Chapter 26

Challenges in regional collaboration

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26.1 WHY COLLABORATION WITHIN A REGION?

When industries dependent on reliable freshwater face structural water stress, they must develop long term strategies to minimize the risk of an interruption in their water supply. This is especially true of industries in the petrochemical sector that use water predominantly for steam production and cooling. Different approaches can be chosen to create a more sustainable water supply, depending on the local situation (Figure 26.1). For example, water stress may occur at the source due to limits on the availability of water, its quality, or the presence of competing users. Similarly, discharge of used water may be limited due to concern about the impact of its discharge into nearby water bodies on water quality, temperature, or other environmental factors.

When it comes to reducing water stress, industries should generally expect to 'reduce, reuse, and recycle' their own water, internally, before looking to 'share' their water issues with others. Nevertheless, there are situations when the best solution for all stakeholders requires regional collaboration with both public sector and private sector partners. In that case, industry managers must work closely with others both inside and outside the company to solve many different kinds of problems, both technical and political, even taking a leadership role as required. And while the challenges are significant, the rewards can be great. This was the situation faced by The Dow Chemical Company in Catalunya, Spain and in Terneuzen, the Netherlands, as described further in the following account.

26.1.1 First things first: reducing the footprint

A measure with great impact is to minimize the footprint of the chemical facility by redesigning or optimizing the chemical process itself so that its net water demand is lower (m^3 of water per kg of

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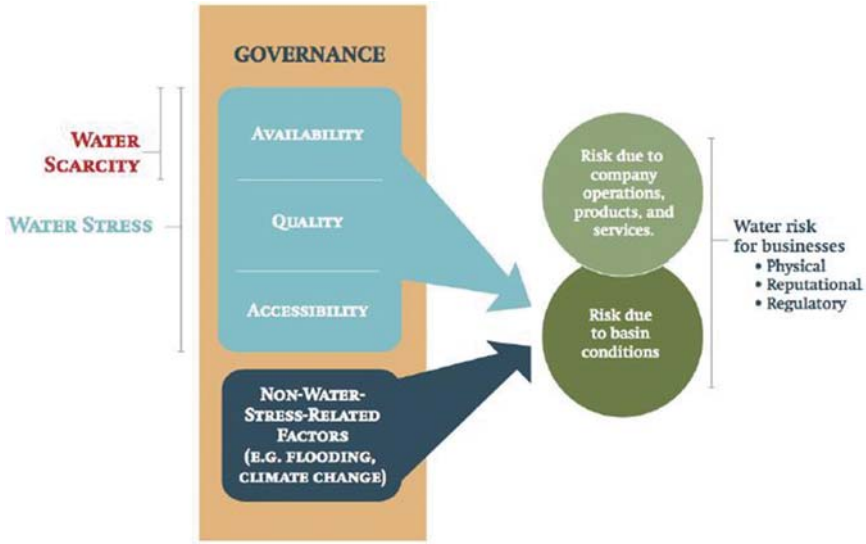

Figure 26.1 Factors determining water stress.

product produced). Significant water savings in cooling, cleaning, and product processing can usually be found in a step-wise method:

(1) Look for ways to *reduce* the amount of water required to perform a process;
(2) *Reuse* water purged from one process in another process where it can be applied directly without further treatment; and
(3) *Recycle* wastewater from a process by treating it to the quality required for reuse.

Reducing steam or cooling demand by interchanging heat, and improving cooling tower operation by increasing cycles of concentration (thereby reducing discharge) can often be accomplished quickly or with a minimum of technical support. It is also possible to reduce the water footprint just by standardizing maintenance and cleaning activities (assure that methods and procedures are optimized and leveraged at the operational levels). As an example, at the Dow facility in Freeport (USA, Texas) Dow saved four million m^3 of fresh water annually through applying Nalco Water's 3D TRASAR™ technology for cooling tower operation. There may also be opportunities to exchange heat between different plants within a chemical complex although the distance between facilities and the complexity of infrastructure connections may ultimately determine the overall cost and feasibility of the project.

Reusing wastewater from one process in another without significant quality enhancement is another attractive option for reducing the water footprint. A classic example here is the return of steam condensate as feed water for medium pressure steam boilers (up to 35 bar). (At higher pressures – 100 bar or more – the condensate may require additional polishing to remove minerals and ions to avoid corrosion and the formation of deposits in the steam/condensate circuit.) Finally, process water can be recycled for reuse at several places within the site's water envelope, after additional and dedicated treatment.

26.1.2 From internal to external

While the aforementioned measures are all within the fence-line of the facility, the first approach should always be to 'clean one's own kitchen first,' and only then search for alternative or additional 'outdoor' measures. Implementing on-site measures first will reduce the demand for freshwater make-up, by reducing the water used in products, losses to the atmosphere (steam, evaporative cooling), and water discharged to a receiving stream. To do more, however, requires collaboration with external stakeholders.

Few large chemical sites possess their own dedicated water sources. Unless they have access to unregulated ground water or have pre-existing surface water rights, chemical facilities are dependent on jointly managed regional sources (e.g., rivers and lakes, coastal (sea) water, groundwater), or on water supplied by public or private utility companies. As a result, facility owners have at least a shared responsibility for solving water supply issues within that region due to their substantial demand for freshwater. In some cases, the government entity managing the watershed actively includes the industry in solving regional problems. In other cases, it is up to the industry to take the lead. These two ideas are discussed further below.

26.2 TERNEUZEN

Dow's Terneuzen site demands 12 million m^3/y of freshwater make-up – about three times more than the water use of the entire region of Zeeuws-Vlaanderen (1200 km^2, 100,000 inhabitants). Water in this region is supplied to residential, commercial, and industrial customers by the water company Evides. Since the 1960s, the water company has built and maintained reservoirs with a total capacity of 6 million m^3 to store river water from the Biesbosch region, a preserved wetland area situated 120 km distance northeast of Terneuzen. To supply Dow's Terneuzen plant, Evides currently provides 6–7 million m^3/y of water collected from Belgian polders in the south under a long-term contract. The plant also receives roughly 1.5 million m^3/y of high quality effluent from the Terneuzen City wastewater treatment plant (WWTP), which leaves a gap of 4 million m^3/y of demand, currently supplied with freshwater from the Biesbosch area.

26.2.1 Early partnerships set the stage for future collaboration

Dow Terneuzen now aims to eliminate its industrial use of freshwater from the Biesbosch in anticipation of increasing pressures from food production, salinization due to sea-level rise, and more severe periods of droughts due to climate change. Dow's intention is to replace its Biesbosch intake by reclaiming and deploying additional regional water sources. To accomplish this, Dow will build upon and beyond existing relationships (established to realize the reuse of effluent from the City of Terneuzen WWTP) in order to create and use additional alternative regional supplies.

The collaboration chiefly involved Dow Terneuzen, Evides Industriewater, the regional Water Board, and the City of Terneuzen. At first, all parties agreed to the reuse the City's effluent, and for two years Dow Terneuzen recycled the WWTP's secondary clarified effluent by directing it to feed Evides' reverse osmosis (RO) membrane plant. At that point, an opportunity arose for enhanced cooperation based on the parties' evolving needs:

(1) In order for the Evides RO plant to continue to operate economically, the WWTP effluent quality had to be improved. Levels of residual organic material and nutrients (e.g., ammonium and phosphate) in the effluent began fouling the RO membranes, despite microfiltration pretreatment to remove the suspended material. This resulted in frequent chemical cleaning, reduced membrane life, higher cost, and lower treated water recovery.

(2) The Water Board determined that WWTP capacity should be expanded by 20% to accommodate future demand.

In response to these issues, all parties agreed to work together to expand WWTP capacity through construction of a membrane bioreactor (MBR) facility. This facility consisted of a dedicated bioreactor to metabolize organic and nitrogen-containing compounds followed by ultrafiltration membrane modules to remove solids, replacing the microfiltration unit at Evides' RO plant. As a result, the treatment plant gained its desired additional capacity and the effluent quality was significantly enhanced to improve operation of the Evides RO facility. Each of the partners recognized the benefit and the full-scale installation was realized ahead of time.

In the absence of such significant drivers, however, the collaboration to replace Dow's freshwater supply proved to be more challenging. Lacking such clearly defined benefits, Dow's previous institutional partners – Evides, the Water Board, and Terneuzen City – were reluctant to move forward quickly. Joint projects with other industries in the area were made difficult by the long distance and varied landscape between facilities, and collaboration with local farmers was complicated by the lack of a common voice that might allow individual farmers to work together with Dow. Farmers also struggled with the fact that in general they cultivate low value crops, while having more water might allow them to move to higher value crops. However, they could not afford the improvements that would make the water available, including the infrastructure for irrigation to reach the many farmers scattered within the region.

Dow Terneuzen might still have developed its own water supply strategy despite these obstacles, dealing with individual partners on a one-to-one basis. However, this posed the risk that the final outcome might satisfy the needs of industry but be suboptimal for the region as a whole. When the regional water planning process is left to 'market players' only, economics tend to become dominant and other values will receive less than desired emphasis. In addition, public support for the decision may decrease, which is negative for all partners at the end. As a result, Dow made every effort to engage the province and government parties in the role of initiator and process coordinator.

26.2.2 A new regional initiative

As pictured in Figure 26.2, the case of Dow Terneuzen was initiated by Dow with the prime objective to explore and use alternative water sources in the region for the reasons stated above. However, from an early stage, other stakeholders and potential parties in the field were invited not only to cooperate, but also to co-create synergy for the good sake of others like agriculture, nature, and other industrial users. So, farmer associations and nature groups have been involved from the beginning to tap into Dow's strategic approach and concrete plans. Other parties have been:

- the regional Water Board ('owning' water ways, dikes, and ditches, 'controlling' groundwater levels, and owning/operating the City's WWTP)
- the municipality of Terneuzen (owning the City's sewer system, but also being responsible for spatial planning)
- the province of Zeeland (responsible for fresh water strategy for that part of the country)
- Evides Industriewater (water supply for city and industry, and owning some vital infrastructure)
- HZ University of Applied Sciences (regional university with specializations in water management and technology, resilience to climate change and spatial planning)
- other industrial users like Yara (fertilizers), Cargill (food), ELSTA (cogen powerplant), ICL-IP (fire retardants), and Heros (solid and liquid waste handling).

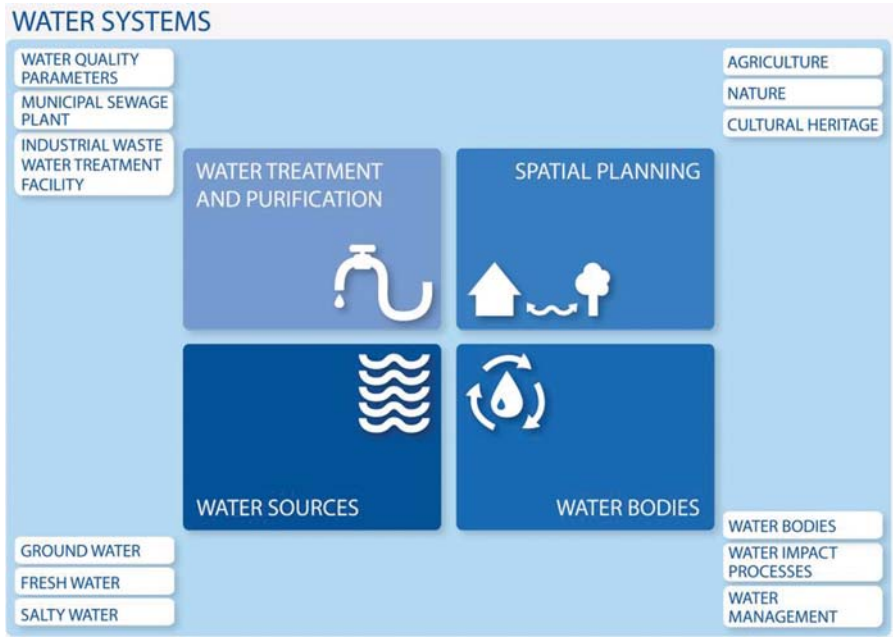

Figure 26.2 Building blocks for integrating different functions of water in a regional setting (regional Impact project by HZ University of Applied Sciences – 2016).

In addition to those mentioned above a few others have been kept informed over the course of the process, for example, Rijkswaterstaat (owner of the nearby major canal and locks) and North Seaports, the regional harbor entity.

Fortunately, the other parties successfully turned the 'Dow-only' scope into a broader strategic approach, called 'Robust Watersystem Zeeuws-Vlaanderen' (Figure 26.2). This approach is committed to the development and implementation of a long-term sustainable water system for the region, optimally providing water for all, including farmers, industry, citizens, recreation, and nature. This regional collaboration is able to identify all needs and receive each stakeholder's perspective, bringing them all together in a short- and long-term project portfolio and a road map for regional implementation.

One major lesson learned from this process is that governmental bodies should be in the driver's seat when searching for regional development to help avoid the risk for sub-optimization. That said, some attention should be paid to the cultural differences between government and industry in order to avoid discomfort or even frustration. For example, while industry typically has a relatively short line for decision-making and a strong focus on getting things done, public parties have a well-established hierarchical structure with multiple procedures to follow and a complex decision-making process. As a result, public and private timelines may diverge significantly. By acknowledging these practical differences in the beginning of the collaboration process, one can avoid unpleasant surprises and unmet expectations further down the road.

26.3 CATALUNYA

The other example of industry and government collaboration is illustrated by events in the region of Catalunya (northeast Spain). There the authorities mandated a regional partnership among a number of

public parties, research institutes, and private companies in order to preserve the water level in the river Ebro, while sustaining the use of water by cities, recreational areas, and industries. During a period of extended drought, water abstraction from the river Ebro for potable and industrial use exceeded the outflow, resulting in a dry river bed. The urgency of this situation was felt by all parties, so it seemed appropriate for the authorities to convene a consortium with the responsibility to create a sustainable water management system for the region.

The consortium installed a 19,000 m^3/day water reclamation plant to treat water from the Tarragona and Vilaseca WWTPs, blend it with Ebro river water and supply it as make-up cooling water for the Tarragona Petrochemical Complex plants. Treatment provided included flocculation, coagulation, and filtration, salt removal with RO, and ultraviolet disinfection. The water reclamation plant facility was built by Veolia, owned by ACA (the Catalan Water Agency) and operated by Veolia and AITASA.

In contrast to early planning efforts by Dow Terneuzen, the process in Catalunya was top-down, driven by clear mandates for individual entities to participate in the collaboration process. As a result, there was a common incentive at a sufficiently high level for all parties to cooperate which ensured there was widespread awareness and support.

26.4 COLLABORATING TO REDUCE THE IMPACT OF INDUSTRIAL WATER USE

Dealing with regional water scarcity should not be addressed by single users independently, but a broader collaboration is needed between multiple stakeholders. Setting a common agenda requires consensus between parties with different cultures, work practices, and business models. Financing of required infrastructure also needs to be resolved to raise integrated water management to a sustainable level. With this in mind, it's interesting to see how industry's role can be optimized with the help of other regional stakeholders to facilitate more sustainable industrial water use.

When a direct common and overarching incentive for collaboration (as in Catalunya) is not apparent, special emphasis has to be given to defining common and mutual interests. Industries are typically focused on long-term uninterrupted water provision for reliable operation, while public entities need to ensure equal access to water for all stakeholders to maintain quality of life for the community as a whole. Once a common approach has been agreed, the collaboration process can begin to address the many other collaborative issues like economics and financial terms, contract clauses, quality guarantees, response to unexpected situations, etc. Only when each partner recognizes and knows its own interest ('what's in it for him or her') can the process accelerate to execution.

First of all, *industry* should define its own position within the region and clearly articulate its ambitions and boundaries. A long-term policy for water usage should be established and a sound business environment should be created to support investments in water-related projects. Internally, industry should encourage a multidisciplinary approach to develop more sustainable production processes with substantially lower water footprints ('reduce/reuse/recycle'). In parallel, industry should reach out to other industrial parties to collaborate 'over the fence' in non-competitive areas.

The national and international *industry associations* within the various industrial sectors can help by collecting and publicizing best water management practices among their industry members. Collaborating with other associations in other sectors, these industry groups can also help identify opportunities for 'over the fence' collaboration among industry clusters (such as food processing and agricultural sectors, and (petro) chemical and steel or mining sectors). Finally associations can play an important role in reaching out to policy-makers to bring across industry's ambitions and limitations.

Government agencies (including policy-makers, legislators, and regulatory officials) can promote effective implementation of improved industrial water use strategies by establishing consistent, fair, and transparent policies and regulations that support long-term industry commitments. Clear guidelines should be provided for effluent discharge quality; strategies can be adjusted but drastic changes ought to be avoided. For example, the European Water Framework Directive specifies national permit limits that require member states to reach agreed upon river basin water qualities by 2027. Water abstraction rights should also be clearly defined to reduce competition among different end-users (urban areas, agriculture, nature, and industry) for access to surface water, groundwater and recycled water (i.e., treatment plant effluent). Finally, officials can stimulate multi-stakeholder collaboration by setting regional objectives and providing financial incentives for the implementation of integrated water projects. Regional policy-makers can foster an open environment for collaboration by engaging multiple stakeholders in goal setting and providing financing through public subsidies or private investments.

The role of *financial Institutions* can have a game-changing impact. The value of water availability at sufficient quality for society as a whole is not reflected by its price alone but also comprises social and demographic aspects. Hence, pay-back times for water-related projects are usually much longer than those in which industry typically invests. Related project benefits not tied to the price of water, like ecosystems improvement, are difficult to monetize and don't figure in business cases. By collaborating with policy-makers, financial institutions can create criteria for financing regional water infrastructure projects that stimulate sustainable water management among multiple parties.

Other entities can also support the development of an effective regional collaboration by helping to define a regional scope that best fits the needs of all stakeholders or by working to create an effective organizational structure and associated governance. For instance, *water and wastewater utilities* have working relationships with both freshwater source suppliers and end-users and can collaborate with parties in all sectors, including policy/law-makers, urban areas, agriculture, industry, financial institutions, and NGOs. Their *professional associations* in turn can stimulate the exchange of information, including best practices and lessons learned in regional watershed management. *Academics* and *consultants* can also contribute their knowledge. Over the past two decades universities and research organizations have generated countless technological advances, such that even a country as small as the Netherlands has over 1000 water tech companies. Many research projects are financed through public-private partnerships, which in turn have led to university spin-offs emerging technology incubators that have piloted new technologies on a meaningful scale. By working with industry to better understand the technical, economic, and social aspects of sustainable water use, these partnerships can help prepare professionals to better address the water needs of society today. In addition, the concerns of environmental and social *groups* should be heard and incorporated in a region's long-term water plan, as they often articulate the 'non-market' value of water to enhance biodiversity. To take one example, in the Breda region of the Netherlands a 'bottom-up' planning approach was initiated by a consortium of local farmers and nature communities who successfully convinced both the municipality and the Water Board to dedicate resources for its implementation. Related to this effort is the role of the public itself – the individual civilians, neighborhoods, communities, and protest groups whose voice must be heard. Crucial for success is to inform the public early in the planning process, to invite their input and suggestions, and to allow them to directly interact with all parties (including industries).

26.5 MAPPING THE COLLABORATION AREA

As the above analysis makes clear, effective communication and trust are critical ingredients in a successful regional strategy. If industry is to reduce its water footprint further by participating 'outside the fence-line', a

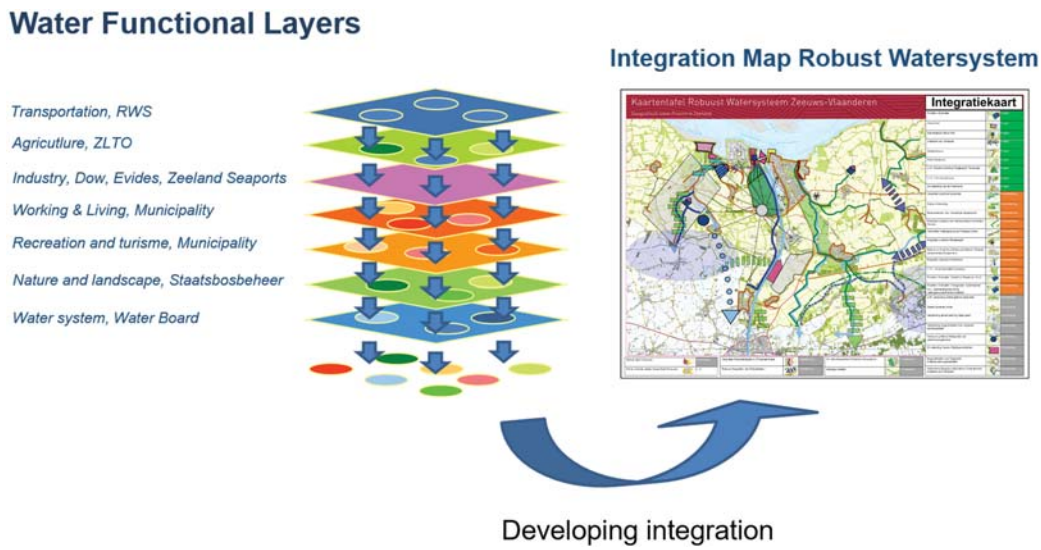

Figure 26.3 Mapping various stakeholders related to water functional layers.

strategy must be in place that clearly represents industry's interest and its impact on regional water use. When industry's issues align well with regional needs, communication of the expected benefits will make these relationships easier to establish. When the advantages of collaboration are less obvious, communication and trust become even more crucial. Certain headwinds are to be expected during the process, and all stakeholders should be asked to collectively develop alternatives that benefit the region as a whole.

A determining factor in the collaboration process is the initiating organization. Typically many different 'players' within a region each play a role in the intended collaboration. When a governmental body like a municipality, province, or (like in the Netherlands) a Water Board is the initiator of regional collaboration, the basic governance is institutionalized and public support relatively easy to obtain given the fact that decisions are taken and strategies are developed on a political level. When an end-user is the initiator – especially an industry – the common interest is not obvious and stakeholders are likely to be more cautious in communicating their real objectives and drivers. For an industry to create a successful collaboration, it must carefully map the organizational structure and identify each participating institution, authority, association, and individual, especially competitive users from agriculture, industry, recreation, and nature (e.g., NGOs). For each of these, individual representatives should be identified as speaking partners in the collaboration process to understand their positions and learn their internal approval processes. One example of such a map is shown in Figure 26.3.

26.6 CONCLUSIONS

Based on Dow's experience at various water-stressed locations in Europe, industries can reduce their water footprint beyond what can be achieved within their own fence line through regional collaborations. Where such collaborations don't already exist, they can be created in a stepwise approach:

(1) Describe the industry's strategy for sustainable water use, clearly articulating its impacts, both positive and negative, on others in the region.

(2) Engage with public authorities at both the strategic and implementation levels to ensure the industry's strategy fits within the region's approach, including legislation, planning, economic development, and environment protection.
(3) Involve a range of participants with a stake in the regional water system, including agriculture, recreation and tourism, academic institutions, environmental groups, NGOs, other commercial and industrial companies, and the public itself.
(4) Challenge the participants to agree on a process with defined owners and leads. When the goal is to implement a regional watershed objective, a public authority may more effectively lead the process until a formal management structure is established. When participant benefits are less clear, industry can lead the development of its plans in concurrence with regional development;
(5) Align project expectations by understanding how timelines and outcomes are addressed in each participant's culture, and encourage each participant to be sensitive to the wishes and contraints of the others parties. Provide an overview showing how parties can support industry efforts towards more sustainable water use.
(6) Develop a business and financing model as soon as project outlines are defined and encourage authorities and financial institutions to create a feasible economic foundation for executing regional improvements.

While there is no 'one size fits all' solution, by following these steps a company can overcome the most common barriers to successful industry-led regional collaboration.