The Waste Energy Factory

Msc Programme: Water Science Management

Course: Water Policy, Governance and Law

Utrecht University

2012-13

Course coordinator: mr. M. van Rijswick

Author (student nr): Bart Gombert (3118029) – Master Sustainable Development

The Energy Factory – Innovation in waste water treatment

Content

Introduction – A new policy design

This paper describes a new policy design for the specific issue of energy production in wastewater treatment. Currently, there is no existing policy in place as the principle of energy production from waste is in an experimental stage. Therefore there is no experience or any particular issue with a policy, which calls for change. Rather, a new policy has to be put in place with the current knowledge and state of affairs.

This in and by itself is a point of future attention; it entails that the new policy should be flexible and adaptable when knowledge on the subject matter is expanded. The EU Water Directive already states that water policy should be flexible and adaptable wherever possible. It is believed that in the end this delivers better water management practice.

This paper will describe and apply the water governance assessment method to assess current knowledge on a waste energy factory. Note: normally the assessment method would assess the current policy. This means that shortcomings and problems and suggest improvements for the policy design are analyzed. Particular attention will be paid to on the expected legitimacy and effectiveness of water management.

Now, what is the waste energy factory all about? The Energy Factory consists of a partnership between fifteen Water Boards (grand total of Water Boards in The Netherlands is 25 as of the first of January 2013[1]). The aim of the participating water boards is threefold[2]:

1) To purify waste water in an energy neutral manner, optionally in combination with other energy-containing organic streams.

2) To supply energy to themselves in the future produced from wastewater. The energy is produced in the form of green electricity, biogas and heat.

3) To improve the image of the Water Boards. The Water Boards want to show that they are dynamic organizations that function in the middle of society as responsible and innovative institutions.

These goals show the Water Boards' perspective on a challenging future. Incoming waste water is no longer viewed upon as a problem to deal with, but rather as an opportunity.

In this paper these ambitious goals are analyzed in the context of a new policy design. First, some more background information on the Energy Factory will be provided. Second, the assessment method will be presented. The results then follow as the integration of the background information and the assessment method. Finally, conclusions will be drawn and recommendations for a new policy will be given, following a discussion on the subject matter.

[1] http://nl.wikipedia.org/wiki/Waterschap_(Nederland) as visited on 1st of June 2013
[2] Water boards project 'Waterwegen' 2008

Background – figures on the waste energy factory

The purification plants are the place where the objectives of the Energy factory must be achieved. These plants can be converted to Energy factories because this was taken into account by their design.

Urban wastewater in the Netherlands is purified by 350 different plants, which are managed by the water boards. Yearly, over 23 million pollution units are purified in these plants and around 25% already generate energy during the purification process[1]. Between 30% and 50%[2] of the plants own energy consumption is generated amounting to a total of 150 GW-h. As the total energy demand of the purification plants is around 750 GWh, the water boards need to purchase an additional 600 GWh to provide for the demand. Besides the power demand the purification tasks also demand gas. In comparison, the energy consumption of the purification process is equal to the yearly energy consumption of around 250,000 households[3].

Looking at the numbers, an energy neutral situation seems to be hard to achieve. Maximizing fermentation is one of the tasks the Energy factory focuses on. By optimizing the fermentation process and sending more organic matter to the process, production of energy should increase. Simultaneously, the process itself should use less energy[4].

Technically it is already possible for the water boards to purify in an energy neutral way. The purification process should be modernized achieving higher fermentation and lower energy consumption. The waste water itself already contains over eight times the chemical energy necessary to run the purification process. Theoretically the water boards can be the biggest green energy providers of the Netherlands.

According to the Energy factory, in the future when techniques become better, it is feasible that the purification plants could produce a surplus of energy. This would even enable to provide green energy to third parties. While it seems possible to achieve an energy surplus in the future from wastewater purification, it is not yet certain that it is economically feasible[5].

The creators of the Energy factory have defined three types of Energy factories and calculated the economic feasibility of each of them. The three types are

- The basis variant, which is already technically possible resulting in energy neutral plants at relatively low costs

- The plus variant, achievable in two years generating an energy surplus. However technically uncertain and economically not feasible on small scale

- The super variant, technically uncertain and this will need at least 5 years of developing. It is however economically feasible providing net income at high amounts of processing.

[1] H.J.M. Havekes, H.F.M.W. van Rijswick, *Waterrecht in Nederland*, Deventer: Kluwer 2010, p. 282.
[2] Rapport '*De Energiefabriek, waterschappen binnenstebuiten*', waterschap Aa en Maas, waterschap Rivierenland, waterschap Veluwe, Hoogheemraadschap Hollands Noorderkwartier, 2009
[3] '*De Energiefabriek, waterschappen binnenstebuiten*' 2009, p. 14
[4] '*De Energiefabriek, waterschappen binnenstebuiten*' 2009, p. 17
[5] '*De Energiefabriek, waterschappen binnenstebuiten*' 2009, p. 19

This brief summary of alternatives does not touch upon all the implications the Energy Factory has. The main concept is that energy neutral waste water treatment is possible and in the longer term possibly even green electricity production. Amongst these pro's for the Energy Factory there are a few con's or points of attention.

Rising electricity prices[1] are assumed in return on investment calculations. The Energy Factory assumes a doubling of prices of energy within 10 years. However, there is a wide range of estimates including one of the International Energy Agency which mentions a doubling of prices in 20 years time.

Other waste streams such as biomass are welcome if not necessary to reach sufficient scale. The impact of the Energy Factory on prices for waste management become apparent on a scale of 350 000 pollutions units. For comparison, only 55% of the treatment plants are large enough to reach this scale. Only in the longer term, the Energy Factory will be deployable on smaller scale. Or in another perspective: by tripling the scale of the factory the payback period is reduced by 25%.

Separation of waste streams[2] will have an impact on the business case as usual. In the past all slurry of households was collected in a single stream. When new sanitation or sewage are installed, a system of separate waste streams is used. This increases the thickness of the slurry, which is easier to handle for the waste treatment plant. Also, the decoupling of rainwater (by rainwater retention) will no longer dilute the waste streams. However, this is a very slow trend as the sewage system has very long expected life time (60-70 years).

CO2 emission rights are possibly a source of extra income for the Energy Factory. Currently this is not taken into account. The energy produced in the Energy Factory is CO2 neutral and could mitigate an amount of 800 tons for small waste plants and up to 5 times that amount for larger plants. Currently one ton of CO2 costs less than 10 Euro's[3], so the financial benefit is negligible.

Stricter water quality norms in the future will increase the energy use of the waste plant. Lower nitrate and phosphor concentrations as well as getting rid of medicinal substances in waste water are likely to be mandated by new European guidelines.

Current regulations of waste treatment plants already allows for increased disposal of biomass and the production or delivery of energy.

[1] *De Energiefabriek, waterschappen binnenstebuiten*' 2009, p. 20
[2] WaterNed, rainwater retention options (2010), p19
[3] Emissierechten, Analyse van de CO2 martk, november 2012

Assessment method

As mentioned in the introduction, there currently is no policy applicable on turning wastewater into a source of energy. Nonetheless, an assessment method can be used to point out what any new policy should especially be aware of. The assessment method used is the one developed by Brouwer, R. et al (2012) – '*An integrated method to assess the Governance of water'.*

The assessment method contains three main parts, comprising a total of nine steps. The three steps are: 1) Content or knowledge base, 2) Organization or weaknesses in the process, and 3) Implementation or service levels. Each part has multiple criteria (in total nine steps) to assess a part of any (new) policy on the governance of water. The three parts are stepping stones towards the final goal: integrated water management as envisioned in the EU Water Directive.

One issue concerning the assessment in this policy is that it's not primarily about water management, but rather the **usage of waste water for energy production**. To make this more explicit in the assessment method *'(energy)*' will be added where necessary.

Each part and each consecutive step in the policy assessment is mentioned next. The assessment criteria is stated and a brief explanation is given as to what that step accomplishes.

Part one, *Content or knowledge base*, contains steps:

1) **Water system knowledge**: this refers to the physical and social features of the given system. They demarcate the boundaries in which the policy has to operate.

Assessment criteria: is there sufficient knowledge of the existing water system (waste energy system) in order to deliver the required service level of societal functions; if not, what are the gaps?

2) **Values, principles and policy discourse**: shared values and principles enables easy solution finding. Transparency on values and principles, whether shared or not, can create better legitimacy. Finally, discourse is the way the story on the policy is framed.

Assessment criterion: Is there sufficient knowledge of shared or conflicting values, viewpoints and principles (represented by different policy discourse coalitions) for water issues (energy issues) and their consequences for facing water (waste energy) management issues?

3) **Stakeholder involvement**: water governance affects a lot of different stakes, especially in a country like The Netherlands. Assumed is that the involvement of stakeholders creates better solutions, with better legitimacy. Decision making can deliberately be influenced by stakeholders.

Assessment criterion: Are all relevant stakeholders involved in their full width and depth? Are their interests, concerns and values sufficiently balanced considered in the problem analysis, solution search process and decision-making?

Part two, Organization or weaknesses in the process, contains steps:

4) **Trade-offs between social objectives:** economic theory dictates that the allocation of resources should be as optimal as possible. This step explores the various (conflicting) objectives, e.g. sustainability, economic efficiency, involved risks. It also involves the means (mechanism) by which the allocation takes place.

Assessment criterion: Are agreed service level decisions based on trade-offs of costs, benefits and distributional effects of various alternatives?

5) **Responsibility, authority and means**: this step includes property rights, an analysis of who bears responsibility, who has the authority to decide and by what means this authority can decide.

Assessment criterion: are authorities, responsibilities and means well-organized to deal with water (waste energy) issues at the appropriate administrative scale(s) in a participative and integrative way?

6) **Regulations and agreements**: this is the synopsis of the first five steps. This step will evaluate whether the regulations and agreements in the first five steps are appropriate as seen the circumstances. More important: do they solve the actual problem and what is the intention of the parties. This step will shed light on the legitimacy of the policy.

Assessment criterion: are regulations and agreements legitimate and adaptive, and if not, what are the main problems with regard to the above mentioned legitimacy aspects?

Part three, implementation or service levels, contains steps:

7) **Engineering and monitoring**: service level agreements determine whether infrastructure needs improvement. Engineering requires the study of alternatives and an economic analysis. Monitoring establishes whether the system meets the stated requirements.

Assessment criteria: Are SLAs sufficient available (implicit or explicit) in order to redesign the existing infrastructure? Are design and consequences of different alternatives sufficient available? Is there sufficient monitoring of the system and are the data analysed?

8) **Enforcement**: a lack of enforceability will hamper reaching the goals set in a policy. This in return requires the policy to be credible and to be viewed as legitimate by parties.

Assessment criterion: are regulations and agreements enforceable by public and/or private parties, and are there appropriate remedies available?

9) **Conflict prevention and resolution**: shared waters (waste energy streams) can be a source of conflict as well as opportunities. This requires '*thinking about water in terms of its value*', rather than in terms of ownership. Information on the value of water can help parties negotiate in water (waste energy) allocation and about benefit sharing.

Assessment criterion: Are there sufficient conflict prevention and resolution mechanisms in place?

Results

This part will integrate the background information and the assessment method in the form of results. The results will be elaborated on step by step.

The first part is on the (creation) of a knowledge base upon which to base the new policy. The very first point of attention is that this policy discerns waste water as an input to energy production. This requires extensive knowledge, facts and figures on this process, which is obviously more difficult for a yet to be developed policy.

Step 1) Water system knowledge

Assessment criteria: *is there sufficient knowledge of the existing water system (waste energy) in order to deliver the required service level of societal functions; if not, what are the gaps?*

Yes, from research it is shown that a significant amount of energy can be produced from waste water. Also, by design the waste water treatment plants are capable of processing the waste water and turn it into energy (either electricity or gas). Already some plants partially produce their own energy needs. It might be that the energy system has to be adapted to a two way system (receiving and transporting energy by the waste plant).

The water system, or waste water system for that matter, is not to be expected to change. By treating waste water, the energy plant merely extents to usefulness of a societal need. Other issues, like the variability of the waste stream will have to be assessed. The usage of waste water to produce energy should always be seen as secondary to the current facilities and not as the main goal of a waste water treatment plant.

Step 2) Values, principles, policy discourse

Assessment criterion: Is there sufficient knowledge of shared or conflicting values, viewpoints and principles (represented by different policy discourse coalitions) for water issues (energy issues) and their consequences for facing water (energy) management issues?

The values touched upon in waste water treatment, will be no different than those when turning waste water into an energy source. However, in the traditional view waste was seen as something to get rid of. Now it can be seen as something to come by; something valuable and this could changes relations. And, the energy factory is besides the main expertise of a water management board.

Values can be elaborated in principles. **Principles** can be grouped in categories and each category bears a connotation on the Energy Factory.

- Institutional principles (subsidiary or integration)

The primary goal of (waste) water management is clean water; and not energy production. **An Energy Factory can either be integrated or a subsidiary, but institutionally it must be clear that it is not the main priority**.

- Good governance (proportionality and public participation)

An Energy Factory entails little or no public participation due to its very nature. This is not necessarily bad, but it should be noted. Policy should also keep an eye out for proportionality. Different alternatives in the Energy Factory allow for energy neutrality to energy surplus generation. The energy surplus generation could be seen as out of proportional problem solving, as it is not the primary goal of the water board to produce (green) energy. **Policy making should not stimulate beyond energy neutrality or even limit the energy surplus generation.**

- Environmental principles: prevention, tackle pollution at the source and solidarity principle.

One might actually argue that (producing) waste is no longer a bad issue in the case of an Energy Factory, as it generates value. **One policy recommendation is to prioritize a minimum waste production, before the waste is valued as a source of value.** Waste water treatment is based on the solidarity principle. For that reason it should not become a nuisance for other stakeholders.

- Technical principles: from global to detailed design

Most current waste water treatments are, by their commercial design, more or less capable of turning into Energy Factories. The basic design is already implemented as some 30-50% energy needs are already generated by the plants themselves. These are usually the larger plants. The development of the Energy Factory could instigate the scaling up of plants. Less, but larger plants are more attractive in terms of operation. The flipside is that less people will experience the nuisance of a waste water treatment plant. But those who do live near an enlarged plant might experience more of the nuisance than before.

The narrative for the Energy Factory is that they are more than capable of meeting their own energy needs. The underlying values appear to be similar to that of water management in general. Some principles may give rise to conflicting issues, but they can be solved. The current trend towards sustainable management is positive for the case of the Energy Factory. The general infrastructure is ready and experience is available. Waste is now turned into a valuable resource, which benefits all the tax payers.

Stakeholder involvement in general enhances the content of policy proposals (because more knowledge becomes available) and **creates more support for legitimacy.** The stakeholder involvement is little or not applicable in the case of the Energy factory. The stakeholders would be all those who pay taxes and more in particular those who produce (the most) waste.

Especially the depth of the participation lacks, because the Energy Factory is a fairly technical issue. However, a lot of stakeholders are involved (width) when it comes to the advantages of the Energy Factory. The lower energy costs should ultimately be reflected in lower taxes of the water boards.

Step 4) Trade-offs between social objectives

Assessment criterion: Are agreed service level decisions based on trade-offs of costs, benefits and distributional effects of various alternatives?

Economics of water management is about the allocation of scarce resources, which can be water quantity, water quality as well as safety against flooding. Does the investment in energy waste facilities mean a trade-off for a water board's main responsibility? Does the process put constraints for example on waste water collection?

The allocation for waste energy does improve self sufficiency in terms of energy. Waste is turned into value, which is a positive social objective. However, at first the introduction of the Energy Factory might put a constraint on (human) resources within the water boards' organisation. Therefore, the Energy Factory can only exist as an addition to the organisation. In the long run, the Energy Factory is a positive contribution to water quality as well as the process requires more extensive filtering of water.

Step 5) Responsibility, authority and means

Assessment criterion: are authorities, responsibilities and means well-organized to deal with water issues at the appropriate administrative scale(s) in a participative and integrative way?

Property rights: The identification of responsibilities and authorities with respect to water starts with the determination of property rights. Who has the property rights of the waste and its benefits? Is it the people who produce the waste or is it the water board which has the responsibility to clean the water?

This is a relevant question as it could give rise to a dispute as soon as the waste is seen accumulating value. **A policy recommendation is to check this with all the stakeholders.** The water board should make transparent that the benefits from the Energy Factory are reflected in lower water taxes.

Allocating authority and responsibility: '*bottom up organised common property arrangements exist for drainage and irrigation. In the first half of the 20th century a growing concern for public health and sanitation results in the development of infrastructure for water supply and sewerage'* (Kissling-Näf & Kuks 2004). Can the same be said for energy issues today?

It can be argued that the Energy Factory can contribute massively to the share of green produced electricity in The Netherlands. Just like drainage and irrigation, this delivers major societal benefits. Solar panels and other renewable energies fit in the transition towards sustainable energy trend that is prevailing today.

However, **if allocated with the authority and responsibility to do so would strengthen water boards' development towards more societal benefits**. Currently, not all stakeholders are aware that the water board is situated on a cross road of water and energy.

Means financing: To restrict property rights, the public domain needs authority at various administrative levels, it needs to assign responsibilities to public and non-public actors, and creates *means* to empower authority. Also empowerment with financial means is needed.

We can think of cost recovery through a *solidarity principle* or *polluter pays principle.* However, in this case, the polluter delivers extra financial means towards society. Does this mean that bigger polluters get more tax cuts in the case of the Energy Factory? A better way would be to use the solidarity principle here. **All the costs of the Energy Factory are socialized and its benefits are redistributed to all those who pay water taxes.** This also fits better with the main priority of water boards to limit the actual amount of pollution (penalize pollution).

Means participation: Decentralization and strong local communities are seen as a favourable condition for participation. It is not likely that a lot of people, communities or interest groups take part in the decision for a waste Energy Factory. This may not be necessary as it is a fairly technical issue. However, all the stakeholders should be informed of the possibilities and the benefits the Energy Factory delivers.

Step 6) Regulations and agreements are the connecting link between content (assessment criteria above) and the implementation (assessment criteria below).

Assessment criterion: are regulations and agreements legitimate and adaptive, and if not, what are the main problems with regard to the above mentioned legitimacy aspects?

Currently, there is no specific policy with regard to the Energy Factory. However, it is not to be expected that regulations and agreements are to be found illegitimate with respect to energy neutral ways of working. This is due to the fact that the Energy Factory is a logical next step in the process of waste water treatment. There is, apart from the risk part, little negative impact for all stakeholders concerned, while there is a large positive factor for all.

However, when the water boards start to collude together to produce a surplus amount of energy, competition law is applicable. This is due to the fact that water boards would limit horizontal competition of green energy[1]. This could include price fixing for energy, which the energy supplier is entitled to buy back from a costumer (albeit at a negotiable price)[2]. Also, there is the matter of taxes levied, while stepping into the energy selling business. This could be seen as state aid. However, competition law does state examples, something the water boards should be aware of.

Appropriateness of rules and agreements is mainly observed by its perceived **legitimacy**. What legitimizes the construction of an Energy Factory? Fuller (2010) developed the following criteria for proper law making being: generality, promulgation, non-retro-activity, clarity, non-contradiction, not asking the impossible, durability, and congruence between rules and official action.

The generality implies here that the Energy Factory is not explicitly mentioned as the means or the goal. Rather, a policy on waste water treatment should state that the waste water treatment plant should strive for an energy neutral operation. The construction or operation of an Energy Factory is not something that can and should not be enforced.

All the other mentioned criteria are quite straightforward: once the policy on waste water into energy is implemented, the policy should be maintained and aided where possible striving for sustainable operations.

[1] Gerbrandy, Competition Law, p. 25
[2] Dutch Energy Law, 1998

Step 7) Engineering and monitoring

Assessment criteria: Are SLAs sufficient available (implicit or explicit) in order to redesign the existing infrastructure? Are design and consequences of different alternatives sufficient available? Is there sufficient monitoring of the system and are the data analysed?

Service Level Agreements (SLA) are used to determine whether the existing infrastructure needs to be improved, and which improvements are needed. However, the waste energy factory creates an entire new Service Level for waste disposal. Objectives/goals have yet to be formulated.

Focussing on only one alternative does not represent the interests of the people involved. In Engineering textbooks a 'from global to detailed' principle is often used: first a global design, then a detailed design, and next the implementation. There are three alternative plans for waste energy factory. Each are stated with their pro's and con's and they should be weighed by the authorities that decide on the Energy Factory.

Economic analysis has a role to play in assessing the returns on investment in constructing infrastructure. This differentiates the three alternatives. The first option is a sure thing, while the second option is not. The third option is profitable in the long term, but this entails a certain risk.

Economic analysis also has a role to play in assessing the cost-effectiveness of alternative infrastructural measures. Is the energy factory cost-effective? An important issue here is to include the maintenance actions in the design, and to make the trade-off between less investment costs or less maintenance costs. This is not entirely clear in the case of the Energy Factory. The more elaborate two options have yet to be built and therefore there is no experience with maintenance costs.

More important is that part of the economic analysis is based on a rising energy price: being a doubling of prices in a 10 year time frame. This is an important underlying assumption

Monitoring is not a goal in itself, but the data have to be used in order see whether the water (energy) system meets the requirements. In the case of the Energy Factory the amount of energy used and produced in the process of waste water treatment should at the least be measured. This ultimately determines the success of the Energy Factory.

Step 8) Enforcement

Assessment criterion: are regulations and agreements enforceable by public and/or private parties, and are there appropriate remedies available?

Good water management and governance should pay attention to the whole policy process from goal setting to the actual achievement of goals. Yet, the precise goals are still to be formulated for the waste energy factory.

It is likely that there are a lot of shared values in the case of the waste Energy Factory, because it is a logical addition to the waste treatment plants that already exist. Therefore it is not to be expected that regulations and agreements cannot be enforced. They will enjoy the existing credibility (and thus in the end legitimacy).

In the case of the Energy Factory strict regulations are not likely. A new policy will be more procedural and open norms should be used, because the final standards in the Energy Factory can only be formulated after development.

Step 9) Conflict prevention and resolution

Assessment criterion: Are there sufficient conflict prevention and resolution mechanisms in place?

Shared waters can be either a source of conflict or they may offer opportunities for cooperation, prosperity and stability. The same goes for waste: it can either be ground for conflicts or, in the case of the waste energy factory, provide benefits for all. It would be advisable to agree with stakeholders who enjoys the benefits from the Energy Factory and in what amount. This discussion should surpass the thinking of ownership of waste (which will be become more important as soon as the waste gets a value) and rather emphasize the advantages of benefit-sharing.

Conclusion and discussion

The one and foremost conclusion is that a policy concerning the Energy Factory is not primarily about water management, but rather the usage of waste water for energy production. Furthermore, the policy can very easily be an extension to the existing policy on waste water management.

All nine steps of the water policy assessment method were reviewed and the main conclusion for each step is summarized below. Some of the steps are more applicable than others; this will be indicated by '**Important'** and motivated why.

Important: There is sufficient **knowledge of the Water System**. The infrastructure and the system is already existent and the Energy Factory is a logical addition to the existing treatment of waste water. This makes it a very neat solution to the existing waste water problem.

Values are considered to be similar to that of normal waste water treatment and so are the **principles** concerned. There are a few important remarks for the Energy Factory.

Important

1) An Energy Factory can either be integrated or a subsidiary, but institutionally it must be clear that it is not the main priority of a water board.

2) Policy making should not stimulate beyond energy neutrality or even limit the energy surplus generation.

3) Minimum waste production is prioritized, before the waste is seen as a source of value.

Furthermore, in the **policy discourse** two principles are leading: that of lowest cost principle and that of sustainable development. These two benefits make up the heart of the policy discourse. The Energy Factory is beneficial in multiple ways to all its stakeholders.

Stakeholder involvement is low due to the technical nature of the Energy Factory. It is the main flaw in the policy; it lacks wide participation. Those few who do participate are deeply involved.

Trade-off between social objectives is likely to be present, but not yet quantifiable. The organization of the Energy Factory might divert means (financial, man power) of the water boards away from other important tasks. The Energy Factory needs an upfront investment of money and time to pay off later.

There is no single authority that has overall **responsibility, authority and means** concerning the formation of Energy Factories. It is up to the water boards themselves to participate/organize this. Just like they are responsible for normal waste water treatment. However, it might be wise to setup a committee with the aim of sharing experience on Energy Factories.

Existing **regulations and agreements** cover the treatment of waste water. The processing of waste in the Energy Factory has the additional benefit of better water quality.

Important: When water boards do decide to produce a surplus of energy, they are applicable to competition law. This will increase the difficulty of regulatory and operational burdens.

There are no service levels on turning waste into energy. There are indicators of quality of water **monitored** when treated in a waste treatment plant. The Energy Factory actually enhances the water quality.

Important: It is not possible to **enforce** the use an Energy Factory. Water boards cannot be obliged to treat waste in an Energy Factory. They can be enticed and stimulated to do so by all sorts of means. In the longer term, voluntary agreements by the water boards to decrease energy use, will in the end lead to similar solutions such as an Energy Factory.

It would be advisable to agree with stakeholders who enjoy the benefits from the Energy Factory to address the issue of **conflict prevention and resolution**. This discussion should surpass the thinking of ownership of waste (which will be become more important as soon as the waste gets a value) and rather emphasize the advantages of benefit-sharing.