (DTO 1994d, introduction). Still, the complexity of the analytic process and the need to attune the various research activities to one another, in the eyes of the project team members, prompted a predetermined sequence of analytical activities. Another managerial consideration that contributed to the inflexible approach was the notion that a formulation of the final results beforehand was necessary in order to enable a quality control of the entire process. As a result, in practice, at least in the initial phase of the analytic process, there was little room for adjustments along the way.

The scope for adjustment was limited to such an extent, that when a particular research activity failed to provide the expected data, it was not the expectations concerning the research process that were adjusted but the data generating activities. When, for instance, the Tvc procedure did not result in a quantified estimation of the extent of meat substitution in 2005 and 2035, the project team itself made an estimation of these percentages, because the data were considered indispensable for the continuation of the analytic process.

The strict timing and the detailed formulation of expected end results in advance roughly determined the course of events in the project. Still, with respect to the contents, the findings of each phase and research activity co-determined the further elaboration of the following analytic steps. As one of the involved researchers put it, time and
again, “the sails had to be trimmed to a new wind”. Indeed, in retrospect, an overview of the objectives of the project as formulated in the subsequent phases in the NPF project shows that gradually, the expectations about the project’s capacities and end-results shifted.” Over time, expectations evolved from the “meat-like substitute product” on the basis of which the project was organised, via the notion of “designing concrete NPF products” to a “sketch of potentially successful NPF-products”. This latter notion changed, under the influence of the findings in the TvC procedure and the views of the involved technologists, into focussing on “potentially successful NPFs as product ingredient” (see below). These ingredients were defined as an “NPF-option”, that is, as a specific combination of protein source and technical processing procedure.

The leeway for substantive change, however, was limited. The ‘closure’ to the project was narrowly set. The two basic points of departure were captured in the project’s problem definition. Firstly, the project team departed from the perspective that the want for meat is motivated by a want for proteins. Secondly, it cherished the view that the envisioned environmental efficiency was to be gained by improving the techniques for processing raw materials into new foodstuffs.

These rules of closure that, unlike the expected end results were not explicated beforehand, implied a major limitation to the range and scope of the issues that could be addressed within the project’s context. Since the project’s major challenge was defined as improving protein processing techniques, other environmental aspects of the production of NPFs were considered to fall beyond the scope of the issue addressed in the project.

The hesitance to include the environmental aspects of the production of protein-containing raw materials is an example of the restriction to the possibilities of the project that this closure entailed. The involved analysts of the technology research cluster, who had emphasised the need to take the entire “protein production chain” into account from the start, gradually reached the conclusion that the main environmental gain in producing NPFs was to be found in reducing the environmental stress that is associated with the agricultural production of protein sources. The project team, however, strongly opposed to including an issue such as crop-protection in the analysis. It argued that even if all known improvements in production techniques were implemented in arable production, still the target of reducing the environmental burden of present-day food production by a factor of twenty could not be realised. The technolo-

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42 Such an overview was included in the concept version of the NPF project’s evaluation report that I produced in addition to the present case study (Loeber 1997). To my surprise, the project team objected to such a presentation of the findings, as it considered the recurrent reformulation of the project’s objectives “a weak trait”, whereas to me, it was evidence of an admirable reflection-in-action that the team had displayed in the course of the project.
gists, in turn, posited that the findings of the NPF project showed that this target was not met by the discussed NPF options either.28

In order to get the environmental aspects of the agricultural production of protein sources acknowledged in the NPF project, the technologists defined the issue in terms that fitted the project’s closure. First, the environmental aspects of crop production were assessed. To that end, the environmental researchers reviewed, in close consultation with the technologists, the analytic framework on which basis they conducted the Life Cycle Analysis of the discussed NPF options, so as to differentiate between various types of crop-protection agents and their use. Thereupon, the technologists formulated the environmental burden in the primary protein production as a “technological challenge” to NPF development. This wording allowed for an inventory in the NPF project context of existing ecologically sound crop-protection methods, for which a number of experts on the issue were consulted. Under the heading ‘technologies to be developed’, subsequently, the technologists remarked that “an environmentally friendly production of these [NPF] sources (...) [is possible] on the basis of existing knowledge” (Linnemann et al. 1996:14). They concluded their argument by stating that in time, each of the described NPF options could meet the criterion of an increased eco-efficiency by a factor 20. Yet, they posited, such a result would be achieved sooner if the exclusive use of ecologically produced raw materials for NPFs was promoted (1996:16). According to the technologists, in other words, realising the ‘factor 20’ objective amounted to a political choice, not a technical challenge.

Political issues were also addressed in the TvC meetings. A number of TvC participants preferred to view the problem of ‘unsustainable’ food as an issue of consumption rather than production. In their eyes, the focus on NPFs precluded a range of other possible solutions to the environmental stress associated with meat production, which deserved attention as well. Some participants sought to include in the discussions other issues than the mere environmental aspects of food production, such as animal welfare and the distribution of food between the North and the South. The project’s focus on the Dutch national context was too limited from a sustainable development perspective, it was argued. The Dutch consumer might do without meat or NPFs, and still have a sufficient protein intake. Some discussants added that to reduce global food shortage problems, however, stimulating the development of NPFs might make sense (Final statement TvC-participants, in Fonk & Hamstra 1996). Such a perspective would imply the need of a different focus in the NPF project. Discussions on such redefinitions of the issue at stake, however, were cut short by the process facilitator in the TvC as falling

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28 The project’s mid-term report, halfway the analytic process, concluded that the selected seven “NPF-options” (i.e. the protein source / processing technique combinations) even if successful in replacing meat on a large scale in 2035, would amount to an increase in environmental efficiency by a factor 1.43 (DTO 1995:35).
beyond the scope of the meeting. With the exception of the TvC’s final statement, these views were not incorporated in the output of the NPF project.

Conditions for learning: balancing between the project’s ambition and its convincing power

To many of the involved researchers and TvC-participants, the narrowly set closure was considered strangely, and sometimes frustratingly, at odds with the overall rationale underlying the project. Given the multidisciplinary approach and the challenging ambition of the ‘factor 20’ concept, “learning as a result of the NPF project was almost unavoidable”, as one of the involved researchers put it. Notably the bi-weekly meetings of the various research groups in the second half of the analytic process not only led to a fruitful exchange of information, but also induced some of the participants to partly review their constructions of the issue at stake, and the way to approach it analytically (these learning processes will be discussed below). Furthermore, the set-up and unusual perspective (the long-term focus together with the multidisciplinary approach) stimulated the generation of creative and innovative ideas. However fruitful the debates with colleagues and fellow-researchers, yet, as a result of the narrowly set closure, they did not affect the course of the project. As one researcher put it: “it were discussions that one simply couldn’t win.”

The odd mix of stimulating creativity on the one hand, and the strict implementation of the project according to a pre-planned design on the other, appears characteristic of the NPF project. A telling example of this inconsistency is the issue of energy use that was put up for discussion by the involved technologists. Originally, the project presupposed implicitly that all energy requirements for the development of NPFs would be met on the basis of mineral oil and other commonly-used energy sources. The general STD Programme’s perspective, however, was an incentive for the technologists to consider alternative sources. The suggestion to consider the production of raw materials for NPFs on the basis of sun energy, yet, was discarded by the project team. The idea, which one of the involved research institutes had roughly developed previously to the NPF project, was rejected as being too far-fetched. Even though it was in line with the rationale behind the project, it did not fit the project’s timing requirements, as quantifiable data to support the idea were not readily available.

As was observed above, in general, the project team favoured a focus on the environmental aspects of the technological processing route rather than on those associated with the production of raw materials. That stage of the NPF life cycle was felt to lie beyond the scope of the project. Moreover, the team considered the presentation of the project’s findings in quantitative terms strategically important in the light of the objective to convince third parties of the economic viability and technical feasibility of NPF development. Equally emphasised from the very start, the intent to be convincing, in practice, came to interfere with the desire to induce learning.
The friction between the two tracks of intent explicitly came to the fore in the TvC set-up. At the onset of the project, the TvC procedure was considered a suitable means to make operational the project’s desire to organise an exchange of information between technologists and consumers or their representatives. As was observed above, such an exchange of information initially was regarded as the backbone of the analytical exercise. The SWOKA researchers shared this view and intended the TvC procedure to “create a platform for consultation, as a result of which the various groups [technologists, consumers and societal actors] may learn about each other’s interpretive frame [referentiekader]” (Proposal NPF research, SWOKA, June 1994:2). Over time, however, members of the project team, for whom the consumers’ research provided a welcome opportunity to involve relevant parties in the NPF project, saw the TvC procedure as a “transmitting aerial” for the project’s analytical findings (Linsen, personal communication, August 9, 1996).

Disseminating and “embedding” the project’s findings

While from the very beginning, the strategic elaboration of the project had been considered at least as relevant as its contents, towards the end, the efforts to “embed” the project’s findings were intensified. In the second half of the project, alongside the analytic activities, the project team systematically organised activities to kindle enthusiasm among third parties (such as industry and business, government and NGOs) for NPF development and to motivate them to “adopt” aspects of NPF development within their professional context.

By that time, the analytic process had come to focus on a limited number of so-called “NPF-options”, that is, on combinations of protein source and processing procedure that could be developed into specific products. The technical analysis had shown that since almost every protein source could be processed into any conceivable protein product, the selection of protein sources was not a sufficient basis for directing further research. Furthermore, the consumers’ analysis indicated that an alternative protein food not necessarily had to be a meat look-alike. Thereupon, the technologists described a number of very diverse product examples, which were given fantasy names such as Fibrex and Protex, on the basis of which a further selection of technical processing routes (that is, of the required treatments from protein source to edible end-product) could be made. Each product was linked up with a particular protein source according to the envisaged texture of the foodstuff. Subsequently, on the basis of the described protein source/product combinations, technological procedures were outlined. The processing routes were selected to deal with as many technical barriers as possible. At the third plenary workshop, it was decided to base the subsequent analytic activities in
each of the other four research clusters on this these NPF-options", which thus could contribute to a further selection of potentially successful NPF options. Furthermore, at that time, it was decided to continue by focusing on NPFs in the form of an ingredient, rather than on end-products that consisted entirely of novel proteins.

Eventually, the results of the ensuing analyses were integrated by the project team, together with one of the involved technologists, by means of a portfolio-analysis. The initial weighing of the various NPF-options in this analysis was based on a criterion of technological feasibility rather than on "reduction of environmental burden". This decision was motivated by the consideration that "environmental concerns have only a limited influence on consumers' strategy for purchasing food, and are of little importance for firms to develop a particular product" (DTO 1995:29; cf. DTO 1996a). To compensate for the loss of environmental efficiency, in a second analysis-batch, a further selection was made on the basis of environmental efficiency factor as well as on several other criteria. The combination of the two sets of findings resulted in a selection of seven suitable NPF-options.19

Safeguarding the project's integrity: securing the project's acceptability

In the second part of the analytic process, the results from the portfolio-analysis formed the point of departure for formulating new and additional research questions (again in the form of a Manual) to further reduce uncertainties in NPF development. In the first plenary meeting of this new phase, it was decided to co-ordinate the various research activities on the basis of the "scenarios for NPF development" that had been outlined roughly by the macro-economic research cluster. The scenarios depicted a trajectory towards meat substitution and covered a period up to 2035.

The project team chose to start from the premise that by 2035, NPFs would have replaced meat consumption by 40%. This substitution target, together with the reduction factor of the product's environmental burden (as compared to pork) of 20, formed the substantive starting point for the research groups to continue their analyses. Each group was to provide relevant information for outlining the "NPF development path" that described the prospective situation of meat substitution in the Netherlands by 1995, 2005, 2020 and 2035 respectively. Two scenarios were to be outlined. In one

19 The subsequent analytic activities sought to reduce the large number of possible NPF-options. First, the project team selected an initial eighteen. This selection, along with pork and a soy derivate, was made in such a way, that the cases together provided more information than the sum of the individual cases. To further reduce the total number of eighteen, the project team drew up criteria for each research cluster by which to assess each option. The researchers of each cluster then interpreted their findings in terms of these criteria.

10 The selected NPF-options were i) 'Protex' from (not-genetically engineered) peas, ii) from genetically engineered (gmo) peas, iii) from lucerne and iv) from spirulina; v) 'Fungopie' from (gmo) lupine and vi) from peas, and vii) 'Fibrex' from fusarium.

11 Halfway its duration, the project was evaluated by an external agency. The project's findings, as well as the evaluation's were considered satisfactory, so in June 1995, following the advice of both the project team and the advisory board, the STD Management decided to continue the NPF project.
scenario, at the initial stage, an emphasis was put on the conditions for marketing NPFs, while relatively little attention was paid to their environmental aspects. The second scenario, in turn, depicted a development in which first an emphasis was put on improving the environmental aspects of NPFs while the substitution of meat in terms of market share was given less priority.

While the respective researchers were elaborating the trajectories, the project team intensified its activities to propagate NPF-development. In addition to the usual PR-activities (press-releases, dissemination of the newsletter, et cetera), the team set out to identify activities that were, on the basis of the scenario descriptions, considered necessary for NPF development. In line with the STD's overall philosophy of backcasting, the team elaborated what needed to be done 'now' in order to achieve the desired meat substitution target and environmental reduction factor by 2035. Thereupon, it matched the required actions with the needs and interests of potentially interested parties.

To gather information on those interests, the second stakeholder-analysis was conducted. It served to identify the potential capacities and willingness of stakeholders to adopt and /or to join in, in the formulated “follow-up activities” regarding NPF-development, which were to be conducted after the NPF project were finalised. On the basis of the stakeholder-analysis, potential “pullers” were identified, that is, actors who could perform a leading role in accomplishing a specific aspect of NPF-development. Furthermore, from the perspective of the various (potential) discussion partners, specific “means for communication” were designed and developed, such as a lecture pack, a business plan, and, eventually, a CD-ROM on which the NPF development trajectory and the project's detailed findings were presented. Furthermore, additional research was commissioned, for instance to an external marketing bureau on how to best position an NPF ingredient in the market.

At the final stage of the project, the project team made a serious effort to ensure a more or less formal continuation of the collaboration between the research institutes and the participating companies, together with interested parties that had not participated in the NPF project, in the form of a NPF research consortium. The project team intended to play a mediating role in the discussions between the various parties, with the intent to eventually have the market actors set up an “NPF-sector” without any interference from the STD Programme or other public actors. This attempt, as did the other embeddings activities, amounted to a great deal of talking, talking and convincing. Specific R&D activities, for example, were discussed with research institutes, research supporting organisations and companies in order to have them put on the organisations' research agenda. In addition, the team approached other, not technology-oriented parties with the intent to convince these to start implementing some specific follow-up activity, or to contribute to NPF development in any other way. The project team hoped to stimulate the installation of a platform through which societal organisa-
tions, producers, retailers and government could structurally discuss aspects of environment-friendly foodstuffs. Several Members of Parliament were approached in order to inform them about the project’s findings, and to stir enthusiasm for NPF-development. Attention was paid to activities as diverse as developing educational material on ‘food and the environment’ for secondary school curricula, or to setting up re-employment programmes for workers that are currently employed in the meat industry.

At this stage, in other words, the number of actors that got involved in the NPF project gradually increased, as did the circle of actors who were informed about the project and its findings. While these actors’ interests and ideas guided, to some extent, the communication products that were developed during this stage of the NPF project, they did not influence the contents of the project as such. The projects’ findings themselves were not put up for discussion. Rather their acceptability and feasibility in the eyes of potential co-producers of future NPF-products was discussed.

The analytic activities were formally finalised in January 1996, on the occasion of the seventh plenary workshop at which the researchers presented their respective findings. On the basis of these findings, the project team described the development of NPFs and the related process of meat substitution for the years 1995 (the present), 2005 and 2035 in a comprehensive way (Quist et al 1996a). The project team’s “embedding” activities continued, however, on various fronts. Research proposals were drafted and submitted for financial support to various organisations, societal organisations were approached to sound out their willingness in further NPF-related activities and to see whether they were prepared go publicly endorse the TtvC final statement. Efforts to initiate the research consortium continued. In addition, attempts were made to set up an organisation for centrally “steering” and co-ordinating further NPF development.

By July 1996, the project was finalised. As the targets for embedding the project’s findings were not met yet, additional financial support (in the form of a subsidy by the Ministry of Agriculture) was found to continue the embeddings activities in a so-called “after-care” phase. In January 1997, the project was formally concluded at a symposium that addressed all STD’s food related projects. About 200 people attended the symposium, to which the former Minister of Agriculture held the opening address.

All in all, the illustrative process on NPFs proved an ambitious project. It not only sought to assess the best options for NPFs as meat replacements from the perspective

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11 In addition to the NPF project, the STD Programme’s food section included illustrative processes on sustainable land-use (which focused on an integration of various potential functions of a rural area, such as food production, recreation and nature development), on “high tech agroproduction” (which focused on producing food crops under controlled – closed system – conditions) and “integrated conversion” (which focused on developing raw materials for food and non-food products that required as little processing as possible).
of a future, sustainable food system. It also aspired to instigate the actual development of the NPFs, even though the project itself did not entail laboratory research. Some internal working documents had even spoken of contributing to the establishment of an “NPF-sector” (cf. DTO 1995a). The above described activities that were employed to achieve these objectives are systematised below (box 5.1).

The project's outcome and results

The project reached the conclusion that NPF production is environmentally desirable, technically feasible and attractive to both producers and consumers. It specified the conditions under which the desired NPF-development could take place, as well as the activities that would stimulate such a development, up to the year 2035. In the process of specifying this trajectory, the initial problem definition, as (implicitly) formulated at the start of the actual analytic process, was elaborated rather than reformulated.

While by the end of the project the major challenge was still conceived of as a technical problem to substitute the nutrition value of meat, the cultural aspects of meat consumption were acknowledged, in a way, in the shift in focus from NPFs as a steak analogue to NPFs as an ingredient in composite food products. However, the project remained focused on the technical and nutritional aspects of meat replacement as it had set out to do, in spite of the fact that during the analytic process, time and again, other aspects of meat consumption (such as emotional aspects, status, et cetera) were put up for discussion in the advisory board, in the TVC and in the discussions in the project team.11 This came clearly to the fore in the project team’s choice to make use in public relations material of the seven creatively named “NPF options” that the technologists had outlined to base further research on. In the NPF project’s newsletters, as well as in other publications and in wall posters, Fibrex, Protex and the like were prominently projected as examples of the project’s outcome.

Furthermore, the environmental aspects of the (agricultural) production of protein sources were included in the resulting problem definition, in addition to those of processing protein sources. This was reflected in the project team’s aspiration to not only stimulate the installation of a research consortium, but to have such joint research cover the entire ‘chain’ of NPF-production, which would involve a collaboration of researchers, producers, retailers as well as of suppliers of raw materials (“from farmer to consumer” approach).

11 In addition, the topic was extensively covered in a research project, conducted by a Master’s student, on product aspects that play a role in consumers’ judgments of NPF projects. It concluded that “affective attributes” (looks; image; familiarity) are at least as important as “functional attributes” (such as taste, nutritional value, et cetera) in a consumer’s decision to buy NPFs, and that therefore, these should be given equal attention (Klinckenberg 1995). Although STD published the findings in the same series as the NPF working documents, they did not play a role in the course of the NPF project.
<table>
<thead>
<tr>
<th>activity</th>
<th>explanation</th>
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<tbody>
<tr>
<td>Developing a project idea</td>
<td>Extensive discussions with a small group of sparring partners. Attempts at roughly translating the STD Programme’s quintessential notions of a <em>leap frog</em> innovation trajectory with a forty-year horizon, the ‘factor 20’ idea and the backcasting concept into a specific project theme and proposal.</td>
</tr>
<tr>
<td>Commissioning preliminary research</td>
<td>Initial elaboration of the project theme in a “definition study” on the basis of literature study and interviews. Designing the project set-up (as a ‘multidimensional analysis’). Continued discussions with actors in the envisioned field of research on the basis of cross-referencing.</td>
</tr>
<tr>
<td>Preparation of main research</td>
<td>Identifying and contracting the implementing research institutes; organising the project’s financial aspects. Installing a co-ordinating project team, attracting someone with name and fame in the field as the project team’s chairman. Conducting a stakeholder analysis to assess the risks and chances for organising a project on the selected theme.</td>
</tr>
<tr>
<td>Organising the analytic process</td>
<td>Drafting a Manual to co-ordinate the various research activities. Organising a Kick-off meeting, to which all involved researching groups attend. Installation of an advisory board to discuss and check the project’s contents and progress.</td>
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<tr>
<td>-first phase</td>
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<tr>
<td>-at project level: Organising for an exchange of information; facilitating a joint, multidisciplinary analytic process</td>
<td>Organising two to three-monthly plenary workshops at which to discuss the respective research findings in relation to one another and to jointly decide on research aspects that concern all (such as the geographical delimitation of the analytic efforts, and the criteria by which to integrate the respective findings). In addition: facilitating an exchange of information between the research groups by means of ‘interaction sheets’.</td>
</tr>
<tr>
<td>-at research level: Conducting the various research processes</td>
<td>Consumers’ aspects: Preliminary desk research; in-depth interviews and survey research to assess the current consumer’s ideas on the issue at stake. Recruiting participants for the ‘interactive sessions’ about the future consumer of the artefact under scrutiny. Participants are selected on the basis of existing contacts in the project and the implementing research institute’s network. Organisation of two interactive meetings of an evening and a day each under chairmanship of a professional facilitator. Technical aspects: Selection of sources and technological barriers to produce the envisioned end-products on the basis of literature studies; design of possible product examples and further elaboration of end-product requirements, processing techniques and potential problems associated with these. Environmental aspects: Assessment of the environmental impact of the artefacts under scrutiny in comparison with the existing, potentially substituted artefact on the basis of a Life Cycle Analysis. Business-economic aspects: Developing criteria by which to assess the commercial attractiveness of the artefacts under scrutiny, on the basis of literature studies and expert-interviews. Macro-economic aspects: Development of a frame of reference for assessing and appreciating macro-economic aspects of the issue under scrutiny on the basis of available data on the potentially substituted artefact. Identification of autonomous trends that might influence the development of the artefact under scrutiny.</td>
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<tr>
<td><strong>Integrating the analytic findings</strong></td>
<td>Portfolio-analysis by which to integrate the results of the various research activities; prioritising assessment criteria towards that end. Deciding upon the ‘substitution percentage’ in the year 2035; i.e. designing the future image on the basis of which a backcasting process could be organised. Evaluation of the project’s process and experiences.</td>
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| **Organising the analytic process**  
  second phase | Raising funds for the subsequent phases of the project. Drawing up of a Manual for the second batch of analytic activities, reformulation of the manual on the basis of feedback of the involved researchers. Organisation of the subsequent research activities in terms of scenario studies on the basis of a future point of departure (backcasting). |
| **at research level: Conducting the various research processes** | Consumers’ aspects: Organisation of a third interactive meeting of an evening and a day each under chairmanship of a professional facilitator. Drawing up a final statement; submitting the statement for revision and amendments to all involved.  
Technical aspects: Elaboration of relevant themes (sensory aspects; nutritional and health aspects; up-scaling of production processes, environmental issues) and technical barriers on the basis of further literature studies and interviewing. Outlining six R&D programmes on the basis of the identified themes and barriers providing a ‘communicable design’ of the suggested artefacts.  
Environmental aspects: Further elaboration of the Life Cycle Analysis and reconsideration of earlier findings on the basis of progressing insight in the project.  
Business-economic aspects: Making an inventory of potential producers of the envisioned artefacts and estimation of their production costs.  
Macro-economic aspects: Assessment of structural effects of implementation of a substitution scenario on national income, employment opportunities and its effect on the balance of payments of the sector that is responsible for the substituted artefact. Interviewing to gain insight in current views on the investigated artefact. |
| **at project level: Organising for an exchange of information** | Facilitating a joint, multidisciplinary analytic process. Organising for an exchange of information and for a maximum of creativity in two-weekly plenary meetings of the involved researchers in an informal atmosphere. |
| **at project level: Preparing a ‘smooth landing’ of the project findings in relevant context** | Organising follow-up activities to actually instigate the envisioned technological development. Formulation of required activities and identification of potential “champions” to “adopt” one or several options for action. Efforts (discussing; lecturing; publishing) to match the formulated activities to identified champions. Initiatives to draw media attention and politicians’ attention to the project and the issue under scrutiny. |
| **Towards the end of the process: Additional efforts to activate the involved network** | Intensifying the frequency of meetings; more frequent contacts with those interested; Attempts at setting up a research consortium on the investigated issues. Attracting media attention. Organising an ‘after-care’ phase. |
| **Publication of findings**  
  Concluding symposium | Publication of final report; of CD-ROM; Organising an concluding conference, suggesting and organising additional publications. |

Box 5.1 Schematic overview of the STD Programme’s approach to designing and stimulating sustainable technology development as elaborated in the NPF project 1993 - 1997
Substantive findings included the insight that sensory aspects of NPFs such as taste and texture deserve particular attention in further research, that the agricultural production method of protein sources entails the bulk of the environmental burden associated with NPF production, and that, on the long run, an up-scaling of the production capacity for NPFs may pose a major problem. These findings, together with aspects of the products’ nutritional value, formed the key issues in the R&D trajectory that was outlined by the participating technologists for future NPF development. Furthermore, the most likely future target groups for NPF products were identified as well as the most suitable product types for various ‘NPF consumption moments’. These findings, from the Tvc-procedure, co-informed the resulting insight that realisation of the target of 40% meat substitution in the year 2035 was not very likely, unless actively backed up by (national) policy measures. This was an uneasy conclusion in relation to the latent desire, to rely on market forces to bring about NPF development, which was inherent in the entire NPF project.

Every analytic activity of the various research clusters resulted in a separate project document. In these documents, the research question for the particular activity and the employed methods were described, as well as its findings. In total, about 20 of these reports (‘working documents’) were published by STD. The last working document presented the NPF development trajectory from 1995 to 2035 (Quist et al. 1996a). The various results were integrated in a final report in 1996 (DTO 1996b). Later, all working documents and the final report were made available on CD-ROM. Furthermore, the findings and the NPF project as such were presented in various publications and lectures by the members of the project team, jointly or on individual title (for instance De Haan et al. 1996; Quist et al. 1996b), and in publications on the STD Programme (DTO 1997b) and its ‘sequels’ of comparable or related sustainable development programmes (cf. Van Kasteren 2002).

In general, the NPF project resulted in various publications on NPFs that were directed at consumers and the public at large. Usually, the project’s ideas on NPFs were mentioned in one breath with products such as Quorn and Tivall, which were just conquering the consumers’ market.

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A remarkable publication was a leading article on NPFs in the free magazine of a major super market chain in the Netherlands (which company had participated in the Tvc-procedure). Not only had the magazine a considerable range of distribution, it also used the phrase NPFs (“novel protein foods are trendy”). Under the heading “the protein sources of the 21st century,” it described the currently available meat substitutes and their nutritional value (Alphaidehde 1998). The Netherlands Nutrition Centre (Voedingscentrum), a forum for questions on food and health which aims to translate academic knowledge and research results into practical and useful standards and information for consumers, addressed NPFs in an overview of meat substitutes, presenting Protex and Fibrex as if these were available in the super market.
Subtle shifts in view and a new protein foods programme: the project’s impact

As observed above, the dissemination of the project’s findings formed part and parcel of the project’s set up, and was taken care of alongside the analytic endeavour. Although during the initial stage, the stakeholder discussions were intended to ensure a proper match between the analyses’ focus and the needs and interests of future ‘co-producers’ of NPFs, the later discussions were intended to disseminate the project’s findings and to stir the interests of various actors for the project’s mission and outcome.

To (some) members of the project team, the dissemination aspect was at least as relevant as the analytic element. The project was seen as an experiment in wilfully influencing the course of technological development without making use of the usual policy instruments. This “hidden agenda” (De Kuijer, personal communication, October 1996) underlay the objective of stimulating the development of environmentally benign technologies. More specifically, over time, the project team came to understand that the biggest challenge for the project was not the development of a research portfolio, but the inducement of a “shift in focus” among the involved researchers. It was the team’s mission to make them see that for a sustainable technological development, regardless of the specific technological artefact under scrutiny, a multi-dimensional approach as adopted in the project was imperative. This was a difficult message to get across. For example, the project team’s wish to make a rough calculation of the cost price of the designed NPFs was met with considerable scepticism on the part of the technologists, who insisted that at this developmental stage, such calculations made no sense. Yet, the project team understood it had to present NPF development as a business case, since commercial parties would not act on it for environmental motives. Likewise, the project team saw it as its mission to make policy actors and societal organisations come to view ‘sustainable development’ as an inherently technical issue as well as a social and environmental problem.

The project team did not formulate the project’s formal objectives in terms of such subtle changes in view. In line with the overall STD set up, the envisioned impact was expressed in numbers of met targets, such as the number of “realised co-operation structures” and of “methods evaluated and employed”. In time, however, it was found that the “adopters” of follow-up activities (DTO 1996c) were not readily counted. Specific project-related developments were few while, in turn, various NPF-related developments were not exclusively linked to the NPF project. The most clear-cut spin-off of the NPF project was a new research programme on protein foods, dubbed Profetas. In addition, minor shifts in emphasis in various protein-related research programmes may be related to the NPF-project. Furthermore, subtle shifts in view on the part of participants concerning their running business may be earmarked as impact of the
NPF project. As subtle, and certainly as relevant, are the envisioned effects that did not come about, notably among societal organisations and governmental actors.

_Innovation network: impact in terms of action..._

A direct spin-off of the NPF project is the comprehensive research programme on Protein Foods, Environment, Technology and Society (Profetas). The programme includes research on the social, ecological and technical aspects of replacing meat in the diet in industrialised countries with plant protein products. The focus on protein foods, and on pork and green peas as reference artefact and protein source respectively, serves as a means to develop a “tool box” to facilitate the solving of “future problems related to food production and consumption”.

The interdisciplinary programme, which runs from 1999 to 2005, includes fourteen projects under the auspices of two Research Schools. In contrast to the NPF project, in this programme, NPF-related laboratory work is conducted, such as on texturizing pea proteins. In addition, consumers' aspects of NPFs, such as taste and texture, are being assessed with the aid of test panels. The aim is to eventually translate consumers’ sensory preferences in product design criteria. Political scientists, environmental researchers and economists investigate the societal aspects of meat replacement.

By those involved, the formulation of the Profetas programme is directly linked to the NPF project (Coenen 2000:77; Van Kasteren 2002:23, 36). Some remark, however, that without the NPF project, a programme on sustainable food production and consumption such as Profetas probably would have been set up anyway, yet possibly without a focus on protein foods. The research themes and the ‘multidimensional’ approach clearly reflect the NPF project. However, the Profetas programme is considered more comprehensive in its elaboration, as interactions between technologists and consumers are put centre stage. Furthermore, neither the specific “NPF-options” as outlined in the NPF project, nor the “factor 20” concept of the STD Programme are adopted in the Profetas context. Although a leading principle in the programme, the ‘sustainable development’ concept is not being made operational in such specific terms.

Participating private firms in Profetas are Gist-DSM, Boekos, Unilever, its former subsidiary company Quest (now ICI), and Cebeco. Of these, only the latter two were not involved in the NPF project. Given the fact that ‘sustainable development’ “is a non-issue to the food industry”, as an NPF participant put it, it is an interesting question

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16 The Wageningen based graduate schools of Food Technology, Agro-biotechnology, Nutrition and Health Sciences (VLAG), and the Netherlands Research School for the Socio-Economic and Natural Sciences of the Environment (SENSE) respectively. The Netherlands Organisation for Scientific Research (NWO) is the programme’s major sponsor (involving an unusual collaboration of NWO’s technology oriented funding organisation and NWO’s social and behavioural research branch), together with the participating research institutes, the Ministry of Agriculture and participating firms.
whether and to which extent the NPF project contributed to these companies’ motivation to further invest in NPF development.

Food companies

In the mid 1990s, (then) Gist-brocaes was the first and the most enthusiastic private contributor to the NPF project. To the company, the project came at exactly the right moment. Just when it set out to investigate the market of processed meat products for new business opportunities, it found that “the meat sector was investigating the non-meat segment” (Geurts, personal communication, September 17, 1996). The enzyme and yeast producer, which also specialised in savoury ingredients (such as for soups), realised it could well develop new business in that area on the basis of its current expertise and patents.

In 1995, the company had sold major parts of its industrial enzyme activities, thus changing its business portfolio considerably. More than before, the emphasis was put on the food and pharmaceutical markets. Consequently, in line with the company’s strategy of continually expanding its business portfolio to guarantee stability in dynamic and volatile markets, the recently set up corporate new business development division almost exclusively came to focus on developing new products for these markets. To this division, NPFs appeared a promising development. It fitted the protein-related activities that the company had been expanding over the past few years, as well as its intentions of developing semi-manufactures for the food market itself. Vegetable proteins were considered more promising (in terms of functionality and image) than animal proteins and the company expected to be able to employ, in due time, newly to be developed procedures for texturising and stabilising proteins in other applications than meat substitutes.

On a practical level, the NPF project offered a welcome opportunity to get acquainted with the major players in the meat business and to further assess the chances to become active in that field. Furthermore, through its early and continued close involvement, the company was able to co-direct the course of the project to match its research interests. An additional asset of the NPF project to Gist-brocaes was the TvC-procedure. In the recent past, negative response to the company’s genetically modified enzymes for fermenting cheese in some countries had heightened its awareness of consumers’ demands. The firm was interested in methods to incorporate consumers’ aspects more systematically in product design. Lastly, to some individuals within Gist-

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7 Gist-brocaes had been closely involved in the discussion on the installation of the STD Programme; it sponsored the NPF project, participated in the TvC-procedure and was a member of the advisory board. Furthermore, all research findings of the technology research cluster were discussed with Gist-brocaes and other sponsors before publication.
brocades, the NPF project's focus on sustainable development presented a timely occasion to explore the potential market opportunities that that concept might entail.

The NPF project lived up to the company's expectations and fuelled its interests in NPF development. Consequently, towards the end of the project, Gist-brocades was eager to continue the joint research efforts on the issue and volunteered to take the lead in setting up the research consortium that the NPF project team had envisioned. The efforts to initiate a research consortium fitted the company's relatively recent R&D strategy of outsourcing fundamental research in favour of strengthening its product-oriented research activities. This strategy entailed a major break with tradition in a company that had a rich and famous history of basic, explorative research (cf. Bennett & Phaff 1993).

In spite of its efforts\(^\text{8}\), however, it could not pull off the desired institutional arrangement. Yet, several bilateral and multilateral NPF-related collaboration projects were initiated. In addition to the later Profetas programme, the most prominent of these was a partnership with Boekos and TNO-Nutrition (i.e. the foods division of the Netherlands' Organisation for Applied Scientific Research).

One of the co-implementers of the technical analyses of the NPF project, TNO-Nutrition had started up a six year research programme called 'Future Protein Foods' (focusing on developing new, functional protein ingredients on the basis of innovative enzyme technology), which formed the context for further collaboration with Gist-brocades and other firms. Contacts with the other partner, Boekos, had come about as a result from the NPF project although that company had not participated actively in the project.

Having heard about the NPF project by chance (in a radio broadcast), Boekos had contacted the STD Programme Bureau for an exchange of information. Boekos is a medium-sized meat processing company that produces for the European market. In the past two decades, the company has shifted the emphasis in its core business from an exclusive focus on pork, to meat in general and eventually to vegetarian products. Consumers' preferences form a major incentive in product innovation and differentiation for the company, which actively seeks to involve consumers, retailers and primary producers in its product design processes in various ways. It observed a trend towards a declining demand of meat products in favour of vegetarian products, which caused the company to put more emphasis on the latter. Boekos had developed an interest in the protein sources that were investigated in the NPF project. Furthermore, it felt that the 'sustainable development' concept could entail interesting marketing opportunities. The NPF project combined expertise on both aspects and was considered very promis-

\(^8\) Among other things, Gist-brocades employed a former member of the NPF project team to co-ordinate the organisation of an 'NPF research consortium'.

Since its R&D budget was limited, the company was extremely interested in joining in the NPF project activities.

By the time Boekos learnt about the project, however, it was well on its way and there was little room for new input or for an exchange of ideas.\(^9\) The company regretted this, as it the company was less interested in the project's specific output (which was rather poorly communicated in Boekos' opinion) than in the opportunity to meet with like-minded parties. "Adoption" of the specific project findings was not an option to the company. Yet, it jumped to the opportunity to establish contacts with research institutes and other parties on NPF-related research in the aftermath of the project.

Various other parties with whom Gist-brocades and the NPF project team discussed the installation of a research consortium on NPFs did not display such enthusiasm. To some potential partners, NPFs did not present a business case ("we don't deal in proteins; we deal in protein-containing food products", as a Unilever spokesperson put it), to others, the business-economic aspects were such that they feared that a collaboration effort might harm their competitive position. Eventually, the mission was called off.

Among the less enthusiastic was Unilever. While the largely independently operating Unilever Research Laboratory had financially supported the NPF project, Unilever's foods division was not convinced of the desirability to invest in NPFs. The third largest food business in the world, the company is notably a strong player in the area of fats and vegetable oils (such as soy oil). Since the NPF project did not include soy-beans as a protein source, the Research Laboratory had limited common ground with the project. The project was considered as being of more interest to Unilever's subsidiary companies which were active in the meat segment, such as UVG (that participated in the TvuC-procedure) and Quest. However, at the time of the NPF project, Unilever was just withdrawing from meat processing activities, selling most of its meat processing industry (among which Quest).

Unilever Research Laboratory's participation in the NPF project\(^6\) was therefore more or less "in spite of itself". After the negative experience with SCP-products in earlier years (see above), many in the organisation doubted whether further investments in the topic of non-meat proteins for the humane food market were useful. The motivation to still participate stemmed from the desire to keep an open eye for new

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\(^9\) Boekos considered the project's target of 40% meat replacement in 2035 realistic. Yet, the company felt that vegetarian substitutes (the steak analogues) could also be successful in the segment of the non-processed meat products. Furthermore, Boekos' views deviated from those in the NPF project concerning the importance of making meat 'look-alikes'. According to the company, the association with meat is essential to the consumer and therefore should be consciously induced in product design (texture, flavouring) and positioning. In addition, Boekos found the project lacking in attention for algae as protein source and for a product's ability to retain moisture as a research theme.

\(^6\) In addition to its financial support, Unilever was presented on the advisory board and was involved via informal consultation. Furthermore, Unilever had an advisory role in the environmental analysis by CML and TNO. UVG Oss, a meat processing company that operates under Unilever's heading, participated in the TvuC-procedure.
developments, and to keep ahead of the firm's direct competition in fermentation technology (i.e. of Gist-brocades and Nestlé). Moreover, the relation between consumers' preferences and the texturing of food products was of interest to Unilever. In addition, the fact that the NPF project team's chairman was a former Unilever manager was an incentive to take part.

Yet, the NPF project met with considerable scepticism within the company. To some, the long term perspective in the NPF project, which lay way beyond the usually employed planning horizon of 3 to 5 years, was considered very unconvincing. In the eyes of the sceptics, the project failed to show how NPF development could present interesting business opportunities in the short run. To others, who did endorse a long term view from a sustainable development perspective, the project failed to convince as "the narrow focus on the solution [fermentation technology] prevented a proper view on the actual question: the environmental impact of food in the future" (Dutihl, personal communication, September 12, 1996). As a result, the environmental analyses in the NPF project did not provide the information that Unilever was interested in from the perspective of relating its business to the concept of sustainable development. Still, apparently, the project did manage to provide sufficient arguments to those in favour of investing in NPF development, witness the fact that the company was willing to financially support the Profetas programme.

Research institutes

The technological research in the Profetas programme is to a large part conducted by the research institutes that participated in the NPF project. In addition, these research groups and others co-operate in various constellations on NPF-related research themes, such as the aforementioned Future Protein Foods project of TNO-Nutrition. The NPF project "boosted to some extent" the attention for those themes, which however were being investigated for various other reasons anyway (Aalbersberg, personal communication, October 14, 1996).

For instance, the NPF project is said to have affected to some extent the research agenda of the so-called Leading Technological Institute on Food (LTI), a "centre of excellence" in research that was called into being in 1997. An LTI is a virtual research conglomerate (that is, it is centrally managed but not necessarily physically concentrated) that bundles expertise on a specific area of study in the field of strategic research. It serves as a clearinghouse of information for the various research groups involved. It is intended to attract the involvement of knowledge-intensive companies and leading researchers from abroad, and thus to stimulate the level of excellence in research from a national perspective.
The institutes (by 1997, four were installed) were established by the government to strengthen the Dutch research infrastructure in the field of fundamental research. The incentive to set up such centres of excellence was the desire to strengthen the innovative capacity and competitiveness of Dutch business and industry. The institutes are subsidised by the central government and are financially supported by companies and institutes that have a stake in the investigated research themes. The LT1 on Food, which is based in Wageningen (the Wageningen Centre for Food Sciences, WCFS), is a public-private partnership in which about fifteen companies participate, among them Unilever (which acts as secretary) and Gist-DSM, as well as four research organisations specialising in food research. The primary aim of the institute is to support the Dutch food industry with exceptionally innovative and original research that is too costly and too high risk for companies to conduct themselves.

Among the research themes that the institute addresses is the relation between microbial functionality and safety, and between structure and functionality of food. This latter research theme involves research on basis of the question ‘how to design and control a successful food product’. While both themes are clearly related to the topics that were addressed and identified in the NPF project, none of the WCFS projects directly relates or can be linked to the NPF project, the selected “NPF-options” or its resulting R&D research agenda. Yet, since the WCFS research is of a very fundamental nature, its findings may in the long run add to the insights required for developing NPFs that are attractive to consumers.

The relation between structure and functionality was also the central theme in the aforementioned innovative research programme IOP-Protein. The research projects that were subsidised in the programme addressed a variety of proteins and application areas and focused on the structure / functionality of proteins in relation to ‘contextual’ factors such as fats or sugars. By the time the NPF project came to an end, the second four year term of the IOP was about to commence. In the preparatory talks on the research agenda for the second term, the results of the NPF project “were not put up for discussion” (Aalbersberg, personal communication. October 14, 1996). However, the relation between the structure of proteins and flavouring components that was propagated strongly by one of the participating food companies was “put higher on the agenda” as a result of the NPF project. From the perspective of the IOP, however, this presented a minor research area that most probably would have been covered without the influence of the NPF project as well.

This observation reflects the general attitude among opinion leaders in the field of protein-related technological research at the time of the NPF project’s conclusion. It was observed that as a result of the project, NPFs were a recurrent discussion topic in the network of companies and research institutes. Yet, its direct effects on research agendas were considered limited. Even if related research topics were addressed, these
were of such a fundamental nature and of such a broad application potential that a link with the project was not considered obvious. In none of the more specific R&D activities, the seven NPF-options elaborated in the NPF project as such were adopted. These findings are in line with the observations of the NPF project team's chairman, who remarked that "the objectives for the first ten years and the focus on sensory aspects of proteins most probably would have been realised without the NPF project taking place as well."

... and learning

To limit an account of its impact to the actual instances of (collaborative) NPF related research projects does not do justice to the NPF project. Its more implicit impact in terms of learning may be difficult to uncover yet may in the long run prove contributory to the realisation of the project's mission. While the project's focus at an earlier stage had been almost exclusively on quantifiable data, the project team itself acknowledged towards the end that "it is the thought that counts [on NPFs as an example of sustainable technology]; a quantitative elaboration of the findings is not so important" (De Kuijer, personal communication, October 1996). The question is whether the project has contributed to an increase in the participants' insight in their own capacities vis-à-vis NPF development (and sustainable technology development in general) and in the capacities and strategies of other actors that may have influence. Such insights – that is, changes in the actors' interpretive frames – may have an impact their actions in the long run in line with the objectives and mission of the NPF project.

The participating researchers report, in addition to the expected increase in knowledge on the technical and environmental aspects of NPFs, an increased insight in the methodical approaches they adopted in the NPF project and in the underlying rational. To (some of) the technologists, working on the basis of a narrowly specified end-product was an eye-opening experience. This experience added to the quality of their professional work, since end-product's qualifications and consumer preferences increasingly determine technological research on foods. To the researchers of the NPFs consumers' aspects, it was surprising to find that the work of technologists in general is not guided implicitly or explicitly by visions of the future consumers of their products. This insight affected their ideas about the application and potential of the TvC-method. For (some of) the involved environmental researchers, the project strongly added to their understanding and appreciation of the applicability of the Life-Cycle Analysis

"Witness of this changing attitude is the laconic reaction to the outcome of the aforementioned calculation of the 'environmental efficiency' to be gained by the researched NPF options in comparison to the then-current practice of pork production. The findings were a far cry from the envisioned factor 20 (namely a factor 1.43; see nt. 28 this chapter), yet they were not considered a threat to the progress or legitimacy of the project. This was remarkable as at the previous stage, a strong emphasis was put on quantifying data as accurately as possible."
approach to agricultural products. In the aftermath of the NPF project, projects were formulated for further refinement of the analytic instrument in this area.

To the participating companies, the project presented an incentive to reconsider the relation between foods in general (and their core business particularly) and the concept of sustainable development. The NPF project was not the first incentive to do so and certainly not the only one, yet the comprehensive approach to elaborating environmental aspects in relation to technical and business-economic aspects which was adopted in the NPF project was “new” (Geurts, personal communication, September 17, 1996).

For Gist-brocades, participation in the project was a stimulant to investigate the potential and meaning of the sustainable development concept for the company’s business operations and business strategy. It turned out that part of the company’s activities could be earmarked as “sustainable” yet that employees were hesitant to use the label for operations that were intended first and foremost to earn money. Furthermore, the NPF project induced learning on the part of the involved individuals from the corporate research and marketing divisions with respect to the potential and meaning of NPFs as a solution to business-economic problems. Although the project’s problem definition did not reflect the company’s interests (the company’s ‘problem’ was to know how to strengthen its business portfolio so as to continue and expand the company’s competitive position “on top of the market”), still the project provided the participating individuals with sufficient arguments “to make the case for further NPF-related investments” within their respective divisions.

An interesting example of the even more subtle ways in which the NPF project had an impact is the case of Avebe’s grass project. Avebe, a producer of potato starch and derivatives, developed an interest in the NPF project and chose to financially support its later stage so as to gain access to the project’s findings and network. The company also participated in STD’s ‘illustrative process’ on integrated conversion. At the time, Avebe was considering investments in refining grass. The idea was to increase the efficiency in the conversion process of grass into proteins by crushing it before feeding it to livestock. Such a procedure would benefit the metabolism of cows, would yield a highly efficient protein-rich pig feed, and the rest-products could be applied in various products (such as alcohol, cardboard, paper, compost and building materials). The idea was championed by the managing director of the R&D division, who in a previous work environment had co-elaborated the concept in the context of an NRLO exploratory study on increasing the efficiency in animal production from an environmental perspective.

Avebe took an interest in the suggestion since the processing of grass could prevent under-utilisation of its machinery during the potato off-season. In the past, it had explored the possibilities of extracting proteins from grass, but at that time, the project was considered economically unattractive. This time, in the company, views differed as
to the desirability of setting up a grass project. Those against it feared unwanted competition with Avebe’s existing product range (notably with animal feed products derived from potato) and did not expect benefits in the long run. Moreover, the off-season (the period between the end of the last potato season and the beginning of the new season) was getting shorter, thereby diminishing the need to invest in non-potato related products. Those in favour, however, expected Avebe to profit substantially from an expansion of its product range in the long run. In addition, ‘the environment’ and the Dutch economy in general might greatly benefit from an increased utilisation of grass. 43

The NPF project provided the protagonists with a strong argument in favour of grass refinement. If indeed in the (near) future NPF development might assume large proportions, vegetable proteins would be highly in demand. Of the protein sources that were discussed in the NPF project, none would be readily available in the required amounts. Cultivation of lucerne, for instance, on a scale necessary to allow for profitable NPF product introduction would imply a major shift in agricultural practice. The accompanying business economic risks for farmers could be reduced if a company such as Avebe were to provide a market for the crop. Technically speaking, the grass project would serve as a preparatory study for processing lucerne supply the NPF industry: “what may work for grass will also work for lucerne and other leafy vegetables” (Sanders, personal communication, September 19, 1996).

Thus, the NPF project contributed to an increased insight on the part of a participant in his own potential for action in line with the rationale of the project and of its underlying programme. Even though the considered action alternatives did not relate directly to NPF development, and were not formulated in the context of the NPF project, still the project was in a way contributory to a more sustainable food production in the future.

This kind of subtle impact – or better perhaps: ‘spin-off’ – is difficult to lay one’s finger on, yet it may illustrate a significant aspect of the way in which the STD Programme stimulated innovative and creative thought. 44

Public policy and societal actors’ response to the NPF project

As observed before, the NPF project meant to rely on market forces to pull off the desired development. Public policy actors and societal organisations were looked upon as

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43 Potential benefits (for the Dutch environment) included a reduction in manure quantities and in the imports of plant nutrients, and the development of profitable ways of processing ‘waste’ grass in addition to the production of environmentally benign substitutes for current products (see Van Kasteren 2002:116-119).

44 Characteristically, the idea of a grass refinement project that was conceptualised before and outside the STD context is related by its spiritual fathers not only to the NPF project in the way described here, but also to the STD’s project on sustainable (“multi-functional”) land-use (in which context the concept of bio-refinement of grass was actually put into practice; cf. Van Kasteren 2002:117) and to STD’s project on integrated conversion (Coenen 2000:71). Apparently, the STD Programme presented a fruitful context for the idea to ripen.
providers of the necessary conditions under which the development of NPFs could come about. Due to this implicit understanding of the role of public institutions and NGOs vis-à-vis the project’s aim, an exchange of information with these actors was given low priority. With the exception of the main Dutch consumers’ organisation, which sat on the advisory board, they were involved mainly through their participation in the TvC-procedure. As said, towards the end of the project, the project team made an effort to inform politicians and civil servants on the project and its findings.

NPF development as a means to reduce the environmental impact of meat was not addressed in the main white papers on relevant policy areas at the time of the project’s conclusion and afterwards. In November 1996, Parliament discussed a white paper on the communal European agricultural policy in the long run. The paper was drafted with the intent “to stimulate discussion” about the “future policy space”. The paper indicated “which trends will present themselves, what will come our way, and which choices we will have to face” (Tweede Kamer 1995-1996, 24 596, no. 1:1). Recent dynamics in the European integration (signing of the Maastricht treaty on the European Union, the planned inclusion of new member countries) was the immediate incentive for publication of the white paper, as well as an “increased attention for agricultural production from an environmental perspective.” Among the issues addressed in the paper was the expected surplus in beef production. The latter issue was the direct cause for a Member of Parliament of the labour party to ask the Minister about his opinion on “novo protein food” (sic!) as a means to reduce meat consumption (Tweede Kamer, 1996-1997, 24 596, no. 6:6). There was no reply from the Minister to this particular question.

Likewise, the concept of NPF development did not affect Dutch environmental policy. With the exception of some references to the project made by Members of Parliament of the labour party⁴⁴, the NPF project was not mentioned in discussions and white papers on environmental management. For instance, it did not enter into the National Environmental Policy Plans (NEPP), the fourth of which was presented in 2001. This NEPP adopted a broad, future-oriented vision on environmental policy and addressed tenacious environmental problems that seem to elude improvement efforts on the basis of the available policy instruments. The Plan suggested an approach to dealing with such problems that amounts to a structural reformulation of the ways in which Dutch society provides its people’s basic needs. The word “transition” is used to indicate the envisioned shift towards a more sustainable society (see chapter 1).

⁴⁴ For instance, the Meat Decrees which limit the amount of non-animal proteins allowed in meat products were revised in 1998, but were not changed in favour of adding NPF ingredients, nor had the NPF project set out to stimulate such a revision.

⁴⁵ In addition to the aforementioned remark of the labour party’s member Woltjer, it was political associate Huys who time and again drew the attention to the NPF project and other STD programmes on sustainable food production and land use (cf. Tweede Kamer 1996-1997, no. 5, nts. 2 and 3, and Tweede kamer, 1995-1996, no 63:3).
Among the problems observed is the overexploitation of natural resources. Land-use for agricultural activities is singled out as a major source of overexploitation, as it leaves little room for more natural eco-systems. "It is striking," two critics write in a solicited comment on the NEPP by the Ministry's advisory council, "that the single major possible transition that may actually result in a reduction of agricultural land-use is not mentioned [in the fourth NEPP]: a shift from animal food sources to vegetable food sources" (Van der Voet & Huppes 2001:36-37). The NPF project is invoked as evidence of the increase in environmental efficiency that may be gained from such a transition.

The conflicting interests in land-use and the potential solution strategies that were formulated in the STD Programme were addressed by the central government, yet only in the context of discussions on the Science Budget from 1997 onward. The STD Programme's approach is echoed in the government's suggestion to invest in research that focuses on "factor 4 innovations", i.e., on technologies and related social and environmental aspects that may serve the desired increase in living-standard while simultaneously reducing environmental impact and resource use (Tweede Kamer 1996-1997, 25 008, no 1-2). In the following years, this line of reasoning was specified in several research stimulation programmes, which in various wordings refer to the sustainable development concept. Among these was the 'Stimulation Programme on Sustainable Agriculture' for which, among other studies, the NPF project's analysis was considered a basis. In addition, the (later) Profetas programme was specified in this context (Tweede Kamer, 1997-1998, 25 608, nos. 1-2:37).

Hence, also in public policy, the NPF project's influence was felt primarily in the realm of research. This is likely due to the fact that the merits of stimulating NPF development from a scientific and an economic perspective were successfully established", yet that the value and desirability of stimulating such a development from an environmental point of view were doubted among relevant actors. In almost all interviews conducted for this case-study, the environmental claims of the NPF project are dismissed as either "unconvincing" on methodical grounds or as "irrelevant" for their generality (for instance, De Vriend, personal communication, August 13, 1996). Typical for this perception of a lack of 'environmental urgency' is that in spite of the NPF project team's efforts, the initiative to set up a platform for consultation on NPFs between policy actors, environmental organisations and industry (comparable to the existing platform on biotechnology) was unsuccessful.

46 The authors are employed by the research institute (CML); one of them was responsible for the environmental analysis in the NPF project.
47 The NPF project proved very successful in convincing the Ministry of Economic Affairs of the relevance of stimulating NPF development to the competitive position of the Dutch food industry. While this Ministry had initially displayed a sceptical stance towards the project by sending a junior employee to sit on the advisory board, by the end of the project, enthusiasm grew and a senior civil servant took part in the stakeholder discussions.
The involved consumers' and environmental organisations did not acknowledge the surplus value of discussing future consumers' products. They expected to act on NPFs only in reaction to the actual products by the time they would become available. In hindsight, the interviewed representatives viewed their involvement in the NPF project merely as "legitimising" the discussed technical developments. They regretted the limited room for putting up for discussion the normative aspects of meat consumption and of the current agricultural practice.

In general, at the time of the project's conclusion, environmental organisations by and large did not share the problem definition that was formulated in the NPF project vis-à-vis meat substitution. The need to reduce the environmental burden of meat production was not considered equal to the need to develop new protein sources: "[Considering the Dutch situation,] there is no need for new protein sources. Rather, more research is required to investigate why, in general, we like meat so much" (Boerma & Haarhuis 1996). More specifically, the project was frowned upon because of the inconsistency, observed by some, in the national government's policy on agriculture from an environmental perspective: "Five Ministries contribute to the development of meat substitutes in order to reduce the environmental impact of meat production. ... At the same time, that very government sustains the problematic stock-breeding practice with millions of subsidies and protective policy measures" (Leeraert 1997:22, my translation).

By way of exception, participation in the TvC-procedure inspired one of the two involved environmental organisations to develop the insight that novel foods may indeed have a role in reducing the environmental impact of meat: "Although such artificial products generally do not 'fit' the worldview of most environmental organisations, I now see that it is not realistic to expect consumers to turn to beans for their protein needs" (Van Wieringen, personal communication, September 20, 1996). This organisation was planning to write favourably about NPF products in its publicity material.

These (subtle) developments can plausibly be linked to the staging of the NPF-project. Yet, they should not be viewed in isolation from other dynamics in the production of meat and meat analogues.

**Dynamics in the project's context**

The NPF project took place at a time when the Dutch meat sector was in turmoil. While the livestock industry in the Netherlands in terms of its absolute size and of employment opportunities was observably declining, meat consumption was expected to remain stable in the long run (as was observed in the NPF project; cf. De Vlieger et al.

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48 The total number of pig breeding businesses in the Netherlands between 1980 and 1997 more than halved (from 44,127 in 1980 to 21,011 in 1997); NRC, January 17, 1999.
Yet, in the mid 1990s, consumers were startled by a series of animal diseases and meat product disqualifications (bacterial contaminations, hormone residues) that might entail a threat to human health. Notably, the coming to light of the potential transmission from bovine spongiform encephalopathy (BSE) to the human population had an impact on the image of meat. While analyses differed as to the actual impact of BSE, *E. coli* infections and salmonella incidences on the consumption of meat and meat substitutes in the Netherlands in the 1990s (Smit 1995; Van Lier 1997; Tazelaar 1997; Van Dinther 1998), the trend towards an increase in demand for substitutes appeared strengthened.

From the very beginning of the NPF project, the project team was conscious of the fact that the meat sector might view NPF development as a threat. It feared strong reactions that might scare away potential commercial investors (DTO 1994e; Vullings 1995). A good understanding with the branch-organisation (*Productschap Vee, Vlees en Eieren*) therefore was considered important. Furthermore, for strategic reasons, the project spoke of “meat supplanters” (*vleesverdringers*) rather than “meat replacements” (*vleesvervangers*). Apparently, the project team’s careful approach was successful.\(^5^0\) Strong negative reactions were absent. In his 1997 new year’s speech, the president of the branch-organisation alluded to NPF development (without using the phrase) in a positive manner. Using the relation between the dairy industry and the introduction of margarine as an analogue, he called on the sector to keep a close watch on the dynamics in the market and to anticipate these: “All of us in the livestock- and meat sector hope for a steady and small vegetarian market. But why not produce for this niche-market?” (Tazelaar 1997).

Against the backdrop of a declining meat industry plagued by negative publicity, in the 1990s, various NPF-related developments were observable. In addition to STD’s NPF project and the aforementioned development of Quorn in the UK and Tivall in Israel, in Norway, a project was conducted to produce edible bioproteins from bacteria that thrive on natural gas. The project, which was earmarked as contributing to a ‘sustainable development’, initially yielded protein mass to be used as fish feed and animal feed but was intended to eventually serve the human market (Didde 1999). Furthermore, quinoa, a Latin American protein-rich plant, was investigated in British and

\(^{49}\) Worldwide, meat consumption was seen to increase (from 1982 to 1994 with 5% per year; Van Kasteren 2002:36) and was expected to do so in the future as well.

\(^{50}\) Obviously, the mildly positive response of the meat sector to NPF development was not just the doing of the project team. Although individual livestock breeders at times strongly protested environmental policy measures, in general, the leading actors in the sector appeared to acquiesce in the unavoidable: the trade union (then the Agriculture and Foodstuffs Union, *Voedingsbond FNV*) was of the opinion that “Continuation of employment opportunities has a high priority. Yet, the [trade union] acknowledges that is it of no use to deny the environmental problems in the pig breeding industry,... in cases were critical limits are at stake, (...) [the [union] accepts that the environment has a higher priority than work and income” (Van Gelder 1996). The propagated strategy to dealing with the various threats to the sector was to focus on improving the branch’s quality at the expense of quantity, that is, on “earning more with less pigs.”
Dutch research within the EU’s Fifth Framework Programme (1998 to 2002) for its potential of yielding new protein foods.

In addition to the dynamics in the livestock and meat industry, the managerial developments in scientific research on food and agriculture are also of relevance for appreciating the NPF project. At the time of the NPF project, a major shift in view on agricultural research on the part of the central government led to changes in the administrative structure for financing research as well as to shifts in the type of research questions. In turn, this affected the research agendas of the agro-food business and research institutes.

In the post World War II area, knowledge dissemination from the governmental research centres on agriculture (the DLO institutes) to farmers was considered the backbone of a thriving agricultural business community. With the growing awareness of the limits to unbridled economic growth, amplified with the national government’s changing perception of its own role vis-à-vis society, in the 1990s, the understanding of the role of agricultural research changed. The research agenda was no longer determined by the governmental agricultural agenda and the underlying ideas about the nation’s interests but by the interests of the agricultural sector and the food business (see also chapter 6). Correspondingly, in these years, the financing system of such research changed fundamentally. While previously, significant amounts of research were conducted on the basis of a governmental lump-sum support system, activities now came to be privately supported on project base. This development reinforced the trend among companies to outsource fundamental research.

Overproduction and market saturation furthermore induced a growing appreciation for so-called ‘exploration of the future’ studies and scenario designing as a basis for formulating research questions. In addition to visions of the future, consumers’ preferences came to (co-)determine agenda setting in research. These developments of “chain reversion” (ketenomkering) converged with the increasing awareness of the environmental problems caused by the post WOI agricultural practice in the Netherlands. Most specifically, the ‘chain reversion’ trend led to an increased emphasis in research on the relation between foodstuffs and public health and on taste and texture aspects of food.

\[\text{In the early 1990s, about 80\% of the budget of the governmental research institutes on agriculture (DLO) consisted of governmental subsidies while 20\% was financed by private parties. In the second half of that decade, this ratio was reversed.}\]

\[\text{An expression of these changing views is the reorganisation of the Netherlands Council for Agricultural Research (NRLO) in the mid 1990s, and the underlying reorientation in its mission and objectives. It was decided to make the ‘sustainable development’ concept a leading motive in all of the Council’s activities. Furthermore, it was acknowledged that such a normative concept requires research methods that allow for the incorporation of subjectively perceived aspects of the issues under scrutiny in addition to objectively assessable data, which led to an appreciation of “unorthodox” research methods (personal communication).}\]
Lastly, of relevance to the NPF project were the dynamics in the project’s institutional setting, the STD Programme. In addition to the NPF project, eventually some 15 projects were set up in the fields of food, transportation, water, housing and chemistry (DTO 1997a). In these, a wide variety of methods was employed to make the basic concepts (among which the backcasting concept and the notion of a Culture-Structure-Technology triad) of the STD Programme operational (cf. Aarts 1997b). With respect to the C-S-T notion, views changed over time and through increasing insight. While reference to the structural and cultural aspects of the issues under scrutiny in an STD programme was merely obligatory at first (as it was technology on which STD focused), gradually (depending on the research topic and the involved researchers) the relation between the three aspects was given more attention. However, a full integration of the C-S-T concept in the various illustrative processes proved difficult. Eventually, it was considered a specific research theme, under which several separate research activities and assignments were grouped.

The elusive relation between the NPF project and a future sustainable diet

The concluding symposium to the STD Programmes on food, with which the NPF project was officially concluded, was entitled “What will we eat in 2040. Towards a sustainable diet and food production.” Given the existing trend towards an increasing environmental awareness in food production and research and the fact that “the focus on sensory aspects of proteins most probably would have been realised also without the NPF project”, the question is what exactly the project contributed to the development of a sustainable diet. The direct effect on the various research agendas was limited; a comprehensive research programme on sustainable food production and consumption allegedly was in the making anyway; none of the seven NPF-options that were elaborated in the NPF project as such were adopted by “third parties” and the envisioned research consortium did not materialise.

As observed above, such a bleak representation of the NPF project’s impact does not do justice to its meaning in terms of the underlying STD philosophy. While health issues and sensory aspects were driving forces in protein-focused research, considerations on sustainable development were not. The project managed to link the two, be it merely as an “interesting idea” in the heads of some technologists and managers, thus adding an additional aspect to the ‘chain reversion’ trend in thinking about food production and research. Be it just as elusively, the project contributed to an appreciation of current plans and activities in a long term perspective, in a way that is illustrated by Avebe in the case of the grass project. While Gist-brocades indeed was focusing already on the meat sector in search of new business, it was because of the project that it “got NPFs in sight.” Although it was unclear what constitutes the surplus-value of non-
animal protein products for non-vegetarians, the NPF project influenced the power plays within the Unilever consortium in such a way as to have it – again – invest in meat substitute development.

Impacts such as these are a far cry from the 'grand design' concept that the NPF project team expressed to aspire in its efforts to pull off an “NPF sector” and instigate an NPF development path. Still, they are evidence of the project’s success in contributing to the STD Programme’s overall objectives. The Programme was intended to not only provide examples of potential sustainable technologies, but also to incite a process of reflection “in the world of technology development” from an environmental perspective about the future. Through its backcasting concept, it sought to bridge the gap between the common good in the long run and business interests in the short term. In addition to the aforementioned impact on food companies and research institutes, the NPF project contributed to realising this ambition notably by kindling enthusiasm with the Ministry of Economic Affairs, a major player in the ‘world of technology development’ in the Netherlands.

In so doing, the NPF project contributed in a very practical way to the ‘governmental think tank’ function that the STD Programme was considered to have. Perceived in this light, the assertion in Weaver et al. (2000:133) about the NPF project’s intentions is comprehensible: “For the STD Programme, the issue was less to provide unquestioning support for a novel protein food development programme than to establish an inclusive process by which the value of such a programme could be assessed and its design influenced by stakeholders.” Yet, if indeed that was the issue, it is interesting to see why in the project’s practice, there was such an apparent discrepancy between the desire to involve stakeholders in assessing the value of NPF development and the way in which the project shunned discussions on normative aspects.

The practical difference between ‘learning’ and ‘convincing’ as a project objective

To set off the envisioned developments, the NPF project – as was observed before – set out to be as convincing as possible. It aspired to make the research findings as plausible as possible by expressing these in quantifiable variables. In addition, the project sought to strengthen its credibility in the eyes of those who were considered relevant from the perspective of a future NPF development by involving researchers and managers of outstanding name and reputation. While eventually the aim to convince was directed both at policymakers, societal actors and technologists alike, in the first instance the efforts were directed at R&D divisions in major food companies and at leading research institutes. This strategy not only left its mark on the impact – the project especially affected the latter, in terms of action as well as of learning – but also had implications for the employed methodology.
Particularities of the participatory process

The adopted strategy to pave the way for NPF development was a conscious choice to deal with the conceptual ‘splits’ that were built in in the NPF project (and in the STD Programme as such). On the one hand, the project sought to stimulate creativity in order to foster a radical break-away from the regular, incremental technological development paths, towards changes in the long term. At the same time, the project intended to inspire action among actors to jointly co-produce the envisioned, “unusual” long-term development by taking the necessary first steps in the short term. To that end, the envisioned activities had to be in keeping with the interests of relevant parties, or had to present a solution to the problems these actors experienced in the here and now.

In order to deal with this in-built tension in the project’s concept, the project was organised as an interactive process. The intentions and intensity of the interaction with the various parties differed according to the stage and particular research activity. While at the earliest stages of the project, stakeholder discussions were meant to provide a critical examination of the ideas on NPF development (and an NPF project as such), in the later stages discussions were primarily meant to “serve” target groups interests and to “influence their attitude and points of view in a positive way” (DTO 1995b:1). The number of stakeholders that were identified as potentially relevant sparring partners increased over time. Of these, a small group of actors who were identified as possible future developers of the NPF under investigation was closely involved from the very start. The purpose of the discussions was to make sure that the ideas that were generated in the project made sense in their eyes. Other stakeholders, many of whom were involved in a later phase, were approached to ensure their co-operation in putting the generated ideas into practice. With tremendous zeal and vigour, the project team sought to convince these stakeholders of the feasibility of NPF development and of its relevance.

The input from the newly approached discussion partners was analysed from the perspective of the possibilities and challenges for stimulating the desired follow-up activities that they presented. The project team during this stage did not aspire to a further “joint” elaboration of NPF-designs and development paths. Why did the project team choose to adopt such an approach to stakeholder interaction in spite of the project’s intentions of establishing “an inclusive process” by which to assess the value of NPF development and to influence NPF design?

The analysts’ role in relation to the institutional setting

First of all, the deliberate choice to focus on technological solution strategies as a way to approach the more abstract and normative debate on sustainable development was considered to imply an *a priori* limitation to the scope and width of the discussions. In
the case of the NPF project, this was expressed in the narrowly set closure that limited the issue of reducing the environmental burden associated with meat production to the technical solution of substituting meat's nutritional value.

It was explicitly acknowledged that, even though technology was the point of departure in STD's investigations, there was a need to address the cultural and structural aspects of technological innovation as well. In the NPF project, this dimension of the issue under scrutiny had been put centre stage in the preparatory phase by organising the analysis as a "multidimensional" process in which the relation between consumer's aspects and technical aspects had a pivotal role. In practice, however, the technical aspects were emphasised most strongly.

Irrespective of the underlying rationale, the focus on the technical aspects of NPF development at the expense of a more comprehensive (in substantive terms) and "inclusive" (in terms of participation) approach resulted from the project's particular institutional setting. This second explanatory factor includes the aspect of the institutional arrangement's convincing power, and the leeway it had in 'making a difference' as well as the aspect of administration and financial management.

The STD Programme was set up and positioned as a governmental analytical body that served as a 'think tank'. Yet, for practical and ideological reasons (the developments it strove to induce were to be market driven), it operated at an arm's length from the central government. As a result, the institutional set-up of the Programme was rather awkward. On the one hand, it derived its legitimisation from its governmental status, but to make its analytical function operational and trustworthy, it had to rely on its own reputation and other immaterial resources.

The independent status of STD was conducive to the creativity and flexibility among private parties required for achieving its ambitious, long term objectives. Yet, conversely, the unorthodox approach to stirring creativity had an impact on the Programme's reputation and credibility. It was – at least initially – looked upon as an activity "to keep a bunch of professors off the street" (Aarts 1997a:11). The Programme's plans were often regarded as a "shot in the dark" and "interesting but not very realistic", and its suggestions for action as rather non-committal. For the NPF project, which was the first to commence, this implied the need to be utterly convincing and to establish the Programme's name as a trustworthy and "realistic" institute.

The administrative embedding of the STD Programme posed a further restriction to the NPF project's leeway to explore the normative aspects of sustainable technology and to incorporate "the technically almost inconceivable" in its analyses (DTO 1994a:7; my translation). Because of its wish to have commercial firms commit themselves financially as well as in words to the various projects and their findings, the NPF project team felt it had to make a convincing case and produce solid figures. In addition, because of the Ministries' support, the STD Programme had to comply with the various
financing regimes. With the exception of the Ministries of the Environment and of Agriculture, the supporting Ministries reconsidered their support on a yearly basis. This implied that the projects had to be evaluated at a pre-set moment on the basis of pre-set targets and expected output.

Hence, to ensure both private and public support, the NPF project had to have something to show for itself at an early stage. In practice, this requirement impeded the possibilities to explore highly innovative and creative ideas. Furthermore, it limited the possibility to organise the project as a genuinely interactive research as the outcome had to be specified in advance.

The tension between these contradictory requirements came to the fore in the ‘double role’ of the project team. On the one hand, the team had a managerial task to ensure a timely delivery of the research portfolio. On the other hand, it had a facilitating role in stimulating creativity and reflection. In practice, the two roles clashed. The managerial role was not conducive to creating an atmosphere in which creativity could thrive. Although all researchers joined in the discussions on which course to take, the ultimate decision making power rested with the project team: “Time and again, we were called back when our suggestions apparently outstretched some agenda that was unknown to us. ... That impeded the creativity up to a certain extent. ... The structure of the project led to an impoverishment in terms of contents” (Eggink, personal communication, October 18, 1996).

In addition, the practical task of attuning the various research activities to one another required a strict planning in advance in the eyes of the project team. This idea changed somewhat towards the second phase of the analysis, when the researchers met on a more frequent basis to improve the exchange of information and stimulate creativity. Then, however, it was because of the institutional embedding of the participating researcher that practical problems arose. Since the bi-weekly sessions were not planned in advance, at least one participating group of researchers could not attend to these. The “expensive hours” that were considered useful in the course of the ‘emergent’ design of the interactive process were not budgeted in advance.

**Particularities of the issue at stake and its context**

The particularities of novel protein foods as a topic for an interactive analysis also impeded to some extent the potential for setting up an interpretive TA. Representatives of environmental organisations, for instance, did not jump to the opportunity to invest valuable time in discussing products of which the environmental benignity was not clear. Consumers’ organisations faced a somewhat similar problem: as long as the products were not available to consumers, these were in fact a non-issue to them. The main consumers’ organisation, which sat on the advisory board, and the societal organisations that participated in the TvC-procedure had little opportunity to relate to the
NPFF project’s problem as long as the product’s desirability from an environmental and a normative consumers’ perspective was not put up for discussion.

Hence, while the project positioned NPFs on the interface between economy and ecology, the problem it focused on was not ‘owned’ by environmental organisations. And in spite of the trend towards ‘chain reversion’, the problem as defined by the NPFF project was not as such recognised as meaningful by commercial enterprises either. The continuity in the consumption of meat and dairy products appeared guaranteed. Moreover, the life cycle of foodstuffs is very long. Add to this the unpredictability of consumer’s behaviour in the long run, and it is clear why the food business community is not interested in developing a long term strategy towards products such as NPFs. Making a short term case for ‘environmentally friendly’ food products is difficult too as long as the environmental aspects of a product are hard to express in quantifiable data and therefore cannot be declared on a product’s label.

As a result, at the time of the NPFF project, no one ‘owned’ the environmental problem for which the development of NPFs could be a solution. Therefore, the project team felt it had to present NPF development as a business case in its own right, in addition to the environmental claim.

*Sustainable technology development vis-à-vis phronësis: a discussion*

Arguably, it is precisely the latter aspect of the NPFF project (its presentation of NPF development as a business case) that makes it a successful case of sustainable technology development. The project developed a practical way to bridge the gap between the idealist idea of long term environmental improvements and the short term practical steps that have to be made to achieve that goal. The choice to rely on market forces rather than on governmental policy measures to instigate the desired changes particularly impelled commercial firms to make the required moves. Since to the latter, environmental motives were not an incentive to invest in NPFs, their co-operation was to be ensured only if the project led to a congruency of meaning, that is, if the suggested options for action made sense in terms of an expected return on investments rather than as a means to contribute to a sustainable development. The environmental claim that the NPFF project team made with respect to NPFs was merely an extra asset.

Considering the impact of the project in terms of influencing the research agendas of relevant research institutes and of two companies, the strategy that was adopted in the NPFF project to make the sustainable development concept operational and contextual seems a plausible one. Given the need to formulate actions which are in keeping with the interests of relevant parties, the choice to focus on a solution rather than on the problem in the analytic process is defensible. In the NPFF project, this focus was
considered to preclude normative aspects of NPF development and alternative solutions from the project's discussions.

The question is whether such a narrowly set closure was inevitable and/or desirable from the perspective of the NPF project objective to stimulate creativity and convince third parties to co-operate, and from the underlying STD objective of contributing to a sustainable development. The case material seems to suggest that not only on ethical grounds but also for reasons of efficacy, it may have been wise to adopt a more inclusive approach to the issue of NPF development. Such an inference of the case material directs our attention to the practical intricacies of adopting an interpretive approach to analysis on issues of sustainable development.

**Dissemination of the project's findings and insight in incentives for action**

Characteristic of the NPF project was its focus on bringing the outcome and results of the analysis to the attention of various audiences. The analytic process and the dissemination of its findings were virtually given equal attention. Even more remarkable was the width of the range of actors that were considered potential audiences to the project's findings, from R&D divisions in food companies to organisations developing educational material for schools.

Of this large variety of identified ‘publics’, the motivation to act on the topic of NPF development of only a small number of actors was taken into account in the analysis. The same holds for the factors that are of relevance to the actions of actors: those trends and issues in the context of the NPF project that were of relevance to the involved companies and research institutes were given due consideration in the first place. As a result, the project’s impact was largely limited to these actors, that is to say, learning in line with the project’s intentions was largely restricted to those parties whose views were accommodated in the analysis.

The restricted inclusion of views and relevant contextual factors arguably kept the project from exploiting its potential to the full in two ways. First of all, it implied an under-utilisation of the creativity that may result from a confrontation of mutually deviating perspectives. Viewed from the opposite direction, this caused the project to run the risk of concurring largely with the dominant discourse in the field that it intended to address.

The latter effect comes to the fore most specifically in the selection of protein sources. In spite of some discussion on alternatives, the ultimate selection by and large does not deviate from the initial selection suggested by the involved technologists in their original project proposal. The specific protein source selection may not be (and is not, in the project) considered of significant importance since “all textures may be developed from any protein source.” However, this line of reasoning embodies the bias towards processing technology that was present in the project and hides from view the
significant differences in environmental burden between the production of one protein source over another. The exclusion of alternative energy sources for the production and processing of proteins also rendered the project's contents rather conservative, as did the exclusion of waste-material as protein source. Furthermore, the elaboration of NPF development in terms of a "business case" to convince specific commercial parties caused the project to comply largely with the then-current assumptions about consumer behaviour. The idea that the consumer is not willing to pay some dimes extra for environmentally friendly produced products was considered a 'given fact'. Hence, the project did not explore the possibility to venture beyond the cultural and structural conditions under which the current 'non-sustainable' food production and consumption patterns come about.

Secondly, for lack of insight in the motives on the part of relevant parties other than the involved firms and research institutes to act on NPF development, the project did not result in information that may incite learning on the part of these actors in the long run. For a project that explicitly aimed at instigating a long term development, this is arguably a serious omission. After all, by the time the envisioned NPF products will be available technically, the actions of government (the TvC-procedure turned out) and of consumers' and environmental organisations will be of utmost importance to eventually meet the meat substitution target as outlined in the project. The project did not yield material (both in terms of results and of outcome) that may enable and possibly incite subsequent learning about NPF options that may trigger policy actors and other societal actors in due time to undertake action towards the project's envisioned goals.

**Keeping a power balance within the analytic process**

By not accommodating dissenting views and avoiding discussions on normative issues, the project team's understanding of its mission caused the project to fall short of contributing to the STD Programme's function of 'think tank' for the Dutch government on the requirements of sustainable technological developments. On a practical level, it provided considerable insight in the 'what' and 'how' of sustainable technology with respect to protein foods, yet it did not yield insight in desirability of such a development.

The fact that the problem was not redefined in the course of the project was not the result of a pre-existing consensus on the proposed problem-solution combination. The focus on substituting meat as a protein source, to the exclusion of other options for sustainable food production and consumption, rendered the project instrumental in instigating this development, while at the same time making it unfit to inform governmental action to stimulate the envisioned changes. For instance, the governmental policy (here, the Ministry's of Health, Welfare and Sport) at the time of the project did not in any way seek to actively stimulate the consumption of proteins. If there were to
be some policy “it would rather be directed at discouraging protein consumption for reasons related to health” (Top, personal communication, October 7, 1996). The active governmental stance towards promoting NPF consumption (or discouraging meat consumption) that was considered necessary for achieving the substitution target in 2035 hence would have to be triggered on different grounds than the nutritional aspect of meat and its substitutes. On potential alternative motives for doing so, however, the NPF project did not shed a light.

Except for the practicality of the project’s findings from this perspective, their ‘fairness’ can be considered an issue as well. Even though the project explicitly focused on ‘knowing how’ rather than on ‘knowing what’ in the light of a sustainable development, it is justifiable to question who determined the agenda of the publicly sponsored project. This question is all the more relevant since the project indeed affected research on NPF-related issues in the way it meant to. The project was a major force in influencing ‘sub-political’ decision making that was, by the inter-ministerial programme STD, captured under the heading of serving the common good (here, a “sustainable diet”). Yet, it did so without opening up those decision making processes to public scrutiny or to structured criticism of so-called ‘countervailing powers’. Since the advisory board de facto did not exercise any influence on the course of the project, this aspect of NPF development was, if at all, covered entirely by the input of participants in the TvC-procedure. The latter construct however was not intended to perform such a role, nor was it in a position within the NPF project’s set-up to do so.

**Method, practice and impact: some observations**

The strategy to ‘convince by illustration’ that was adopted in the NPF project, and its elaboration in practical aspects such as contracting a person of good name and standing as the project’s champion, was reinforced by the project’s institutional and administrative embedding. The fact that the project was the STD Programme’s first endeavour, the Ministry of Economic Affairs’ demands of a “demonstrable interest” in the project among market parties as a prerequisite for contributing, and the inevitable compliance with the various supporting Ministries’ financing regimes all contributed to the emphasis in the project on solid quantifiable data, to the technical elaboration of the issue under investigation and to the narrowly set closure.

Next to these practical considerations, the focus on convincing various audiences of the feasibility and desirability of NPF development was also a deliberate, methodological choice. In addition to using the convincing power of the comprehensive analysis, the project team developed an active strategy to strengthen the analysis’ chances of having an impact on the research agendas of relevant market parties and on the decision making processes of other actors.
Given the project’s impact in relation to the project’s intentions, the adopted approach apparently also has had some major drawbacks. Firstly, not all relevant actors have been reached. While the co-operation of a wide range of actors was considered necessary for the instigation of the envisioned changes (see the second stakeholder analysis, the agenda of embedding activities and the TvC-findings with respect to the substitution targets), only a small group of actors was successfully approached. These were the actors that were either closely involved from the very start of the project or for whom the project (accidentally) touched on issues which they already focused on. In these cases, a congruency of meaning between the options for action that were discussed in the NPF project and those action alternatives which they already pondered in the light of their problem definition(s) resulted in actions that may be earmarked as ‘impact’. The NPF case material, hence, underscores the effectiveness of facilitating learning in order to influence action. At the same time, it shows the very limited effectiveness of putting an emphasis on mere information dissemination and educational activities.

Secondly, the adopted approach not only posed a strategic problem but also a contents-related one. The ambition to ‘convince by illustration’ to the NPF project team implied a reasoning away from the normative aspect of the sustainable development concept in favour of a quantifiable and technical elaboration. Yet, witness the discussions in the TvC sessions and the advisory board meetings, the ‘messy character’ of the problem could not be glossed over by the focus on a technical elaboration. In the interviews that were conducted for this case study, the interviewees almost without exception indicate that notably the lack of attention for the unstructured character of the problem at stake rendered the project and its findings little convincing.

Of a more fundamental nature is the following, related observation. The NPF experience seems to indicate that in addition to the acknowledged tension between ‘innovation’ (the desire to formulate “leap frog” innovations and “nearly inconceivable” technical ideas) and ‘acceptance’ (formulating options that are in keeping with the interests of relevant parties), an analytic project on sustainable (technology) development also potentially harbours a strained relation between the desire to instigate change and the requirements for yielding knowledge on ‘what to do’.

The first ambition (instigating change) implied the need to closely involve players with the technical know-how and the investment power to pull off the discussed developments. However, this venturing into the real world to ensure implementation of the analysis’ findings caused the project to drift away from the methodological prescriptions on the basis of which it was set up (see the sections on ‘organisational focus’; cf. Weaver 2000:135-136), which, in this book, are understood as the requirements for informing political judgment. These methodological notions need to be made operational in order to serve the latter ambition (yielding phronésis), not only because of ethical considerations concerning the ‘democratic quality’ of the process and the legitimacy
of its findings, but also for the aforementioned practical, strategic reasons. First and foremost, such a methodological elaboration entails an equally influential involvement of other stakeholders in addition to the technically knowledgeable and financially powerful parties and inclusion of normative aspects in the discussions. Yet, this requirement may cause the project to lose its focus on the issues for which the investors are willing to make a commitment.

The case material on the NPF project not only seems to suggest that the two aims (which in an earlier chapter were identified as the two intrinsically interrelated aspects of *phronēsis*) in practice are at odds with each other. It also provides clues as to how to deal with the seeming dilemma in a practical way. The findings indicate that the level of specificity into which the NPF options were elaborated is not a prerequisite for success. The elaborations did not result in a literal "adoption" of the specific NPF options by third parties for further development. This finding coincides with the self-reported experience of the project team that, contrary to the expectations, the quantitative detailing of the analytic findings was of little consequence compared to the discussions on the general idea of NPF development in convincing relevant parties into co-operation. These findings suggest that the level of detailing of the technical aspects of the issue under scrutiny is not the decisive element in generating an impact in terms of action and hence does not have to impede the 'think tank' function of an analysis on sustainable (technology) development.

Another contents-related ‘way out’ of the apparent dilemma is offered by the ‘backcasting’ concept that was developed in the STD Programme. The T\&C experience showed that discussions about a shared vision of the future, in this case, on a sustainable diet, in spite even of the technical focus in the assignment, inevitably resulted in an explication of the political nature of the issue under scrutiny. In contrast to other STD projects\(^5\), the NPF project made little use of the potential that such an exercise offered for incorporating normative aspects in the project’s discussion and for creating support for the project as such (irrespective of its findings).

Furthermore, the NPF case material shows that the institutional embedding of a project strongly influences its methodical elaboration. The NPF project as well as the STD Programme as such entailed a quest not only into novel ways of contextualizing the sustainable development concept, but also (witness its methodical objectives) into new ‘rules of the game’ to do so. On the other hand, the project and the Programme were tightly embedded within the existing administrative and institutional regimes. This organisational aspect added to the complexity of relying on market forces for instigating the desired developments, without any back-up of the usual means of more tra-

\(^5\) In the STD project on chemistry especially, the backcasting concept was successfully elaborated by inviting knowledgeable actors to write essays on the subject that stimulated "innovative ideas and creativity," which were then submitted for comments to a larger, heterogeneous public (cf. Aarts 1997b:119-145).
ditional governmental organisations (authority and legitimation derived from their institutional position, reputation, legal framework and so on).

The implications for the STD Programme's rather awkward institutional position for the methodical elaboration of its mission apparently had been given little thought in advance. Hence, these implications showed in the course of events and surfaced in the NPF project. A variety of lessons may be drawn in this respect, from the need to consider the conditions that influence the project team's perception of its own role, to very practical managerial issues such as organising the finances in a way that an emergent project design is at least possible (avoiding, for instance, the situation that any of the participants will have to skip additionally organised conferences for budgetary reasons).

In general, hence, a second solution strategy to dealing with the tension between the ambition to inform political judgment and to instigate actual changes in line with the informed judgment entails, the NPF case material suggests, a conscious effort to attune a project's institutional setting to its methodological requirements.