Restoring Waters in the Baltic Sea Region

A STRATEGY FOR MUNICIPALITIES AND LOCAL GOVERNMENTS TO CAPTURE ECONOMIC AND ENVIRONMENTAL BENEFITS

BCG

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Zennström Philanthropies was founded in 2007 by Niklas and Catherine Zennström. Its mission is to support and engage with organizations that fight for human rights, work to stop climate change, and encourage entrepreneurship in order to protect our natural environment and allow those who live in it to realize their full potential. For further information, please visit zennstrom.org.

Race For The Baltic started in 2013 as an initiative of Zennström Philanthropies and works to convene leaders made up of forward-thinking politicians, industry professionals, NGOs, and local governments who are determined to reverse the negative trends and restore the Baltic Sea environment, so as to ensure the long-term economic viability of the region. For further information, please visit raceforthebaltic.com.

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PREFACE

Zennström Philanthropies, an organization working to restore the Baltic Sea environment, has commissioned The Boston Consulting Group (BCG) to produce this report in order to better understand the multiple benefits a municipality can capture by addressing eutrophication and restoring the waters in the Baltic Sea region, as well as provide guidance on how to navigate and prioritize among the many proven measures. Our approach has been to use a corporate strategy and change-management lens to view the environmental issues and complexities facing the Baltic Sea, the nine coastal states, and their 1,500 municipalities.

In the report we (1) give an overview of the current state of the Baltic Sea and the role of municipalities in addressing one of the core problems, eutrophication, as well as provide an understanding of the vastly different starting points and challenges municipalities face; (2) highlight the wide range of economic and environmental benefits a municipality can capture in the clear waters state; (3) explore proven municipality measures to address eutrophication; (4) present a structured approach to determine the most cost-effective local combination of measures to implement; and (5) suggest a concrete action plan for municipalities to successfully drive impact. Key findings in the report include the following:

- The Baltic Sea is at a critical juncture. Eutrophication, caused by excess nutrients entering the water, is one of the major threats to the sea, coastal areas, and inland waters. Despite progress in reducing nutrient load, the water quality in the Baltic Sea continues to deteriorate. In order to reach sustainable nutrient levels and begin restoring the waters, local initiatives led by the 1,500 municipalities in the catchment area will play a critical role. The starting points of these municipalities are, however, vastly different, and two-thirds of the municipalities are either unaware of the problem or have insufficient resources to effectively address it.

- The economic benefits of water restoration are manifold. By restoring local waters, a municipality can develop sustainable businesses and increase recreation, aesthetic value, flood control, biodiversity, and population's well-being. For an average municipality, the difference between two scenarios, clear waters state and shipwrecked state, could amount to almost 3,000 fulltime jobs and €270 million in economic output aggregated over the course of 15 years. For the entire region this would imply a difference of 900,000 jobs in year 2030 alone, corresponding to approximately 2 percent of the region's total labor supply.

- To capture local benefits, municipalities can limit nutrient discharge through a broad range of targeted investments and policies. Agriculture, wastewater, and stormwater account for over 90 percent of the region's waterborne discharge into the Baltic Sea. As a result, actions to mitigate nutrient loads from these sources should be made a priority. Municipalities can also limit nutrient load through restoration measures in already degraded areas.

- To restore Baltic Sea waters, a municipality should reduce 10 to 500 kg phosphorus and 180 to 2,850 kg nitrogen per 1,000 inhabitants per year on average, depending on the country. To reach local reduction targets and capture the economic and environmental benefits, municipalities must spend their resources and time effectively. By applying a structured and holistic approach to finding the most cost-effective local combination of measures, municipalities can reduce nutrients up to a 40 percent lower cost. Although approaches may be similar, each municipality will need to implement solutions tailored to the local context. There is no one-size-fits-all solution.

- Best practice examples from leading municipalities around the Baltic Sea show four actions crucial to becoming an attractive community for citizens and businesses: i) define objectives and set strategic direction, ii) engage local stakeholders, iii) cooperate across borders, and iv) secure resources and funding. There is a clear link between level of voluntary activity and size of the municipal environmental team; an estimated 60 percent increase in team size would enable substantial progress in the Baltic Sea region.

This report builds on findings from a municipality survey conducted during fall 2014 with approximately 250 respondents, as well as over 60 interviews with municipalities and topic-experts throughout the region. Assessments are based primarily on existing data and trends. The future scenarios and implications include approximations and assumptions.

We aspire to increase awareness of the critical state of the Baltic Sea to highlight economic and environmental benefits of addressing eutrophication and identify required actions at the municipality level to make the needed changes. Accelerating change at a local level to restore the waters in the Baltic Sea region and understanding the prerequisites for creating a favorable outcome for the region's environmental, social, and economic interest now and in the future, are central themes of this report.

EXECUTIVE SUMMARY

The Baltic Sea is at a critical juncture. Eutrophication, caused by excess nutrients entering the water, is one of the major threats to the sea, coastal areas, and inland waters. Despite progress in reducing nutrient load, the water quality in the Baltic Sea continues to deteriorate. In order to reach sustainable nutrient levels and begin restoring the waters, local initiatives led by the 1,500 municipalities in the catchment area will play a critical role. The starting points of these municipalities are, however, vastly different, and two-thirds of the municipalities are either unaware of the problem or have insufficient resources to effectively address it.

- Eutrophication, caused by an excess of phosphorus and nitrogen entering the water, is one of the largest threats to the Baltic Sea. Today, 90 percent of the coastal areas are classified as having an impaired eutrophication status, implying moderate, major, or severe deviation from natural levels. Algal blooms in municipality waters are the most obvious effect of eutrophication, preventing people from enjoying their beaches and water-related activities. Beyond that, dead zones can be found under the surface and water transparency is decreasing, negatively affecting the entire marine ecosystem.

- Even though nutrient discharges have been reduced in recent decades, the progress has been too slow. All coastal states have agreed on nutrient reduction targets per country, but actions are not being implemented at the necessary pace. In order to reach the clear waters state, free from eutrophication problems, change must be accelerated.

- The 1,500 municipalities in the catchment area play a crucial role in restoring the waters in the Baltic Sea region. Municipalities are of great importance, as they have the ability and responsibility to enforce national laws within areas such as wastewater, and initiate additional voluntary actions together with the local business community and citizens.

- Municipalities in the Baltic Sea region have vastly different starting points when it comes to addressing water quality and eutrophication. Two-thirds of the municipalities are either unaware of the problem or have insufficient resources to effectively address it. A few municipalities are, however, working strategically with initiatives to reduce nutrient load and restore the waters. By learning from the leading municipalities, others can overcome challenges and accelerate action.

The economic benefits of water restoration are manifold. By restoring local waters, a municipality can develop sustainable businesses and increase recreation, aesthetic value, flood control, biodiversity, and population's well-being. For an average municipality, the difference between two scenarios, clear waters state and shipwrecked state, could amount to almost 3,000 full-time jobs and €270 million in economic output aggregated over the course of 15 years. For the entire region this would imply a difference of 900,000 jobs in year 2030 alone, corresponding to approximately 2 percent of the region's total labor supply.

- By restoring waters in the Baltic Sea region, a wide range of benefits can be captured locally, contributing positively to associated industries, including water technology, tourism, recreational fishing, and real estate.

- By contrasting two scenarios for the Baltic Sea region, the total difference in fulltime jobs could amount to almost 3,000 and generate up to €270 million in economic output in aggregate between 2015 and 2030 for an average municipality. This is equivalent to approximately 1 percent of an average municipality's total economy.

- Eutrophication is a global issue and the Baltic Sea region is better positioned than most to find and develop solutions for addressing it. For a municipality, this is an opportunity to create local jobs and highlight the importance of supporting local businesses while becoming a global hub for water technology innovations.

To capture local benefits, municipalities can limit nutrient discharge through a broad range of targeted investments and policies. Agriculture, wastewater, and stormwater account for over 90 percent of the region's waterborne discharge into the Baltic Sea. As a result, actions to mitigate nutrient loads from these sources should be made a priority. Municipalities can also limit nutrient load through restoration measures in already degraded areas.

- To reduce nutrient discharge from agriculture, municipalities must cooperate with farmers to find win-win solutions. For example, by applying recycling, or a closed-loop system, it is possible to reallocate and reuse excess nutrients from the Baltic Sea, lakes, and wastewater as fertilizers in agricultural activity.

- Municipalities can reduce nutrient discharge from wastewater by leveraging targeted investments such as municipal wastewater plant upgrades and expansion of municipal networks. Municipalities can also work with policies and inspections and by providing information and financial incentives to enforce and encourage sufficient levels of nutrient treatment of wastewater from private units such as scattered settlements.

- By effectively managing stormwater, municipalities can limit nutrient discharges and simultaneously benefit from reduced risk of flooding and increased green areas in cities. Beyond targeted investments and policies, municipalities should also ensure that stormwater management is considered and integrated in the planning for new public areas, construction projects, and traffic solutions.

- In addition to limiting discharges, municipalities also must implement targeted restoration measures to remediate the natural mechanisms for nutrient retention.

To restore Baltic Sea waters, a municipality should reduce 10 to 500 kg phosphorus and 180 to 2,850 kg nitrogen per 1,000 inhabitants per year on average, depending on the country. To reach local reduction targets and capture the economic and environmental benefits, municipalities must spend their resources and time effectively. By applying a structured and holistic approach to finding the most cost-effective local combination of measures, municipalities can reduce nutrients up to a 40 percent lower cost. Although approaches may be similar, each municipality will need to implement solutions tailored to the local context. There is no one-size-fits-all solution.

- By applying a structured approach to prioritization, here referred to as the Staircase framework, municipalities can find their optimal combination of measures and target their efforts accordingly. The Staircase can be deployed in three steps: (1) calculate the local reduction target, (2) identify the top five to ten local measures applicable in the local context and calculate cost-effectiveness for each measure, and (3) prioritize among measures and develop a plan for implementation.

- The Staircase framework is illustrated for three municipality archetypes: the mid-sized city, the agricultural municipality, and the archipelago municipality. By applying this structured approach to prioritization, municipalities can reach the same nutrient reduction for up to 40 percent lower costs.

Best practice examples from leading municipalities around the Baltic Sea show four actions crucial to becoming an attractive community for citizens and businesses: i) define objectives and set strategic direction, ii) engage local stakeholders, iii) cooperate across borders, and iv) secure resources and funding. There is a clear link between level of voluntary activity and size of the municipal environmental team; an estimated 60 percent increase in team size would enable substantial progress in the Baltic Sea region.

- A first step for successful and long-term actions is commitment from local politicians and the municipality leadership team. When the commitment from key stakeholders has been secured, the municipality's overall objectives must be defined and translated into a strategy and concrete action plan specifying how the local objectives should be reached.

- A municipality is dependent on engagement of its citizens, organizations, and companies to effectively reduce nutrient load. Many examples exist where locally driven initiatives have played a vital role in addressing eutrophication.

- Cooperation beyond the municipality borders is also important, since it facilitates knowledge and experience sharing. There is also an opportunity to identify synergies between municipalities, for example, in processes related to external funding applications.

- Limited resources and funding is a challenge for many municipalities in the Baltic Sea region, and critical to achieving a higher level of voluntary activity in areas beyond mandated wastewater management. Lifting all municipalities to a similar activity level as the top third would require a 60 percent increase in environmental team size, equivalent to 5,200 new hires or reallocation of efforts in the entire Baltic Sea region. Further, a long-term perspective for securing resources and funding is needed, so that pilot projects can be turned into sustainable operations.

A CRITICAL STATE AND DEGRADATION CONTINUES

WHAT IS THE CURRENT state of the Baltic Sea? The Baltic Sea is at a critical juncture. Eutrophication, caused by excess nutrients entering the water, is one of the major threats to the sea, coastal areas, and inland waters. Despite progress in reducing nutrient load, the water quality in the Baltic Sea continues to deteriorate. In order to reach sustainable nutrient levels and begin restoring the waters, local initiatives led by the 1,500 municipalities in the catchment area will play a critical role. The starting points of these municipalities are, however, vastly different, and two-thirds of the municipalities are either unaware of the problem or have insufficient resources to effectively address it.

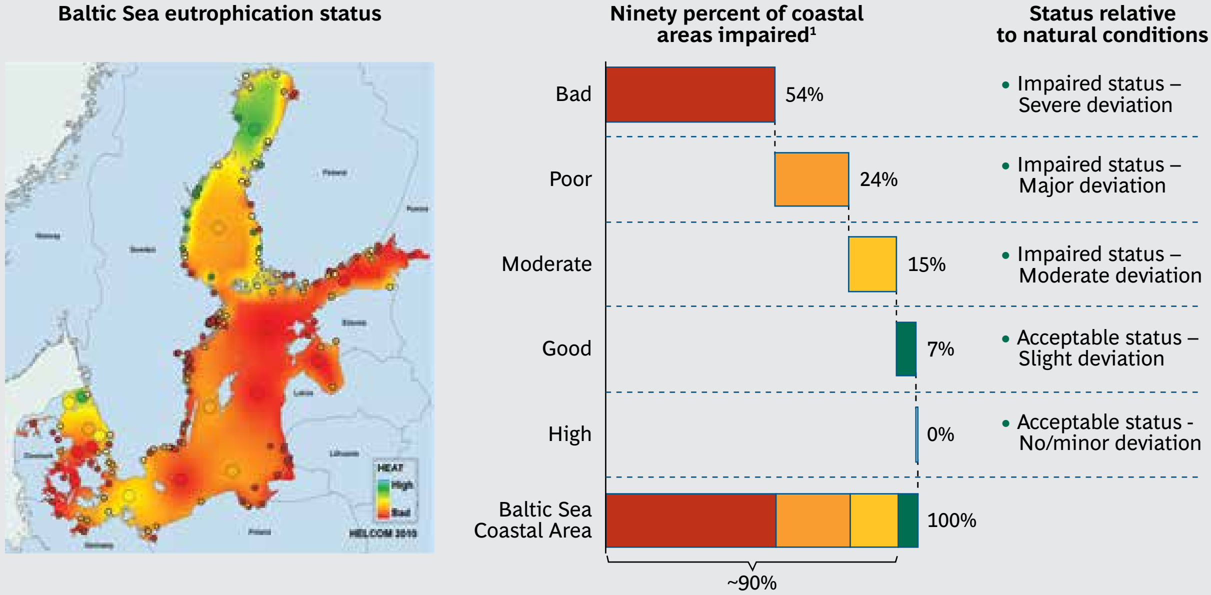
Unique and eutrophic Baltic Sea

The Baltic Sea is small on a global scale, but it is unique. The sea, enclosed by the nine coastal states — Poland, Sweden, Russia, Finland, Denmark, Germany, Lithuania, Latvia, and Estonia — is one of the largest brackish bodies of water in the world, with a salinity four times lower than the global oceanic average.[1] Furthermore, the Baltic Sea is shallow, with an average depth of only 55 meters, compared with the average Mediterranean depth of 1,400 meters. Additionally, the narrow outlet to the Northern Sea limits the rate of water exchange, resulting in a renewal cycle of over 30 years and making the current water very sensitive to any discharges. With a surrounding land-based catchment area four times larger than the sea surface, the unique characteristics of the Baltic Sea make it highly sensitive to human activity.[2]

The Baltic Sea is facing massive environmental challenges. The latest assessment is alarming, concluding that it has an unacceptable environmental status throughout.[3] The many challenges it is facing includes hazardous substances, overfishing, biodiversity loss, marine litter, and perhaps most worrying: eutrophication. Eutrophication is caused by excessive amounts of nutrients (mainly phosphorous and nitrogen) being discharged into the sea. Almost 90 percent of all anthropogenic[4] waterborne nutrient discharges originate from two main sources: agriculture and wastewater.[5] The increase of eutrophication in the Baltic Sea highlights an urgent need to act, as 90 percent of the Sea's coastal areas have an impaired eutrophication status (see Exhibit 1). A recent study also shows that all open basins, from Bothnian Bay in the north to Kattegat in the southwest, are affected by eutrophication, a worse situation than previously thought.[6] Furthermore, inland lakes and rivers in the catchment area are also affected by the excessive nutrient loads. For example, in Finland, 15 percent of lakes and 35 percent of rivers do not meet the criteria for good ecological status,[7] and eutrophication is a large part of the problem (especially for small lakes).[8]

Algal blooms in municipality waters are the most disruptive effect of eutrophication to

EXHIBIT 1 | 90 Percent of Baltic Sea Coastal Areas Have Impaired Eutrophication Status



Source: HELCOM BSEP133, 2010; HELCOM BSEP 122, 2010.
[1]Based on 167 coastal assessment points.

humans, preventing people from enjoying the beaches, swimming, and participating in other water-related activities. Also, since the early 1900's, water transparency in the Baltic Sea has decreased from an average of 9.5 to 6 meters.[9] Reduced water transparency hampers the ability of light to penetrate through water, which affects biodiversity. On the Helsinki Commission (HELCOM)'s red list of species in danger, three species are considered regionally extinct and 69 species endangered or vulnerable.[10]

Further, the increased growth of plankton and algae due to eutrophication puts more pressure on the Sea by creating oxygen deadzones. In the last century, the area of dead or dying seabed (oxygen levels below 2 mg/l) has increased tenfold and has now reached 70,000 square km,[11] 1.5 times the size of Denmark. The impaired status of the sea not only means decreased biodiversity, but also potential threats to human health through polluted drinking water and toxic algal blooms created by cyanobacteria.[12]

Progress made but degradation continues

Nutrient discharges into the Baltic Sea grew rapidly until the 1990s.[13] However, between 1994 and 2010, discharges were substantially reduced, and annual phosphorus discharge decreased by 18 percent and nitrogen by 16 percent.[14] The reduction in discharges can be explained by an increase in national and regional regulations as well as international conventions addressing the environmental sustainability of the Baltic Sea. One of these important agreements was the Baltic Sea Action Plan (BSAP) by HELCOM, signed by the nine coastal states in 2007. In it, the states reached consensus on limiting the nutrient discharges according to calculated reduction targets per country and sea basin.

However, the progress to limit nitrogen and phosphorous discharges has been insufficient. For example, only Germany and Finland are on track to reach the BSAP targets for reducing eutrophication; the seven other countries are lagging behind, having failed to achieve four or more of the ten goals agreed upon.[15]

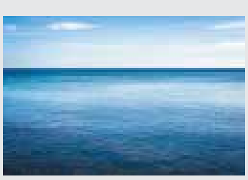
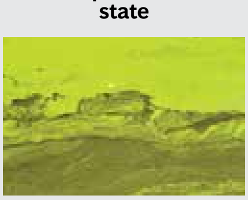
Looking forward, countries need to not only find solutions to limit current nutrient levels, they must also take into account future trends that threaten to put additional pressure on the Sea. One such trend is the growing middle class in Europe, which is expected to increase by 16 million people between 2009 and 2030.[16] This will result in a substantially increased demand for resources such as meat and other agricultural products from the Baltic Sea region, which may increase nutrient discharges even further. Also, as it is part of a larger ecosystem, the Baltic Sea is expected to be affected by global environmental trends such as climate change. Due to increased levels of carbon dioxide, temperatures could increase by 1°C by 2030,[17] contributing to even higher biomass production and levels of algal blooms in the Baltic Sea region.

Further limitation of nutrient load is needed to restore Baltic Sea waters. Looking forward to 2030, two potential scenarios can be illustrated; the positive clear waters state and a negative shipwrecked state (see Exhibit 2). The two scenarios are to a large extent built on WWF's "Counter Currents" report and HELCOM's BSAP. Complementary data regarding future trends has also been taken into account. Even though BSAP is aiming to reach good ecological and environmental status in the Baltic Sea by 2021, many argue that the target period must be extended.[18] The timeline for reaching the reduction target is set to 2025 in these scenarios, and positive effects on the ecosystem are expected by 2030.

In the clear waters state scenario, municipalities in the catchment area have taken actions to reduce nutrient discharges. The key success factor has been engagement from municipality staff and political leaders, as well as local organizations, companies, and citizens. The targets for nutrient loads by BSAP are met by all Baltic Sea states in 2025, and nutrient discharges are kept at target levels going forward. As a result, the effects of eutrophication are kept at natural levels, in terms of nutrients in the sea, water transparency, and biodiversity. Algal blooms still occur, but to a limited extent in line with natural occurrence. With a cleaner sea and inland waters, citizens are enjoying recreational areas and clean beaches in healthy and attractive municipalities. The tourism industry grows and water technology industries are thriving due to large investments over the past 15 years. Some municipalities are even globally recognized as innovation hubs with worldwide reach and impact, taking advantage of their experience to export know-how and technology to other countries facing similar problems.

On the contrary, in the shipwrecked state scenario, the BSAP targets for nutrient reduction are not met by 2025 and the load increases further due to lack of action on the municipality level. The effects of

EXHIBIT 2 | Two Scenarios Illustrated in 2030 — Clear Waters State and Shipwrecked State

	Actions 2015–2030	Ecological status	Industry impact
Clear waters state 	• HELCOM's Baltic Sea Action Plan (BSAP) nutrient reduction targets reached by 2025 • Targeted municipality investment and policies key driver for reaching targets	• Acceptable eutrophication status • Natural levels of nutrients and water transparency, sustained biodiversity • Natural level of algal blooms	• Growth in water technology industries making Baltic Sea region a global exporter • Tourism unaffected by eutrophication • Property values in cities increase
Shipwrecked state 	• HELCOM's Baltic Sea Action Plan (BSAP) targets not reached by 2025 • Limited local actions driven by municipalities	• Continued impaired eutrophication status • Unnaturally high levels of nutrients leading to decreased water transparency and loss in biodiversity • Yearly algal blooms during long periods	• Stagnating water technology sector, solutions must be imported from outside the region • Tourism declining over a five-year period due to severe algal blooms • Property values near waters decrease

Sources: World Wildlife Foundation (WWF) "Counter currents", 2012; HELCOM; Swedish Environmental Protection Agency; BCG Analysis.

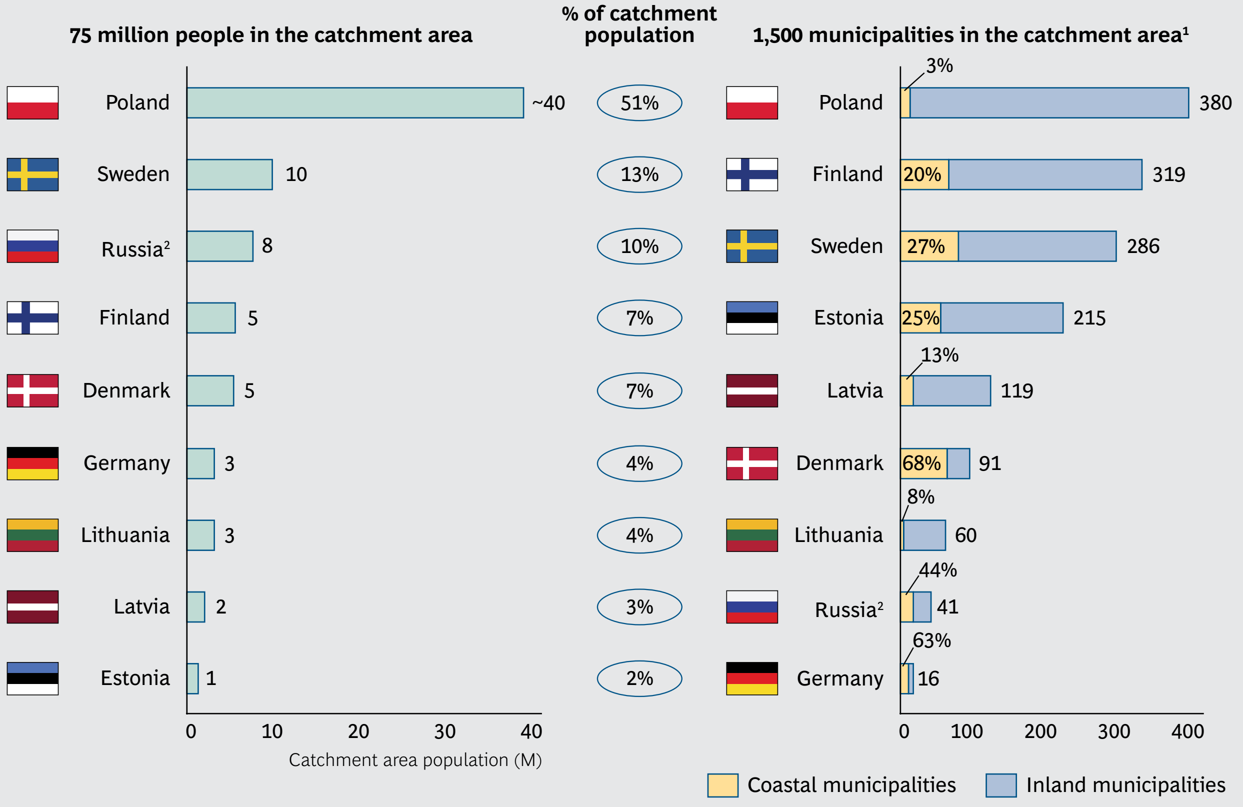
eutrophication expand, which in turn has a devastating impact on the ecosystem. Algal blooms are now reoccurring on a yearly basis across the Baltic Sea area, causing green, odorous beaches on the coast and inland. As a consequence, residents can no longer enjoy beaches and waters, and the number of tourists declines. The lack of interest in overcoming eutrophication from the municipality has also dampened the demand for water technology innovations, and any solutions for handling eutrophication are imported from other countries.

Municipalities crucial to restoring waters

There are about 1,500 municipalities, home to about 75 million people, in the Baltic Sea catchment area, spread over nine coastal states (see Exhibit 3). These 1,500 municipalities play a crucial role in reducing nutrient load to create a safe and healthy environment for the population. They also must also enforce national laws within areas such as wastewater and can drive or increase local voluntary actions.

One of the major nutrient sources to address is municipal wastewater, which is controlled either directly by the municipality administration or by separate water enterprises. Despite extensive previous investments, HELCOM estimates that up to 80 percent of the reduction target for phosphorous can be reached with further expansion, adjustments, and upgrades of municipal and private wastewater treatment plants around the Baltic Sea.[19] For this to happen, municipalities must play a key role in enforcing these ambitions and converting them to actual upgrades and investments on a local level, as in the cases of Riga and Kohtla-Järve (see Exhibit 11). In the case of private wastewater treatment, municipalities must enforce national laws via approval processes and inspections.

EXHIBIT 3 | Close to 75 Million People and 1,500 Municipalities in Baltic Sea Catchment Area



Sources: Eurostat; National statistics; The Council of European Municipalities and Regions; BCG analysis.
Note: Only Baltic Sea coastal states included.
[1]LAU-2 level of administrative unit used for all countries except Denmark (LAU-1), Germany (NUTS-3), Lithuania (LAU-1), and Poland (LAU-1).
[2]Only Kaliningrad, Leningrad, and St Petersburg regions included.

In addition, in order to meet BSAP targets, other measures, apart from wastewater management, are needed. This is especially true for nitrogen, where wastewater investments are estimated to account for only 15 percent of total reduction targets. This means that 85 percent of nitrogen reduction and at least 20 percent of phosphorous reduction must be driven by reductions from sources other than wastewater, such as agriculture and stormwater.[20] Measures to reduce the load from these sources are voluntary to a large extent, therefore the actions of municipalities are vitally important. The municipality serves as the key stakeholder, and has a comprehensive overview and knowledge of the local area, waters, and discharge sources. Also, as the most local authority, municipalities can coordinate initiatives and influence the behaviors of local businesses and citizens.

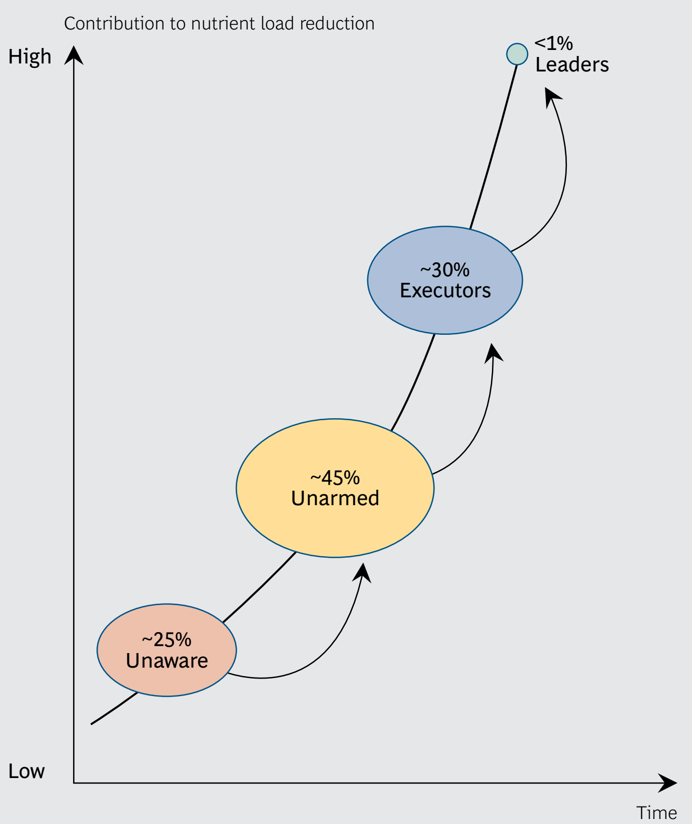
Currently, municipalities are aware of their own importance and responsibility. In fact, 80 percent of the municipalities in the Baltic Sea region recognize their own ability to drive impact, rating local actions and policies enforced by the municipality as just as important as national and international policies.[21] Municipalities must apply this sense of responsibility to the issues relating to Baltic Sea waters.

Vastly different starting points and challenges

Municipalities have vastly different starting points for addressing eutrophication in the Baltic Sea region, and the challenges they face also differ. Based on this, four different types of municipalities have been identified: unaware, unarmed, executors, and leaders (see Exhibit 4).

Municipalities' different starting points. Awareness of the severity of the Baltic Sea status is vital. Without awareness, there is

Exhibit 4 | Two-thirds of Municipalities Unaware of Baltic Sea's Critical Status or Have Insufficient Resources to Effectively Address it



Leaders
• Plans for reducing nutrient discharge to meet local targets well integrated with overall strategy for municipalities • Maximizes impact by applying structured approach to prioritizing measures

Executors
• Implements measures to reduce nutrient discharge from sources other than mandated wastewater • Does not capture full potential due to lack of long-term perspective

Unarmed
• Lacks resources to implement measures other than legal minimum. Nutrient reduction not high priority on municipality agenda

Unaware
• Unaware of the Baltic Sea's critical status, so not engaged to take action

Source: BCG Baltic Sea Survey, 2014; Expert interviews.

limited motivation for both politicians and municipality employees to implement actions that reduce nutrient load. Looking across the nine coastal states, approximately 25 percent of the municipalities underestimate the current severity of the state of the Baltic Sea, and can therefore be considered "unaware".

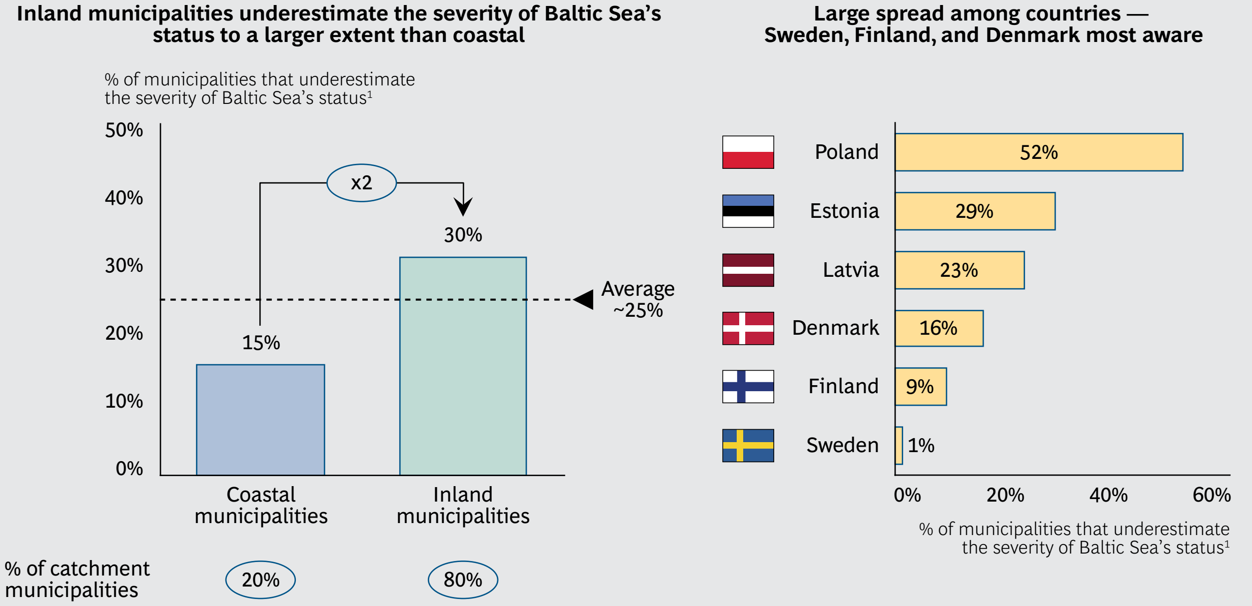
On average, inland municipalities are less aware than coastal municipalities. About 30 percent of inland municipalities underestimate the severity of the Baltic Sea's state compared with 15 percent (see Exhibit 5). Since coastal municipalities are more exposed to the Baltic Sea, it is natural that they are more aware of the sea, while inland municipalities are more aware of the problems with local rivers and lakes. However, since discharges from inland municipalities affect the surrounding inland lakes and rivers and eventually the Baltic Sea open basins, it is crucial that inland municipalities understand both the critical state of the Baltic Sea, and their importance to the process of restoring the Baltic Sea waters. There is also a large difference in awareness among countries. In Poland, Estonia, and Latvia, municipalities are generally less aware than in Denmark, Finland, and Sweden.

Another 45 percent of the municipalities are considered unarmed meaning they are aware of the current state of the Baltic Sea, but lack sufficient level of resources to reduce nutrient load beyond the legal requirements around wastewater management. As previously mentioned, voluntary actions outside wastewater management are needed to meet the BSAP targets, but many lack the resources to institute them, often because of low prioritization by the municipality management.

"Executors" — 30 percent of the municipalities—implement a large share of actions in areas outside mandated wastewater management. However, executors are not reaching their full potential, since they do not implement the most cost-effective measures for their local setting. Executors' investment decisions are instead influenced by factors such as political agenda and available funding.

"Leaders" — less than 1 percent of the municipalities in the region — have created a plan for reducing nutrient load to meet local targets and have integrated the plan within the overall strategy for municipalities. With a comprehensive understanding of key local sources of discharge and cost-effective mea-

Exhibit 5 | Approximately 25 Percent of Municipalities Unaware of Baltic Sea's Critical Status



Sources: BCG Baltic Sea Survey, 2014; HELCOM; BCG Analysis.
Note: Country comparison excluding Russia, Lithuania, and Germany due to low response rate. n = 210 unique municipality respondents.
[1]If a municipality underestimates the severity of Baltic Sea's status by two or more levels on a scale 1 to 5 (Excellent to Bad), the municipality is considered unaware. Responses are matched with Baltic Sea status from HELCOM BSEP 115B 2009.

sures, leaders work in a structured way to maximize the reduction of nutrients, and are thus able to capture the full potential of the associated benefits.

Three challenges to overcome. In order for municipalities to climb the ladder from unaware to leaders, they must face three common challenges: 1) demonstrate local benefits, 2) navigate a broad range of proven measures to address eutrophication, and 3) find the most cost-effective local combination of measures to maximize impact.

Challenge 1 — Demonstrating local benefits

To position nutrient-load reduction on the municipality agenda, there must be a wide understanding of the eutrophication challenges and opportunities, both from the municipality leadership and citizens. A key success factor for getting the local stakeholders on board, as evidenced from the experience of leading municipalities, is the ability to clearly demonstrate local benefits, in both the short and long term. The section "Demonstrating local benefits" demonstrates how municipalities can overcome this challenge.

Challenge 2 — Navigating a broad range of proven measures

The next challenge is to identify which measures to implement in order to capture local benefits. There are many sources of anthropogenic phosphorous and nitrogen waterborne load, and therefore many areas of action to consider, including wastewater, agriculture, stormwater, and restoration. Also, within each of these areas, there are often hundreds of measures to choose among. Navigating these different options can be challenging and will be further discussed in the section "Navigating a broad range of proven measures."

Challenge 3 — Finding the most cost-effective local combination of measures

The third challenge a municipality must overcome to become a leader is prioritizing the many available measures to find the most cost-effective local combination of measures. This can be a challenge since knowledge about local discharge sources, cost-effectiveness measures, and reduction potential is needed, but is often limited. For a structured approach to overcoming this challenge, see "Maximizing impact – a framework for prioritization."

Notes

1. HELCOM, 2010
2. Swedish Agency for Marine and Water Management (HaV), 2013
3. HELCOM, 2010
4. Anthropogenic = caused by humans
5. HELCOM PLC-5, 2011
6. Fleming-Lehtninen et al., 2015
7. See EU Water Framework Directive
8. Finnish Environmental Institute (SYKE), 2013
9. HELCOM, 2013
10. HELCOM, 2013
11. Swedish Meteorological and Hydrological Institute, 2013
12. World Health Organization, 2002
13. Savchuk et al, 2012
14. HELCOM, 2014
15. WWF Baltic Ecoregion Programme: "Baltic Sea Action Plan – Is It on Track?", 2013
16. The Organisation for Economic Co-operatation and Development (OECD), 2010
17. Intergovernmental Panel on Climate Change (IPCC), 2014
18. Swedish Water Authorities, 2014; PLC5, 2011
19. HELCOM PLC-5, 2011
20. HELCOM PLC-5, 2011
21. BCG Baltic Sea Survey 2014

DEMONSTRATING LOCAL BENEFITS

WHY should municipalities care about addressing eutrophication? The economic benefits of water restoration are manifold. By restoring local waters, a municipality can develop sustainable businesses and increase recreation, aesthetic value, flood control, biodiversity, and population's well-being. For an average municipality, the difference between two scenarios, clear waters state and shipwrecked state, could amount to almost 3,000 fulltime jobs and €270 million in economic output aggregated over the course of 15 years. For the entire region this would imply a difference of 900,000 jobs in 2030 alone, corresponding to approximately 2 percent of the region's total labor supply.

Municipality benefits to capture in clear waters state

Polluted waters and eutrophication should be seen as opportunities for growth and welfare in the local community, not just an environmental problem. With responsible, long-term water-quality management, each municipality in the Baltic Sea region can capture considerable economic and environmental benefits from transitioning to the clear waters state.

As a result of investments in water technology, nutrient load into waters is reduced, yielding benefits arising from improved and sustained ecosystem services (services or benefits to humans provided by the ecosystem, such as recreation and diversity).[1] These benefits will in turn increase the population's well-being. There are multiple benefits a municipality can capture in the clear waters state. These six are identified as key benefits: sustainable business development, recreation, aesthetic value, flood control, biodiversity, and population's well-being (see Exhibit 6).

Sustainable business development. In the clear waters state, the local business community is growing in a sustainable way. This is partly driven by municipal investments in water technology, such as wastewater treatment and stormwater solutions, and partly by business-owners and citizens who are investing in economically and environmentally viable solutions within, for example, wastewater and agriculture.

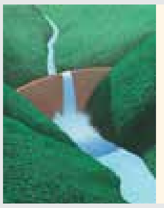
As a result of a long-term focus on clear waters, municipalities can gain strong expertise in the field and create a local hub for water technologies, which attracts other businesses, and generates export opportunities to companies both within and outside the Baltic Sea region.

Recreation. In a municipality with clear waterways there are plenty of recreational opportunities. Citizens enjoy healthy rivers, lakes, shorelines, and beaches, as well as green parks, forests, and city areas, which encourage swimming, fishing, sailing, and other outdoor activities. These same

Exhibit 6 | Municipality Benefits to Capture in the Clear Waters State

Sustainable business development

Local business community thrives as a result of investments in water technology[1]

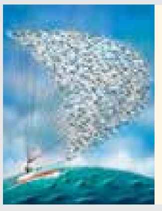


Flood control

Risk of flooding danger and damage is minimized as a result of investments in green city areas

Recreation

Citizens and tourists enjoy healthy rivers, lakes, shorelines, and beaches

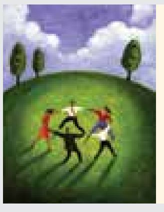


Biodiversity

Natural variation of animal species and habitat

Aesthetic value

A beautiful neighborhood attracts citizens and businesses, and increases property values



Population's well-being

People are healthier with access to clean water and recreational activities

Sources: Millennium Ecosystem Assessment; Chesapeake Bay Foundation; Swedish Environmental Protection Agency; BCG Analysis.
Note: Key industries are industries most affected by eutrophication in Baltic-Sea-region waters.
[1]Industries offering technologies that affect nutrient load, such as wastewater treatment and wetland construction.

attractions draw in tourists, and as a result, hotels, restaurants, and retail businesses are booming.

Aesthetic value. As green parks and public areas develop, the aesthetic value of a municipality increases. This also has a positive impact on property values. For example, in the U.S., Philadelphia's program for a greener city estimates that property values in the green neighborhoods will increase 2 to 5 percent.[2] The value of properties close to water are highly dependent on water quality. Allowing an area to reach a shipwrecked state with substantial algal blooms, can potentially lower property values up to 50 percent.[3] A beautiful neighborhood also attracts citizens from other municipalities and creates satisfied tenants. For example, in the Augustenborg district in Malmö, Sweden, investments in green public areas resulted in a 50 percent decrease in tenant turnover.[4]

Flood control. Maintaining green areas with good water retention minimizes the risk of flooding. One of the key motivations behind the green roofs, open channels, and other green investments made in Augustenborg was frequent basement flooding during heavy rains. During the rainy season of 2014, the return on the investments was made plain by the fact that Augustenborg had less storm-related damage than in previous years and compared with neighboring districts.[5]

Biodiversity. Biological diversity — the variability among living organisms[6] — is threatened by excess levels of nutrients. In the clear waters state, lakes, rivers, and the sea — as well as wetlands — hold natural levels of nitrogen and phosphorous, and show no sign of loss in biodiversity. There are normal volumes and variation of fish and other aquatic life as well as viable habitats. In addition, citizens and tourists in these areas can enjoy the wildlife with activities such as recreational fishing and bird watching.

Population's well-being. Clear waters create both recreation opportunities and clean drinking water. This also improves the life quality and health of the population since people exploit recreational opportunities such as running and swimming, and also have secured access to clean drinking water.

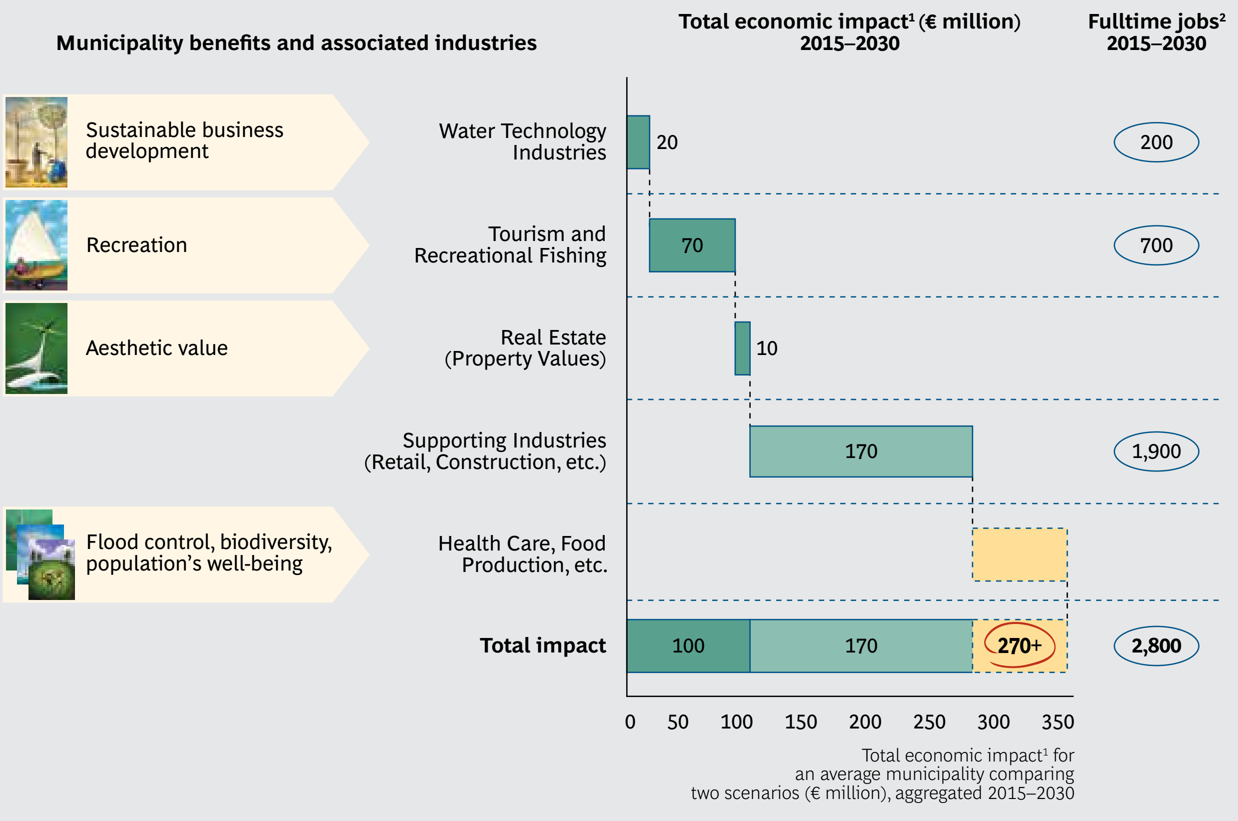
Further, unexpected costs for water treatment can be reduced or avoided. There are several examples of how municipalities have paid high, unforeseen prices for polluted and eutrophic local waters. For example, Lake Erie in the U.S. was so adversely affected by algal blooms in 2014, that 400,000 people were without drinkable tap water for two days. As a result, the Environmental Protection Agency had to invest $8.6 million to reduce phosphorous discharge from agricultural sources.[7] In Östersund, Sweden, in 2010, a parasite outbreak in the municipal wastewater treatment plant sickened 27,000 people, mainly with stomach-related illnesses, at a cost of €25 million for the society.[8] These examples show how clean water can play an important role in municipalities' future in terms of health care costs and population's well-being, and in the long term, affect migration patterns and potentially increase the tax base.

To quantify the impact for a single municipality, industries associated with the six benefits named above were identified. These industries are: water technology, tourism and recreational fishing, and real estate. Looking at how these industries are affected by differences in ecosystem services in the two scenarios, it becomes clear that a municipality can capture considerable economic value and employment by addressing eutrophication and restoring the local waters.

The local 3,000-job opportunity

Comparing the two scenarios presented earlier, the clear waters state and the shipwrecked state, the difference in accumulated impact for an average municipality could amount to 2,800 fulltime jobs[9] and €270 million over the course of 15 years (see Exhibit 7). This is equivalent to 1 percent of an average munici-

Exhibit 7 | Approximately €270 Million Economic Potential for an Average Municipality Comparing Clear Waters and Shipwrecked State Between 2015 and 2030



Sources: National Statistics; Eurostat; World Travel and Tourism Council (WTTC); United Nations World Tourism Organization (UNWTO); World Input-Output Database (WIOD); Swedish Environmental Protection Agency; BCG Baltic Sea Survey 2014; BCG Analysis.
Note: Estimates are based on an average Baltic Sea region municipality with 45,000 inhabitants, aggregated 2015–2030.
[1]Aggregated direct, indirect, and induced real values of total economic gross output for an average municipality between 2015 and 2030.
[2]Aggregated fulltime jobs between 2015 and 2030. One fulltime job is defined as the work of one fulltime equivalent (FTE) during one year. Hence one fulltime job carried out over 15 years equals 15 fulltime jobs in aggregate.

pality's total economy. For the entire region, the difference between the clear waters and shipwrecked state would be 900,000 jobs in 2030, corresponding to 2 percent of region's total labor supply.[10]

In order to reach the clear waters state, local stakeholders (the municipality, households, and corporations) must invest in local businesses providing water technology. Investments should focus on limiting nutrient load from the main sources of discharges — municipal wastewater, private wastewater, agriculture, and stormwater — as well as restoration measures. The investments should be made before 2025 in order to reach the BSAP targets, and they will have an accumulated economic impact of €20 million and 200 fulltime jobs for an average municipality.

Job creation from water technology investments can be seen clearly in the region. For example, a wastewater treatment plant upgrade in Russia is estimated to generate 300 new jobs (see "Algal blooms threaten municipality tourism industry while water innovations create jobs").

In the shipwrecked state, one of the most visible effects of increased eutrophication is the substantial yearly algal blooms that cause green waters and make beaches offensive. This will mainly affect coastal municipalities, but also inland municipalities to a small extent due to eutrophied lakes and rivers. It is assumed that this environmental degradation would lead to a drop in number of tourists between 2025 and 2030. For an example illustrating the negative impact on tourism due to algal blooms, see "Algal blooms threaten municipality tourism while water innovations create jobs." In contrast, in the clear waters state, tourism growth is sustained. As the ecosystem services improve, fish stocks will increase, as will the demand for recreational fishing. In total, the difference between the two scenarios can amount to 700 fulltime jobs and €70 million in economic impact from the tourism and recreational fishing industries for an average municipality between 2015 and 2030.

ALGAL BLOOMS THREATEN MUNICIPALITIES' TOURISM INDUSTRY WHILE WATER INNOVATIONS CREATE JOBS

The negative impact on tourism industry from a eutrophic sea, and the positive impacts from addressing it with investing in water technology can clearly be shown in cases from Öland, Sweden, and Petrozavodsk, Russia.

€27 MILLION DROP IN TOURISM INDUSTRY DUE TO ALGAL BLOOMS[1]

- Borgholm, located on the island of Öland in the Baltic Sea, is one of Sweden's largest tourism municipalities
- Due to substantial algal blooms in 2005, Öland experienced a €27 million decline in the tourism industry, corresponding to approximately 25 percent of the total tourism spend

300 NEW JOBS GENERATED FROM WASTEWATER INVESTMENT[2]

- In 2013, Petrozavodsk, in northwestern Russia, began upgrading its wastewater treatment plant, aiming to reduce over 60 tonnes of phosphorus discharge per year
- It is estimated that the project will generate approximately 300 new jobs
- The project will be financed with €32 million in local and international funds

Notes
1. Interviews, Swedish Environmental Protection Agency, 2008; Visita, 2009
2. Nordic Investment Bank, 2012; northern Dimension Environmental Partnership, 2013

Property values are similarly affected by the degree of pollution and green areas. In the clear waters state, green areas resulting from stormwater management in cities will increase property values, while the substantial algal blooms in the shipwrecked state will lower values for properties near polluted waters, both coastal and inland. For an average municipality, the difference in economic impact from property values between the two scenarios will be €10 million from 2015 to 2030.

Using economic theory, also indirect and induced economic impact can be calculated (referred to as "Supporting Industries" in Exhibit 7) since the difference in demand, also called direct impact, will have a ripple effect in the community. The indirect impact, also known as supply-chain impact, includes intermediate supply-chain effects. For example, demands from water technology industries and tourism will have an indirect impact on supplying industries such as construction and retail. Induced impact refers to impact from payroll expenditures made by water technology and tourism companies and their supporting vendors. Payroll expenditures boost household income and drive additional consumption, typically in categories such as retail. For an average municipality, the difference in economic impact from these supporting industries, when contrasting the two scenarios over the course of the next 15 years, amounts to €170 million.

€270 million in economic potential for an average municipality.

The methodology for estimating economic impact is detailed in the Appendix. Values will vary by local setting and tourist spending. The Appendix also includes an overview of total economic impact for different types of municipalities, depending on the level of tourist spending.

There are many other benefits for a municipality that have not been quantified in this report, such as the value of flood control, biodiversity, and a happy and healthy population. In addition, if a municipality can build its expertise in water technology and innovations, there is a substantial value to be captured from exporting such solutions to other municipalities, Baltic Sea coastal states, and internationally.

Stimulating innovation

Eutrophication is a global challenge, present on all continents. For example, the World Resources Institute has compiled an overview of 500 coastal areas around the world affected by eutrophication—70 percent of these are experiencing depleted oxygen levels (hypoxia). This is evidence that municipalities and companies leading the way in water technology innovations have the opportunity to capture additional value by exporting solutions not only to other municipalities and Baltic Sea coastal states, but also globally. Conversely, those municipalities with a limited supply of eutrophication-related solutions will have to import solutions from beyond their borders, fueling businesses elsewhere instead of locally.

Comparing the Global Innovation Index and relative purchasing power of regions shows that the Baltic Sea region and its municipalities are better positioned than most to develop solutions to water-quality-related challenges such as eutrophication. Thus, the Baltic Sea region can be considered a leader in innovation, driven by the region's financial strength, well-educated population, and high-quality research.[11] Together with a concern for the environment, many companies have demonstrated innovative projects in the Baltic Sea region for addressing eutrophication (see Exhibit 8). For example, the John Deere company has, together with industry partners, developed a technique for using sensors to regulate the amount of manure, and thus nitrogen, in fertilizer applications, which can further enable nutrient recycling in agriculture worldwide.

For municipalities with the ambition to create a water-focused technology hub, a broader vision and strategy beyond innovative pilot projects is required. In this context, Singapore serves as an inspiring example of how a coun-

EXHIBIT 8 | Baltic Sea Innovations — A Small Selection of Initiatives

Enabling use of manure with nitrogen sensors (John Deere; Germany)

- In cooperation with industry partners, John Deere has developed a technique to use manure as fertilizer with nitrogen sensors
- The technique adjusts the flow of manure to deliver the exact quantity of nutrients needed according to the nitrogen sensor, enabling sustainable usage of nitrogen

Oxygenation of deep waters to reduce phosphorus (Sweden)

- BOX-project in Sweden used an electric pump to oxygenate deep water in a bay for two-and-a-half years.
- 86 million m^3 of surface water was transferred to the bottom sediments of the bay, reducing phosphorus concentration by 80 percent

Commercial use of wild macroalgae (Estonia)

- Est-Agar AS in Estonia uses algae collected from the Baltic Sea to commercially produce stabilizing and thickening products used in jam and marmalade
- The company collects 1,000 to 2,000 tonnes of algae (wet weight) per year

Dredging with giant vacuum cleaner (TechMarket; Sweden)

- TechMarket has developed a dredging technique that collects sediment from the Baltic Sea seabed at depths over 100 m
- Total cost for collecting the phosphorus is estimated to be €120,000 per tonne, and 75 percent is expected to be financed by converting sediments to biogas and fertilizers

Use of aluminum to remove phosphorus (Vattenresurs; Sweden)

- Financed by the project "Baltic Sea 2020", Vattenresurs has shown that by treating Baltic Sea deep water and sediment with aluminum, the concentration of phosphorus in the bottom waters can be reduced up to 95 percent[1]

Large-scale mussel farming — a commercial opportunity (Sweden, Finland, Latvia)

- Baltic Blue Growth project led by the Kalmar municipality investigates options for large-scale mussel farming
- Mussels improve water quality as they feed on plankton, and they can later be used in animal feed products

Source: Company websites; Stigebrandt et al, 2014; Interviews.
[1]According to Svealands kustvattenvårdsförbund, 2013.

try with less land area than the average Finnish municipality, created a commercially viable water technology hub. Wanting to become self-sufficient in terms of drinking water, Singapore introduced a national strategy in 2006 with the aim of becoming a global hub for water technology. Targets included increasing value-added contributions from the water sector from 0.3 percent (€0.32 billion) to 0.6 percent (€1.1 billion) of GDP and doubling the number of jobs in the sector to 11,000 by 2015.[12] Having research and development as the main driver, the Environment and Water Industry Programme Office (EWI) was set up to spearhead the development which so far has been successful. In 2013 alone, investments in the water sector will create an incremental value-add of €95 million and 500 jobs. Since 2006, results include:[13]

- On track to reach target of water sector's contribution to GDP of 0.6 percent in 2015
- Surpassed target of 11,000 employed in water sector by 2015
- EWI grants of €190 million in research funding awarded to more than 100 projects
- Tripled number of water sector companies to about 150
- Ninefold increase in number of research-and-development centers, from 3 to 26

Just as Singapore turned its water challenge into an opportunity, Baltic Sea municipalities can turn the current eutrophication challenge into local growth.

By investing in water technology and innovation, the future can bring major opportunities in employment and economic impact — a sure sign of the importance of municipalities taking action and addressing eutrophication today.

NOTES

1. For more information, please see the Millennium Ecosystem Assessment.
2. Philadelphia Water Department, 2009
3. Swedish Environmental Protection Agency, 2008
4. City of Malmö, 2014
5. Swedish Public Service Broadcaster (SVT), 2014
6. Convention on Biological Diversity
7. The Washington Times, 2014
8. Swedish Defence Research Agency (FOI), 2011
9. One fulltime job is defined as the work of one fulltime equivalent (FTE) during one year. Hence one fulltime job carried out over 15 years equals 15 fulltime jobs in aggregate.
10. This can be compared with the 550,000 job figure presented in the BCG report "Turning Adversity Into Opportunity – A Business Plan for the Baltic Sea" from 2013, studying the development of three industries: coastal tourism, agriculture, and commercial fishing. This 900,000 figure also includes municipalities, which mainly drives the higher number of jobs in 2030.
11. See BCG report "Turning Adversity Into Opportunity – A Business Plan for the Baltic Sea"
12. Singapore Ministry of the Environment and Water resources, 2006
13. The Business Times: "Water sector here growing talent and seeding innovation," 2014

NAVIGATING A BROAD RANGE OF PROVEN MEASURES

How can municipalities address eutrophication in the local community? To capture local benefits, municipalities can limit nutrient discharge through a broad range of targeted investments and policies. Agriculture, wastewater, and stormwater account for over 90 percent of the region's waterborne discharge into the Baltic Sea. As a result, actions to mitigate nutrient loads from these sources should be made a priority. Municipalities can also limit nutrient load through restoration measures in already degraded areas.

Municipality investments and policies

The excess nutrients causing eutrophication originate from a number of sources within a municipality. To maximize impact and reach the clear waters state, the primary focus should be on the largest sources of nutrient load: agriculture, municipal and private wastewater, and stormwater (see Exhibit 9). Agricultural nutrient load consists mainly of fertilizers and manure. Wastewater consists of black and gray water from municipal and private treatments. Stormwater is surface water, originating from rain and snow, often transported in pipelines without natural retention of nutrients.

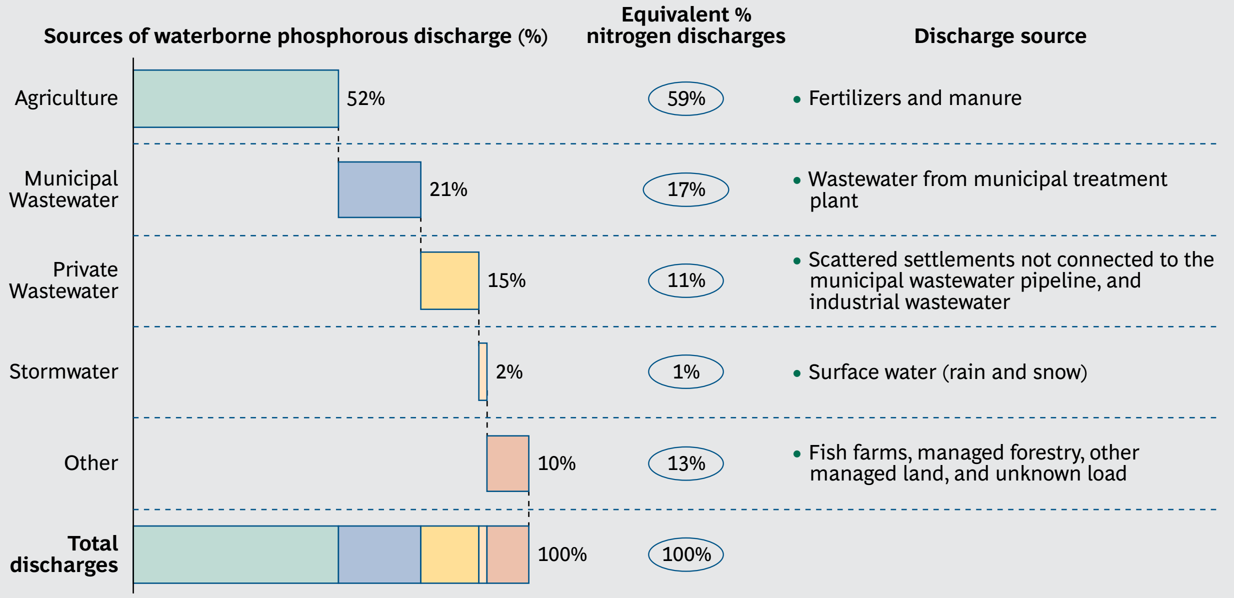
In addition to limiting future discharges, it is important to rehabilitate natural methods of cleaning the water, such as restoration, which has an environmental impact and enhances recreational values.

Municipalities can implement measures via two main approaches: (i) targeted investments and (ii) policies, information, and financial and non-financial incentives.

- Targeted investments are often made by municipalities to infrastructure initiatives, such as wastewater upgrades and network expansion, as well as stormwater solutions in public areas. Municipalities can also directly invest in restoration measures to restore wetlands, lakes, rivers, and beaches.
- Policies, information, and incentives can also be leveraged by municipalities to reduce the load from private sources and land, such as farms, and households with wastewater treatment.

Since sources of nutrient load depend on the municipality setting and starting point, different measures should be considered. For example, a municipality with large areas of agricultural land will naturally have a higher share of nutrient load from agriculture, and an urban municipality with a large population will experience a higher share of nutrient load from municipal wastewater. A municipality must therefore understand its main sources of discharge in order to know what measures to prioritize.

EXHIBIT 9 | Approximately 90 Percent of Waterborne Discharge Comes from Agriculture, Wastewater, and Stormwater



Source: HELCOM PLC-5, 2011 (data from 2006).
Note: Discharges from waterborne anthropogenic sources. Transboundary load and natural background load excluded. Also, discharges from Russia not included since most sources are unknown.

Agriculture: Cooperation with farmers to reach win-win solutions

Because agriculture is the largest source of nutrient discharge, it is often the most important challenge. Agricultural regulations are managed on a national or even international level, so municipalities are limited in their ability to enforce or create regulations. This is a big challenge for the Baltic Sea region, and should be discussed on national and international levels. However, at present there are a number of proven initiatives municipalities can implement to involve farmers when working toward the clear waters state. To reduce discharge from agriculture, municipalities must understand the broken cycle of nutrients, as well as recognize the value of collaboration and dialogue with farmers.

The broken cycle. Nutrient discharges from agriculture account for the largest share, 50 to 60 percent, of the anthropogenic waterborne nutrient load into the Baltic Sea. Most of this can be explained by a broken cycle of nutrients. Historically, nutrients were used in agriculture as fertilizers and animal feed; humans later consumed food from the crops and livestock; and the waste from humans and animals was put back into the land as fertilizer, feeding a new cycle of nutrients. However, this natural cycle of nutrients has been broken, resulting in farmers having to increasingly import nutrients from abroad. These are added to the cycle, causing an excess of nutrients. Two major trends are driving this disturbance: the mismatch between nutrient demand and supply (humans move to cities where nutrients are not needed and instead are treated in wastewater plants, as well as the separation of livestock and crops), and higher pressure on farming and animal yields (meaning more fertilizers are added to crops and animal feed). Furthermore, as urbanization continues and demand for food grows, this disturbance and excess of nutrients increases.

Collaboration for nutrient recycling. Municipalities play a crucial role in repairing the broken cycle of nutrients by implementing measures to both reduce and recycle nutrients. Agricultural discharge should not be seen as purely a problem, but also as an opportunity for farmers and municipalities to find sustainable win-win solutions. There are many examples of municipalities in the Baltic Sea states working with local farmers to collect sediment from eutrophic lakes and bays, algae, reeds, and wastewater, and converting it to agricultural uses. Västervik, in Sweden for example, is currently reviewing options to use water from eutrophicated bays on agricultural land. Also, in 2012, the Södertälje municipality in Sweden, along with a local farmer, started testing a unique solution for converting household wastewater into fertilizers (see Exhibit 10). Currently, more than 600 households are connected and further expansion of the program is expected. In order to reach sustainable win-win solutions for the municipalities and farmers, cooperation, respect, and open dialogue are essential.

Initiate dialogue. For a municipality, the first step is to inventory agricultural activity in order to familiarize itself with the local starting point and discharge levels — if such an inventory does not already exist. It is also important to understand the landowners' previous and current measures to reduce nutrient load. The municipality can also inform the farmers about available, proven measures to reduce nutrient load, including manure storage, retention zones, and nutrient management (see "Top proven measures to reduce nutrient load: agriculture").

Municipalities can help make connections between farmers and experts, such as is done by Focus on Nutrients, which provides free advice to farmers. Since 2001, "Focus on Nutrients" has met with farmers over 50,000 times, resulting in nitrogen reductions of 800

TOP PROVEN MEASURES TO REDUCE NUTRIENT LOAD

Agriculture[1]

Changes in crop and livestock management can reduce nutrient load.

- Grass cultivation on arable land — Grass planting on arable land, which reduces both nutrient loads and soil erosion.
- Winter crops — Crops that can provide a vegetative cover and efficiently take up nitrogen and phosphorus from the soil.
- Catch crops — Plants seeded together with crops that can take up the excess nitrogen from the soil after harvest of the main crop and hence reduce the nitrogen loads. Catch crops can also be used in biogas production.
- Structural liming — Burnt and slaked lime that is spread on clay soils in order to reduce phosphorus load, which also benefits the crops.
- Nutrient management and precision — Nutrient balance calculation on farm and/or field level, as well as use of technologies to fertilize according to actual needs, such as a nitrogen-sensor that adapts fertilizers to chlorophyll content in crops.
- Adopting phased feeding — Feed livestock depending on their growth stage and thereby use nutrients more efficiently.
- Manure storage — Storage to prevent nutrient leakage of manure from livestock. The storage should be appropriately dimensioned for seasonal changes and potential growth in number of animals.
- Drainage management — Adapt land for optimal drainage which minimizes nutrient discharge and benefits profitable crop production.
- Increased retention — Create areas for increased retention such as buffer zones, two-step ditches, wetlands, dams, and similar measures to slow down the water flow and increase nutrient retention.

Note
1. Expert Interviews; HELCOM; Baltic Compass; Baltic Deal; Swedish Environmental Protection Agency.

tonnes — equivalent to 10 percent of Sweden's total reduction target. The EU project BERAS has also shown that through the combination of ecological agriculture methods and providing information to consumers about conscious food-consumption, nutrient load can be reduced up to 80 percent. In addition, municipalities can use incentives to encourage farmers to invest in environmentally friendly solutions. For example, the World Wildlife Fund (WWF) highlights farmers who use "Baltic-friendly" farming methods in the presentation of their "Farmer of the Year" award, aiming to inspire other farmers to adopt proven best practices (see Exhibit 10).

Wastewater: Complement targeted investments with policies

Municipal wastewater treatment plants, industrial wastewater plants, and household wastewater units (mainly from scattered settlements), are all sources of nutrient discharge. The private units - industrial and household units - are sometimes connected to the municipal pipeline and sometimes separate.

Municipal wastewater: Potential for further reductions. Municipal wastewater nutrient load is the second-largest source of discharge, accounting for 25 to 35 percent of all anthropogenic waterborne discharges into the Baltic Sea. It is handled by treatment plants that are

EXHIBIT 10 | Case Studies of Agricultural Initiatives

Farmer reduces cost of fertilizers by recycling nutrients from wastewater

- By using a unique reactor that converts wastewater from 600 households into fertilizers, a farmer in Södertälje municipality reduced his costs for fertilizers by around €5,000 annually while reducing load from wastewater treatment
  - Current target is to double capacity by 2020
- Key success factors: collaboration among the farmer, Södertälje, and the municipality-owned company Telge Nät AB (providing the reactor)

Investment:
Approximately €810,000, partly financed by national "LOVA"-subsidies

Nutrient reduction:
Approximately 5,000 kg nitrogen less fertilizers bought by farmer per year (now taken from wastewater instead)

Free advice to farmers reduces 800 tonnes of nitrogen while improving efficiency

- "Focus on Nutrients" offers free advice to farmers to help identify win-win solutions for the environment and farmers while reducing nutrient load
  - Project run by national authorities and farmers' association
- Approximately 50,000 individual advisory appointments since 2001 and about 11,000 farmers currently participating in the project

Investment:
State-financed with €4.4million yearly — free for farmers

Nutrient reduction:
15–30 tonnes phosphorus per year and 800 tonnes nitrogen
per year from farms (corresponding to 5 percent and 10 percent of Sweden's reduction targets)

Project BERAS shows up to 80 percent of nutrients can be reduced from agriculture by applying ecological methods

- EU-project BERAS (Building Ecological Recycling Agriculture and Societies) aims to develop, demonstrate, and communicate sustainable food practice in the Baltic Sea area by:
  - Promoting agricultural practices that focus on recycling of nutrients accompanied by guidance on "good" consumption behavior — generally, locally produced food and less meat
  - Providing information on ecological methods for farmers and ecological food choices for both schoolchildren and public school kitchens, with practical examples — "Diet for a Clean Baltic"

Investment:
€4.6 million, EU-financed project

Nutrient reduction:
19 kg nitrogen/hectare equals over 50 percent less nutrient load from farms using BERAS' recommendations, can be up to 80 percent if accompanied by reduced meat consumption by consumers

"Baltic Sea Farmer of the Year Award" inspires farmers to reduce nutrient runoff

- Since 2009, WWF, in collaboration with farmers' organizations from the Baltic Sea region, recognizes farmers who use "Baltic-friendly" farming methods and innovative measures to reduce nutrient runoff from their farms
- Yearly national and regional winners are selected and receive certificates and rewards of €1,000 and €10,000, respectively

Sources: Interviews; BERAS and WWF websites; BCG Analysis.

either operated directly by the municipality administration, or indirectly, by a separate water enterprise. The nutrient load is largely black and gray wastewater from households (mostly sewage), but also from industrial operations. Regional trends such as increased meat consumption also raise the nitrogen load. A recent study shows that meat consumption in Sweden has increased 30 percent since 1980, and further investments in Swedish treatment plants are now necessary to manage higher nitrogen loads in the wastewater treatment plants.[1]

Upgrading a wastewater treatment plant can have a substantial impact on nutrient loads. HELCOM estimates that 70 percent of the phosphorous reduction needed to reach BSAP targets could come from efforts within municipal wastewater management. For example, in Riga, Latvia, the upgrade of the treatment plant resulted in a reduction of 120 tonnes of phosphorus and 1,800 tonnes of nitrogen—corresponding to 40 to 70 percent of Latvia's entire country target (see Exhibit 11).

Basically, there are three types of wastewater treatment with different levels of nutrient reduction:[2]

- Primary: mechanical treatment only
- Secondary: mostly mechanical with biological treatment, reducing approximately 30 to 40 percent of nutrients
- Tertiary: mechanical, biological, and chemical treatment, reducing usually more than 80 percent of phosphorus and 70 percent of nitrogen

In 1991, the EU adapted the Urban Waste Water Treatment Directive that regulates the level of treatment for different volumes of wastewater, stipulating that plants treating wastewater from over 2,000 population equiv-

EXHIBIT 11 | Case Studies of Wastewater Initiatives

Riga wastewater treatment upgrade contributes 70 percent to Latvia's nitrogen reduction target

- In collaboration with the EU PURE project, JNF, and Ålandsbanken, Riga city wastewater treatment plant invested in a complete treatment upgrade, including, for example chemical phosphorus removal, improved sludge handling, and more accurate analytics of incoming wastewater
- The investment enabled a reduction of phosphorus and nitrogen which corresponds to 40 and 70 percent, respectively, of Latvia's country reduction targets

Investment:
Many separate investments — investment for improved efficiency of phosphorus removal was €410,000 (excluding construction costs), funded by JNF

Nutrient reduction:
Reduction corresponding to 40 percent and 70 percent of Latvia's phosphorus and nitrogen reduction targets, respectively[1]

Wastewater upgrades removed Kohtla-Järve treatment plant from HELCOM hot-spot list

- Kohtla-Järve wastewater treatment plant invested in improved sludge handling and water treatment
- As a result of the improved treatment, Kohtla-Järve was removed from HELCOM's hot-spot list and surpassed the BSAP targets, with phosphorus and nitrogen removal rates of 93 and 94 percent, respectively

Investment:
Investment in treatment plant and sewage network system of €38 million, mainly funded by EU ISPA (Instrument for Structural Policies for Pre-Accession)

Nutrient reduction:
79 tonnes nitrogen (73 percent lower nitrogen load in 2011 than in 2003)

Södertälje introduces policy to increase recycling of nutrients from private wastewater

- The municipality of Södertälje, with two of Sweden's most polluted lakes, has adopted a policy that encourages and enforces households to invest in private wastewater solutions that enable recycling of nutrients, such as vacuum toilets and urine separation systems
  - Nitrogen and phosphorous from private wastewater are then converted into agricultural fertilizers used by local farmers
- One key challenge for the municipality was to convince citizens of the long term benefits of recycling nutrients, but after persistent work the policy is widely accepted locally and has also inspired other municipalities

Investment:
Municipality policy

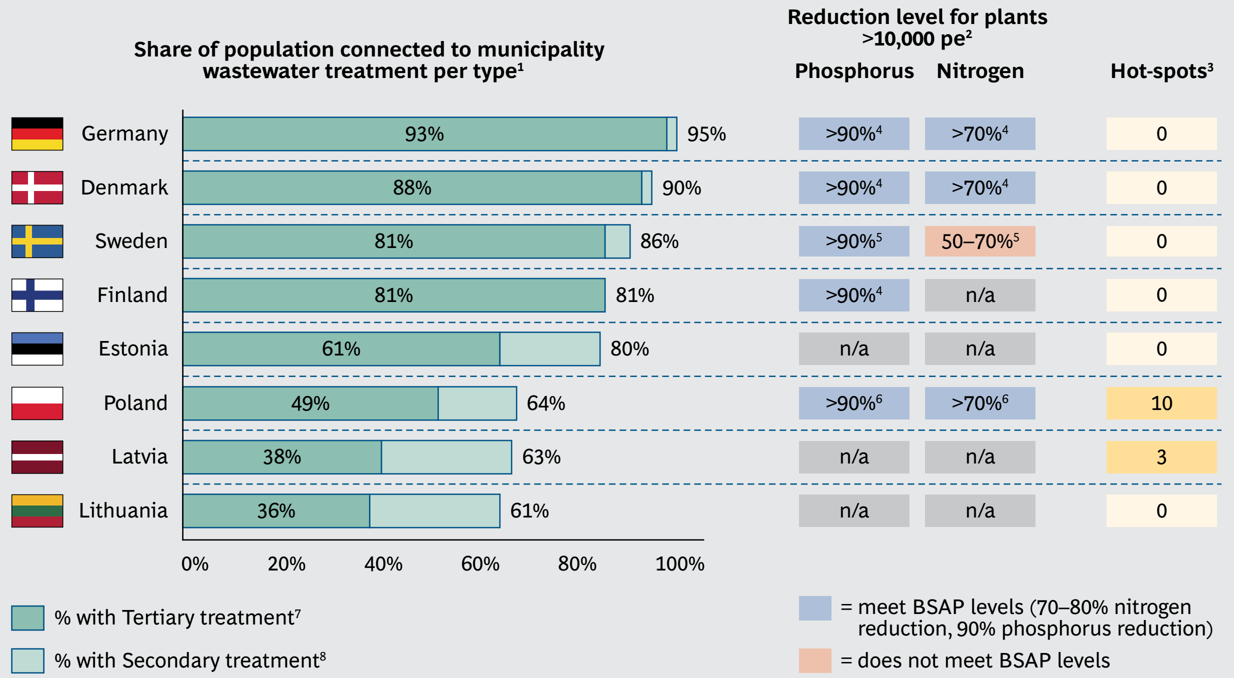
Nutrient reduction:
Recycling of nutrients

Source: Interviews; PURE project website; JNF Foundation; EU ISPA.
[1]According to PURE-project (project on urban reduction of eutrophication) presentation.

alents[3] should have secondary treatment, and that plants treating wastewater volumes from over 10,000 population equivalents in sensitive areas should have tertiary treatment (implying a 70 percent reduction of nitrogen and 80 percent reduction of phosphorus load). In the BSAP, HELCOM has put a higher restriction for the larger plants, requiring a phosphorus reduction of 90 percent. The current state of treatment varies widely among countries, revealing potential for further reductions. As seen in Exhibit 12, there is much room for improvement, especially in Poland, Latvia, and Lithuania, where the share of population connected to more stringent tertiary treatment is relatively low. However, large investments have been made in past years and treatment levels have increased. As seen in the case of Poland, recent data show that municipal wastewater treatment plants for over 10,000 population equivalents currently achieve a treatment level in line with BSAP targets.[4]

Progress has been made, and the share of people connected to secondary treatment increased by 10 percent between 2004 and 2009.[5] On the HELCOM hot-spot list of seriously polluted spots by municipality wastewater, there are currently only 15 spots, down from 54 in 1992.[6] One of the municipal wastewater treatment plants removed from the hot-spot list in 2012 was Kohtla-Järve in Estonia, currently at a 93 and 94 percent removal rate for phosphorous and nitrogen (see Exhibit 11). In fact, the treatment plants already reaching the EU standards of tertiary treatment of phosphorus could, by adjustments in their operations, easily increase the treatment level to reduce 90 percent to meet HELCOM's BSAP standards. This would not require any major investments, and only incur an additional cost of €0.20 to €0.40 per inhabitant[7]. If all wastewater treatments having the capacity would do this, phosphorus load would decrease by approximately 3,000 tonnes[7] (in comparison

EXHIBIT 12 | Potential to Reduce Discharge from Wastewater, Mainly in Poland, Latvia, and Lithuania



Sources: HELCOM; Swedish Environmental Protection Agency; National Water Management Authority in Poland (KZGW); BCG Analysis.
[1]HELCOM, data from 2009.
[2]Municipality wastewater treatment plants managing wastewater from over 10,000 population equivalents.
[3]Municipality hot-spots as of June 2013 according to HELCOM's list of heavily polluted areas.
[4]HELCOM PLC-5, 2011.
[5]Swedish Environmental Protection Agency, 2014.
[6]Analysis from 458 MWWTPs for >10,000 population equivalents. Data from KZGW, 2013. According to HELCOM PLC-5, there are in total 578 plants for >10,000 population equivalents in Poland.
[7]Tertiary treatment implies a nutrient reduction level of usually over 80% phosphorus and 70% nitrogen.
[8]Secondary treatment implies a treatment level of approximately 30 to 40% nutrient reduction.

with the lower treatment efficiency required by the EU standards), corresponding to 20 percent of BSAP reduction targets for all nine coastal states together.

Another way to reduce nutrient load from wastewater is to expand the municipal pipeline network so that more scattered settlements are connected to municipal treatment plants. However, as expanding the wastewater network may not always be cost-effective, municipalities should urge households to treat their own wastewater.

Private wastewater: Information, incentives, and regulations. Currently about 20 million people in the Baltic Sea states are not connected to a municipal wastewater network,[8] and possess their own treatment plants or solutions with varying standards. In Sweden alone, there are 700,000 houses not connected to the municipal wastewater network, of which about 50 percent[9] have insufficient nutrient treatment solutions in place. In addition, discharges from industries, especially the pulp and paper sector, account for 3 to 4 percent of the total anthropogenic waterborne load discharged into the Baltic Sea.[10]

There are several methods municipalities can use to enforce national and local regulations to limit nutrient discharge from private wastewater, mainly from scattered settlements, including:

- **Providing information about options:** Often given during inspections and approval processes; free advice regarding upgrades
- **Financial incentives/disincentives:** Offering financial subsidies for plant upgrades or levying fees against people not complying with legal requirements and local policies
- **Regulation/policies:** Defining local policies and strategies about recommended or required treatment solutions

One way of controlling the wastewater from scattered settlements is by inspections. In Värmdö, Sweden, the municipality has set a goal of inspecting all household wastewater treatment facilities by 2020—a pace of approximately 1,200 inspections per year. The inspections are partly financed by the municipality (about €750,000 per year), but mostly paid for by the homeowners (about €2.5 million per year) in the form of hourly fees for the inspections and administration. In this way, Värmdö has come up with a solution to make the polluters—the homeowners—finance the efforts of enforcing the law.

Södertälje, Sweden, provides an inspiring example of how a municipality can leverage policymaking to recycle nutrients locally. Their “Recycling Policy” (“Kretsloppspolicy”) builds on the principle that nutrients from wastewater from scattered settlements should be used in agriculture, and they therefore encourage and enforce citizens to invest in specific solutions (see Exhibit 11).

Stormwater: Nutrient reduction with additional benefits

Municipalities can make use of both targeted investments and policies to influence the behavior of others when managing stormwater solutions.

> 20 million people are not connected to municipal wastewater network

Flowing nutrients. Stormwater is water from rain and snow that can flow to rivers, filter into the ground, or evaporate. As it flows through different landscapes, the water collects nitrogen and phosphorus. Traditionally, stormwater is managed by underground sewage systems, which lead the water to rivers, and later to the sea. Because of impermeable underground pipes, the nutrient loads are not filtered naturally by the soil and are therefore discharged when released from the sewage systems. As urbanization increases, there are more and more impermeable areas, such as big parking lots at shopping malls, which put more pressure on the sewage systems. If the sewage systems are filled with more stormwater than they can manage, flooding will occur and can also cause combined sewer overflows at the municipal wastewater treatment plants, where untreated wastewater is discharged into the local waters.

Permeable green solutions can complement traditional sewage systems. These aim to absorb stormwater on site instead of channeling it away; for example, by using a “Bioswale” (a swale filled with grass and plants) or installing permeable pavements. With these techniques, nutrients are filtered and reduced naturally, while the water retained in the soil also lowers the pressure on sewage system. Applying these types of green stormwater solutions in urban areas will not only reduce the risk of flooding, but also increase green areas that enhance the recreational value for the population and contribute to a nicer, more attractive city (see “Top proven measures to reduce nutrient load: stormwater”).

Green policies. Apart from investing in infrastructure on municipal land, municipalities can also use policies to influence suppliers, industries, and citizens to limit nutrient discharges from stormwater. This can be done effectively by integrating stormwater management into multiple departments, such as traffic, city planning, and construction.

Berlin is a successful example of industry regulation. There, construction companies that build new houses must include a specified amount of surrounding green areas referred to as the “Biotope Area Factor” (BAF). The construction company is free to design the area to its liking, as long as the regulated ratio of green space is achieved. In this way, the municipality can require and encourage green areas and stormwater solutions in new construction projects with relatively little effort. Similarly, Helsinki, Finland, has addressed one major source of nutrient discharge–construction sites. Their stormwater policy addresses runoff from explosion activity during construction, and the responsibility is put on the construction company to limit its nitrogen load (see Exhibit 13).

In Växjö, Sweden, a stormwater fee was introduced to influence the behavior of property owners. The fee can be reduced if investments are made in efficient stormwater solutions that reduce stormwater runoff. This way, the city directs fees toward those who use the stormwater systems most (see Exhibit 13).

TOP PROVEN MEASURES TO REDUCE NUTRIENT LOAD

Stormwater[1]

Buffers and permeable pavements are ways to reduce the damage from stormwater sources.

- Bio-retention — Planting areas where stormwater can be temporarily stored and then filtered or infiltrated into the soil, for example lawns, plantings, and flower beds in roads, and green swales (bioswales) in parking areas.
- Forest buffers — Trees, shrubs, and vegetation alongside water or flood that take up nutrients from land before they enter the flood.
- Tree planting — Trees in urban pervious areas that can absorb stormwater with their roots and thereby take up nutrients onsite.
- Wet and dry ponds — Excavated basins with or without water in them that collect and store stormwater. For dry ponds, the water is kept underground. Because they reduce the water flow, retention, as well as nutrient reduction, is increased.
- Permeable pavement — Collects stormwater through voids in pavements and can later lead the water away or infiltrate the water into underlying soil which increases the nutrient retention.

Note
1. Expert Interviews; U.S. Environmental Protection Agency.

EXHIBIT 13 | Case Studies of Stormwater Initiatives

"Biotope area factor" requires minimum share of green areas in Berlin

- In Berlin city center, all new construction (development or redevelopment) must be built in accordance with a Biotope area factor (BAF) which requires a minimum share of green and ecological space within the development
- With this policy, Berlin influences development plans to protect the urban soil functions, which can limit risk of flooding and increase nutrient retention

Växjö introduces stormwater fee depending on usage

- In order to connect municipality water fees to property owners' stormwater system usage (in line with a "polluter-pays" perspective) Växjö, Sweden, has introduced a stormwater fee adjusted by size of impermeable areas
- All property owners can reduce their stormwater fee by investing in stormwater treatment
- With this policy, the municipality influences population's investment decisions to limit risk of flooding and increase nutrient retention

Helsinki stormwater policy for construction sites reduces nitrogen discharge

- After finding high levels of nitrogen (up to 300 mg per liter) in stormwater runoff from explosives activity at construction sites, Helsinki introduced a policy to handle explosives runoff connected to permits for noise and vibration
- The policy requires the construction company to plan how to collect and treat the runoff from explosions in order to reduce nitrogen levels to ~3–5 mg per liter before being released

Investment:

Requires one fulltime employee at municipality office — investments are made by construction companies

Nutrient reduction:

Up to 50 tonnes nitrogen per year — aim for higher reduction in future

Source: Interviews; Berlin and Växjö websites.

Restoration: Remediating environmental conditions

The high levels of phosphorus and nitrogen in the Baltic Sea catchment area today are to some extent a pre-1990's legacy. In fact, there are currently 350,000 tonnes of phosphorus on the floor of the Baltic Sea that are the result previous years' discharges.[11] In order to remediate the sea's natural state, methods described in the chapter on innovation are currently being tested. There are also bays and inland waters in need of restoration measures. Many options exist for municipalities to invest in directly, including wetlands and biomanipulation. A selection of proven restoration measures is found in "Top proven measures to reduce nutrient load: restoration".

One of the most commonly used measures for restoring natural mechanisms is wetlands. Wetlands provide areas with efficient spaces for natural nutrient removal along with other benefits, such as promoting biodiversity. The construction of wetlands is encouraged on an EU level, and can be eligible for subsidies from the EU LIFE and other programs. In a study of a wetland in Värmdö, Sweden, the value of the ecosystem services improved by the wetland amounted to €2.2 million (see Exhibit 14). Sweden also demonstrates the importance of wetland construction, and thus has included wetlands as one of the country's 16 key environmental objectives. As a result, 5,700 hectares of wetlands were created or restored from 2000 to 2011,[12] demonstrating that reviewing the potential to increase wetlands can be a good starting point for restoration measures within a municipality.

Restoration measures are also needed to remediate natural mechanisms in areas reconstructed by humans. One such example is man-made straight ditches to the sea, which are often on agricultural land. By rebuilding ditches in more natural shapes, or by creating a two-step ditch, the natural mechanisms of nutrient reduction are enhanced and restored by creating a larger area of soil in which water can be retained. In addition, many waterways to the coast have been narrowed by hu-

TOP PROVEN MEASURES TO REDUCE NUTRIENT LOAD

Restoration[1]

Restoration measures are needed to remedy natural mechanisms in areas reconstructed by people.

- **Wetland** — Excavated (or natural) pool that collects water, slows down the water flow, and increases nutrient retention. A wetland also benefits biodiversity and improves recreational value.
- **Two-step ditch** — Ditch constructed with two levels of floors to increase the water retained by the soil and thereby limiting nutrient load.
- **Manage waterways to the coast** — Enlarge and adapt waterways by removing items limiting the water flow to restore natural setting. Fish will thrive and multiply, and nutrient load can be limited.
- **Reed management** — Cut reeds by seaside to improve nutrient reduction and benefit biodiversity. Reed waste can later be used in biogas production or be converted into fertilizers.
- **Bio-manipulation** — Adjusting fish populations to reduce eutrophication and restore natural balances of nutrients, for example by using pike factories to increase number of pike or by extensive fishing to reduce number of sticklebacks.

NOTE
1. Expert Interviews; Swedish Water Authorities.

EXHIBIT 14 | Case Studies of Restoration Initiatives

€2.2 million value generated from a single wetland in Värmdö municipality

- By calculating the value of provided ecosystem services, Värmdö, Sweden, estimates that a wetland in its municipality is worth €2.2 million
- The ecosystem services recreation, water purity, fish production, flooding control, and benefits of media coverage were valued
  - Värmdö also highlights the importance of additional values such as sustained biodiversity and groundwater quality

Investment:
€400,000 by the municipality to create the wetland and its surroundings

Nutrient reduction:
100 kg phosphorus and 4,000 kg nitrogen[1]

Submariner lists innovative uses of Baltic Marine resources

- EU-funded project "Submariner" has created a comprehensive compendium of innovative possibilities using Baltic Marine material such as algae and reeds as resources
- Market opportunities are assessed, and available technologies described, within eight areas: macroalgae harvesting and cultivation, mussel cultivation, reed harvesting, large-scale microalgae cultivation, blue biotechnology, wave energy, sustainable fish aquaculture, and combinations with offshore wind parks

Restoring the HELCOM hot-spot channel in Liepāja

- The Karosta channel in Liepāja has been a polluted area since it was part of a military base in the mid-1990's, and it is one of HELCOM's hot spots of high pollution
- In order to restore the channel and remove it from HELCOM's hot-spot list, the municipality has recently initiated a 1.5 year project to remove polluted sediments

Investment:
Estimated €23 million, financed by EU Cohesion Fund, Latvian State, and Liepāja Municipality

Nutrient reduction:
Unknown — will remove 700,000 m^3 of sediments from the bottom

Sources: Interviews; Submariner website; BCG Analysis.
[1]According to estimates for an 18.5 hectare wetland based on data from Swedish Water Authorities for an average wetland by the sea.

mans, and simply rebuilding and widening them enhances and restores natural nutrient reduction.

Sometimes the easiest way to restore natural mechanisms is to remove polluted materials and sediments using dredging and other methods. Liepāja, Latvia is working to restore a major channel by removing polluted sediments from the bottom (see Exhibit 14), which will create benefits such as well-being of citizens who can use this area for recreation. In addition, some types of sediment materials can be used in biogas production. This use of materials recovered from the sea was the focus of the EU project Submariner that assessed market opportunities for eight different areas where materials previously considered waste can be turned into useful resources (see Exhibit 14).

Enforcing the national laws addressing wastewater discharges will result in meeting only 20 percent of the nitrogen and 80 percent of the phosphorous BSAP reduction targets. Voluntary measures outside of wastewater management are required. Using their unique local knowledge, municipalities can implement the measures seen above to create local win-win situations for both stakeholders and the environment — the decisive factor for reaching the clear waters state. Not only do investments in water technologies stimulate the local business environment, they are also the foundation of many local benefits, chiefly tourism and population's well-being.

Notes

1. NyTeknik, 2014
2. HELCOM estimates, 2011
3. Population equivalents is a measure for estimating flow and load into wastewater treatment plants
4. The National Water Management Authority in Poland (KZGW), 2013
5. HELCOM PLC-5, 2011
6. HELCOM, 2014
7. John Nurminen Foundation, 2014
8. HELCOM PLC-5, 2011
9. Swedish Agency for Marine and Water Management (HaV), 2013
10. HELCOM PLC-5, 2011
11. Nordic Environment Finance Cooperation (NEFCO), 2014
12. Swedish Environmental Protection Agency, 2012

MAXIMIZING IMPACT — FRAMEWORK FOR PRIORITIZATION

How should municipalities prioritize the many proven measures? To restore Baltic Sea waters, a municipality should reduce 10 to 500 kg phosphorus and 180 to 2,850 kg nitrogen per 1,000 inhabitants per year on average, depending on the country. To reach local reduction targets and capture the economic and environmental benefits, municipalities must spend their resources and time effectively. By applying a structured and holistic approach to finding the most cost-effective local combination of measures, municipalities can reduce nutrients up to a 40 percent lower cost. Although approaches may be similar, each municipality will need to implement solutions tailored to the local context. There is no one-size-fits-all solution.

Framework to prioritize actions

Municipalities must decide how to prioritize the broad range of proven measures that reduce nutrient load. To reach the clear waters state and capture local benefits, a municipality must find the most cost-effective combination of measures for the local setting. One effective way is to apply a structured approach for prioritization — in this report referred to as the Staircase framework. The Staircase framework can be applied by following a three-step approach to reduce phosphorous (P) and nitrogen (N) (see Exhibit 15).

Step 1: Calculate local reduction targets (such as kg P/year)

Step 2: Identify five to ten local measures applicable in local context and calculate their cost-effectiveness (such as €/kg P/year)

- Step 2a: Calculate the total reduction potential for each measure (such as kg P/year)
- Step 2b: Calculate the total cost for each measure (€/year)
- Step 2c: Calculate cost-effectiveness for each measure by dividing 2b by 2a.

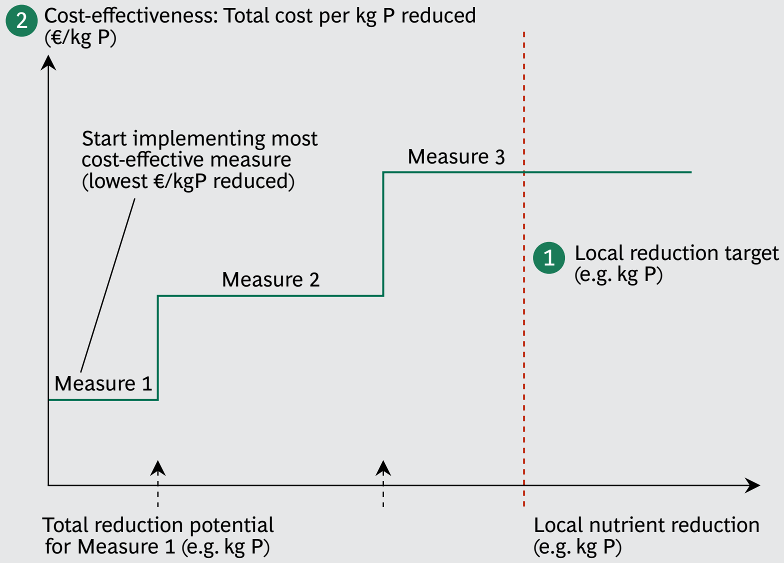
Step 3: Prioritize measures using the Staircase framework and develop a plan for implementation

In the first step, the municipality must calculate or estimate the local reduction target for phosphorous and nitrogen. In the second step, the municipality must identify relevant measures and calculate total reduction potential and cost for each of these measures. To identify what measures are relevant, it is important to know what the main sources of nutrient discharge are.

In the third and final step, measures are prioritized using the Staircase framework. The Staircase framework illustrates how a municipality should prioritize selected measures to reach the highest level of nutrient reduction for the lowest total cost. Every step or level in

Exhibit 15 | Prioritize Actions in Three Steps — Applying the Staircase Framework

1. **Calculate local reduction target**
   - In total, how many kg phosphorous and nitrogen need to be reduced in the municipality to reach BSAP reduction target and good ecological status?
2. **List top five to ten local measures; calculate cost-effectiveness for each measure**
   - Cost-effectiveness = total cost of reducing 1 kg of phosphorous or nitrogen (per year)
   - Calculation can be done in three steps;
     a) Calculate total reduction potential for each measure (e.g. kg P/year)
     b) Calculate the total cost for each measure (€ /year)
     c) Calculate cost-effectiveness for each measure by dividing 2b by 2a.
3. **Prioritize measures using the Staircase and develop a plan for implementation**
   - Staircase is a graphic illustration of how measures should be prioritized, starting with most cost-effective measure
   - Develop plan to implement prioritized measures



Source: County administrative board in Västmanland; Swedish water authorities.

the municipality Staircase framework represents one measure and is ranked based on its cost-effectiveness, for example, cost per reduced kg of phosphorous or nitrogen.

The first level of the Staircase framework represents the least expensive solution, and the last, and highest, step is the most expensive. The length of each step on the x-axis represent the total reduction potential in kg for a specific measure. The Staircase framework shows that a municipality should start by implementing the first, least expensive, step (measure) to its full potential (for example 100 kg of P), and then continue working this way until the local reduction target is reached.

The Lillån example. As an example of how this approach can be instituted, the case of Lillån in the Västerås municipality in Sweden, is explained in detail (see Exhibit 16). The area of Lillån is 200 km^2, and is dominated by farmland and pasture (8,600 hectares).

In the first step of the Staircase framework, Lillån determined that its total reduction target was 3,200 kg phosphorous per year. This estimate was based on phosphorous samples from the local waterways, which showed phosphorous levels needed to be reduced from 216 microgram/liters to 100 microgram/liters. The two largest sources of discharge were agriculture (90 percent) and private wastewater (5 percent).

In the second step, Lillån identified ten measures and calculated the cost-effectiveness of each by looking at both the total reduction potential and the cost (illustrated for a wetland in Exhibit 16). In this case, information was gathered from public databases, literature and reports, and assumptions based on internal knowledge. As a last step, the information and data from the two previous steps was compiled, and the Staircase graph was developed.

The example presented in this report focuses on phosphorus reduction, but the same methodology applies for nitrogen reduction. Also, since some measures reduce phosphorus and nitrogen simultaneously, a Staircase framework based on the combined effect can also be developed.

How to overcome the data challenge

The Staircase framework should be tailored to the individual municipality — there is no one-size-fits-all solution. In order to complete the

EXHIBIT 16 | Steps 1 & 2 in Staircase Framework Illustrated for the Agricultural Land Area Lillån

Step 1:
Need for 3,200 kg P reduction in Lillån

Step 2:
Cost-effectiveness was calculated for ten measures — detailed calculation illustrated for wetland

Lillån is a 200km² land area in Sweden

- Land dominated by agriculture (8,600 hectare), used for livestock and crop farming

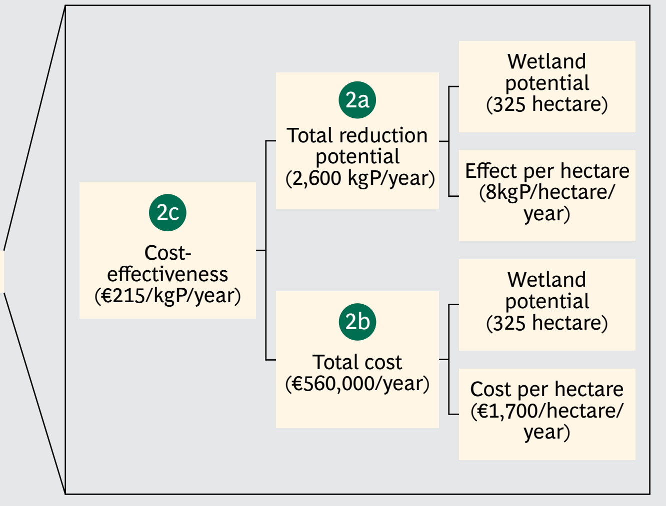
3,200 kg phosphorous (P) reduction needed in Lillån

- P levels needed to be reduced from 216 to 100 microgram/liter to reach good ecological status

For more information and detailed calculations, see report from Länsstyrelsen Västmanland (2013:16)

Selected measures	Cost-effectiveness (€/kgP/year)
1. Structural liming	0
2. Adapted buffer zones	55
3. P-ponds	70
4. Management of fertilizers usage	175
5. Manure storage management	190
6. Wetland	215
7. Under-drain with structural liming	445
8. Two-step ditch	550
9. Private wastewater	1,115
10. Buffer zone (20m wide)	1,730

Method for estimating cost-effectiveness for each measure — calculations for wetland illustrated



Source: Länsstyrelsen Västmanland, report 2013:16 "Åtgärder för god ekologisk status i ett jordbruksdominerat avrinningsområde — Exemplet Lillån"; Expert interviews.

three steps and find the optimal combination of measures, several parameters must be identified, collected, calculated, or estimated. Calculating all data points to the most granular and exact degree would be too time consuming, so municipalities should be pragmatic in their approach. For example, a good start is to use public databases, reports, and literature to find national or regional data on costs and efficiency for measures. Furthermore, cooperation and discussion with other municipalities with similar challenges can be helpful, as can discussions with universities and research institutes.

The first challenge municipalities might experience is how to calculate the local reduction target. There are several ways to do this. In the case of Lillån, the need for phosphorous reduction was calculated based on the level of phosphorous in water — data was collected from almost 40 samples taken during 2010 and 2011. Still, if a municipality does not possess this kind of data, there are other, more pragmatic, but less accurate, methods that can be applied in the short term.

For example, in HELCOM's BSAP, reduction targets for phosphorous and nitrogen have been defined for each Baltic Sea state. Since these targets are presented on an aggregated level for an entire country, it can be challenging for a municipality to relate and apply these targets to its own daily work. In order to overcome this challenge, HELCOM's targets can be broken down to a municipality level using population as a key metric. The results show that on average, a municipality should reduce 10 to 500 kg phosphorus and 180 to 2,850 kg nitrogen per 1,000 inhabitants, depending on country (see Exhibit 17). Since there are factors other than population also driving nutrient discharges (such as amount of agricultural land and number of private wastewater units), these targets should be used as approximate guidelines, rather than exact recommendations.

To find the measures most relevant in the local setting, it is important to understand the sources of the nutrient discharge. As seen previously, 90 percent of nutrient load comes from agriculture, wastewater, and stormwater, but since this can vary from municipality to municipality, a local inventory of potential discharge sources must be conducted by measuring nutrient levels in the water at strategic

Exhibit 17 | Municipality Annual Reduction Targets Per 1,000 Inhabitants

Municipality reduction targets[1] (kg/1,000 inhabitants)	Sweden	Finland	Denmark	Germany	Poland	Estonia	Latvia	Lithuania
Phosphorus	60	70	10	50	200	250	110	500
Nitrogen[2]	780	460	180	620	1,030	1,210	710	2,850

Example: A Polish municipality with 40,000 inhabitants needs to reduce:

Phosphorus: 200 x 40 = 8,000 kg

Nitrogen: 1,030 x 40 = 41,200 kg

Source: HELCOM Country Allocated Reduction Targets (CART), 2013; National statistics.
Note: Illustrative targets - dependent on discharges per source within each municipality.
[1]Reduction targets illustrate required reduction for waterborne nutrient load into the Baltic Sea, i.e. not at source.
[2]Refers to nitrogen waterborne load.

places, or by doing a practical inventory that includes identifying agricultural land and manure-handling practices; mapping location and size of municipal wastewater treatment plants; measuring capacity and nutrient reduction levels; and identifying properties with private wastewater handling and their nutrient-treatment levels.

Once a municipality identifies its main sources of discharge, the appropriate measures for limiting the nutrient load from these sources must be identified. The top proven measures for agriculture, wastewater, stormwater, and restoration that were identified in the previous chapter are a good starting point for municipalities. The cost-effectiveness of these measures will, however, vary, as both costs and effectiveness (for example, reduced kg of phosphorous) will vary by local setting. Costs for implementing measures often vary less than their effectiveness, and can often be found in national databases and reports.

One must also remember that these cost-effectiveness measures relate to phosphorous reduction only–and do not include the total economic and environmental benefits a municipality can capture (see chapter "Demonstrating local benefits"). Many measures have dual benefits. Some measures reduce both phosphorous and nitrogen, which would decrease the total cost per reduced nutrient. Furthermore, there are many additional benefits from implementing measures. For example, a wetland has additional benefits such as positive impact on biodiversity, and a private wastewater treatment upgrade mitigates risk for contamination, which contributes to reaching the clear waters state.

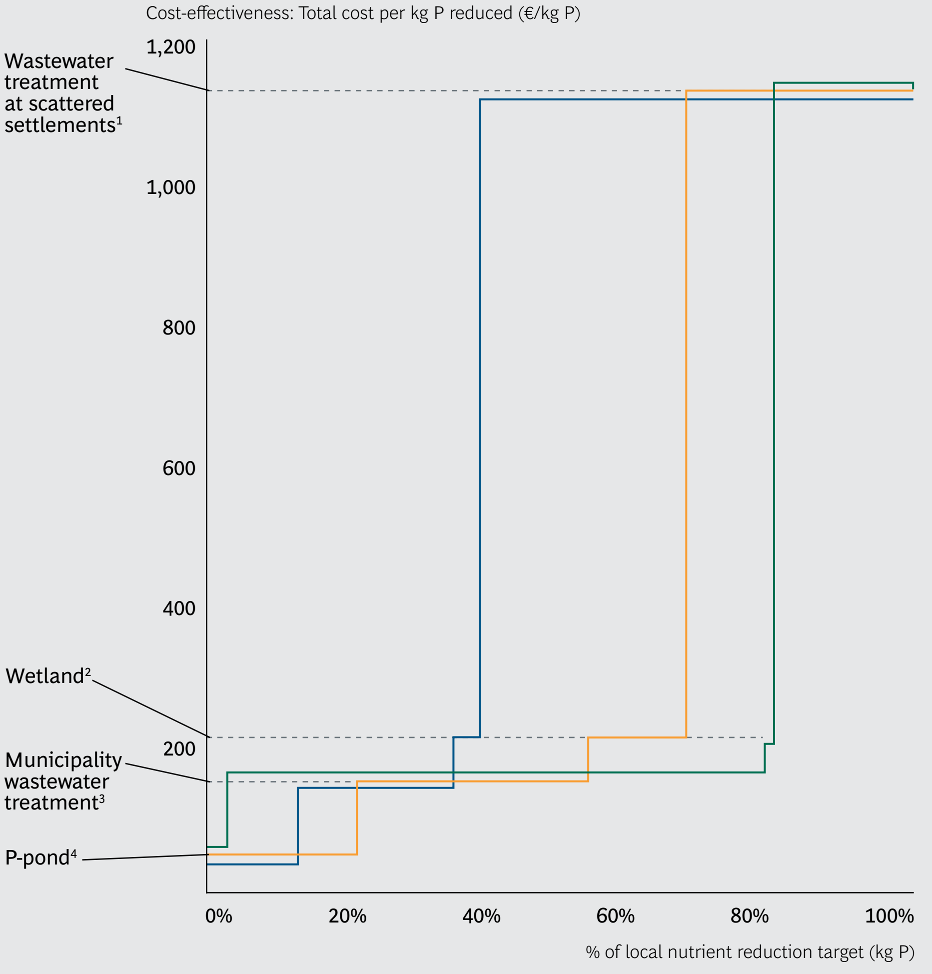
Illustrating three municipality archetypes

To demonstrate how the Staircase framework will be different for different municipalities based on the local setting, three fictional municipality archetypes are illustrated in Exhibit 18: a mid-sized city, an agricultural municipality, and an archipelago municipality. The three archetypes have different characteristics, such as number of inhabitants, size of land area, share of agricultural land, municipal wastewater treatment level, and number of households not connected to the municipal wastewater network.

For the sake of simplicity when illustrating the Staircase framework for the three archetypes, four measures were selected and calculated with similar cost-effectiveness for each municipality: p-ponds[1] (€70/kg P), increased phosphorous treatment level in municipal wastewater treatment plant (€161/kg P), wetland (€215/kg P), and upgrade of private wastewater treatment (€1,115/kg P). In reality the cost-effectiveness of these measures would be different for each municipality and also for different locations within the community.

The sample mid-sized city is assumed to be one with 100,000 inhabitants and which aims to reduce at least 15 tonnes of phosphorous. Since the municipality has limited agricultur-

EXHIBIT 18 | Up to 40 Percent Cost-Savings Potential by Using a Structured Approach to Find the Most Cost-Effective Local Combination of Measures



Assumptions

Mid-sized city

- 100,000 inhabitants
- Reduction target: 15,400kg P
- 800km² land, 20% agricultural
- 60%→80% phosphorous treatment level of municipal wastewater
- 5,900 scattered settlements[5]

Cost saving: ~10%

Agricultural municipality

- 45,000 inhabitants
- Reduction target: 7,000kg P
- 650km² land, 80% agricultural
- 80%→90% phosphorous treatment level of municipal wastewater
- 4,200 scattered settlements[5]

Cost saving: ~40%

Archipelago municipality

- 20,000 inhabitants
- Reduction target: 3,100kg P
- 400km² land, 10% agricultural
- 80%→90% phosphorous treatment level of municipal wastewater
- 3,500 scattered settlements[5]

Cost saving: ~20%

Sources: HELCOM; County administrative board in Västmanland; Swedish water authorities; BCG Analysis.
Note: Reduction targets based on HELCOM CART, 2013. Cost saving = Compared with reaching reduction targets by only leveraging measures for municipal wastewater and scattered settlements.
[1,2,4]County administrative board of Västmanland — Lillån example, 2013.
[3]Swedish water authorities — Södra Östersjön, 2014.
[5]Number of households not connected to the municipality wastewater treatment plant network and with insufficient levels of nutrient treatment of their wastewater.

al area, the potential for such measures is small (less than 5 percent). The largest potential, representing almost 80 percent of targets, comes from an upgrade of the municipal wastewater treatment plant that will increase nutrient treatment level from 60 percent to 80 percent.

The agricultural municipality, with 45,000 inhabitants and reduction target of seven tonnes of phosphorous can reduce more than 35 percent of its target by constructing p-ponds and wetlands, and another 35 percent by upgrading the municipal wastewater from an 80 percent to a 90 percent phosphorous reduction.

The archipelago municipality is assumed to have 20,000 inhabitants, and a reduction target of three tonnes of phosphorous. There are 3,500 private wastewater units that need a higher treatment level. These upgrades represent 60 percent of local targets.

All three municipalities can reach their individual phosphorous target for up to 40 percent less money by applying the Staircase framework, than if they had leveraged only municipal and private wastewater measures. This shows how important it is to implement measures that limit nutrient loads from sources beyond wastewater, such as agriculture.

When a municipality has compiled its own Staircase framework and knows how to prioritize measures, a more detailed implementation plan must be developed. As described in the previous chapter, “Navigating a broad range of proven measures,” municipalities can use targeted direct investments and also influence the investment decisions of others through policies, information dissemination, and incentives.

By using the Staircase framework, municipalities can find the most cost-effective local combination of measures, and the most advantageous way to prioritize them, when developing their strategy for reaching the clear waters state.

Note

1. P-pond is a pond collecting phosphorus

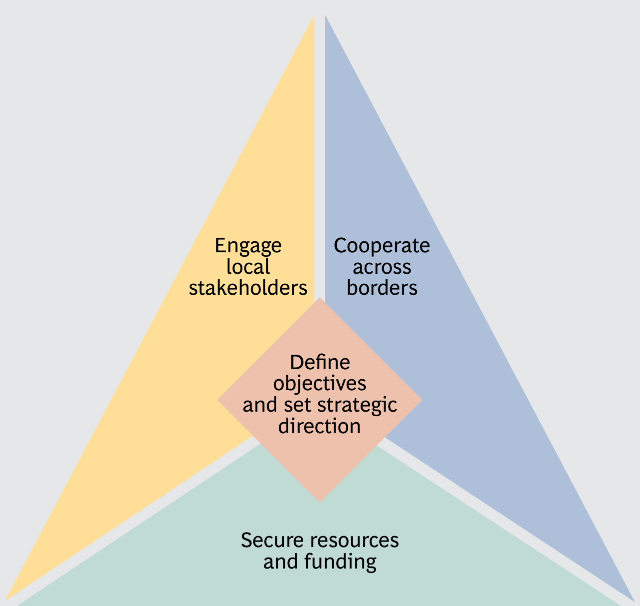
BECOMING A LEADER — HOW TO MAKE IT HAPPEN

How can municipalities accelerate change and begin to become leaders? Best practice examples from leading municipalities around the Baltic Sea show four actions crucial to becoming an attractive community for citizens and businesses: i) define objectives and set strategic direction, ii) engage local stakeholders, iii) cooperate across borders, and iv) secure resources and funding (see Exhibit 19). There is a clear link between level of voluntary activity and size of the municipal environmental team; an estimated 60 percent increase in team size would enable substantial progress in the Baltic Sea region.

Define objectives and set strategic direction

Clearly defining long-term objectives and setting the strategic direction for addressing eutrophication is fundamental for a municipality

Exhibit 19 | Four Actions Crucial to Address Eutrophication and Becoming an Attractive Community



Define objectives and set strategic direction
- Secure commitment and buy-in from key stakeholders within the municipality organization
- Define municipality's overall objectives for addressing eutrophication, and develop a strategy
- Integrate strategy across departments, incorporate in public procurement

Engage local stakeholders
- Gather and mobilize local citizens, landowners, companies and organizations for joint efforts
- Raise public awareness
- Recognize and support locally driven initiatives

Cooperate across borders
- Cooperate with stakeholders outside municipality borders; regionally, nationally, and internationally
- Facilitate knowledge-sharing and find opportunities for synergies and pooling of resources

Secure resources and funding
- Complement internal budget with external sources such as loans, grants, and fees
- Secure resources and competence such as via cooperation with universities and research institutes

Sources: Municipality and expert interviews; BCG Analysis.

to capture local benefits. To define objectives and aspirations for addressing eutrophication, commitment from local politicians and leadership must be secured. This can be a challenging task in municipalities where other issues have higher priority, but several alternatives are available. For example, electing and recruiting dedicated individuals with a passion for the Baltic Sea and clean water in general has proven to be effective.

Another option is to create commitment over time by demonstrating and communicating the wide range of local benefits from addressing eutrophication and reaching the clear waters state (sustainable business development, recreation, aesthetic value, flood control, biodiversity, and population's well-being). As the previously shown, the difference between the clear waters and the shipwrecked state could amount to almost 3,000 fulltime jobs, aggregated over 15 years, and an opportunity for local businesses to become regional, national, and global suppliers of water technologies.

When the commitment from key stakeholders, including local politicians and the leadership team has been secured, the municipality's overall objectives for reducing nutrient load and addressing eutrophication must be specified, and translated into a strategy. As described in detail previously, structuring the most cost-effective combination of local measures is an important building block of the municipal strategy. The municipality should also make sure the strategy is well integrated with the overall agenda and is anchored in all departments so actions can be incorporated into the work of city planning, construction projects, environmental planning, and traffic planning, among other things. In public procurement processes, for example, suppliers with environmentally friendly solutions for reducing nutrient load can be promoted by including environmental criteria.

When developing an action plan and strategy for the municipality, international and national goals should be taken into account. Gävle in Sweden provides an inspiring example of a municipality that has succeeded in integrating EU and national strategies into its local strategy. With a structured approach, Gävle compared the Europe 2020 strategy and EU Strategy for the Baltic Sea region (EUSBSR) with their local challenges in order to identify common prioritized areas for improvement. The work was a year-long process of seminars and discussions with the entire organization, and has resulted in a strategy with the long-term motto "Areas of improvements–not projects." The strategy, with similar language and clear connection to EU strategy, has also been shown to be a key success factor for attracting external funding.

Commitment from local politicians and municipality leaders is crucial.

The cities of Helsinki and Turku in Finland demonstrate that a well-defined municipal strategy can also influence other municipalities to take action. In 2007, the two cities committed to voluntary actions to protect and restore the Baltic Sea and created action plans for addressing eutrophication under the initiative The Baltic Sea Challenge. Since then, they have inspired over 200 cities, authorities, and organizations to join the initiative and create their own action plans for how to reduce nutrient load.

Engage local stakeholders

Involving, engaging, and gathering local citizens, organizations, and companies in addressing eutrophication is vital for the success of the municipal work. Local stakeholders' behaviors not only drive nutrient discharges, but can also play an important part in finding solutions for limiting them.

An important aspect of local stakeholder engagement is raising public awareness. There are many examples of how municipalities around the Baltic Sea are working to raise public awareness in various forms, and Hiiu in Estonia is one of them. Hiiu decided to raise public awareness over the long term, by engaging and educating young students about the critical state of the Baltic Sea. Municipalities can use digital tools to engage citizens. For example, when the Latvian-Estonian project, Drain For Life, was planning to extend municipalities' green infrastructure and other stormwater solutions in public areas, social media was used to gather input from citizens.

> A municipality can use the Baltic Sea as a resource by implementing measures that generate revenues.

It is also important to recognize initiatives driven by citizens and local organizations. The initiative Rädda Burgsviken (Save the Burg's Bay) on Gotland in Sweden provides an example of how local citizens and organizations can restore their valuable, but eutrophic, bay. The project, driven by more than 20 local organizations, tested several measures to prove that the total cost of restoring the bay would require €3 million in public investments, and could lead to the release of more than €30 million in private investment. Using this business case as a foundation, the project's next step is to secure funding for implementation. For a municipality, it is important to identify, support, and cooperate with these locally driven initiatives to make sure local engagement is preserved and actions are implemented.

Cooperate across borders

Cooperation outside municipality borders has proven important for achieving superior results. Sharing knowledge and experiences with other municipalities in the country and across other Baltic Sea states can be of great value, both in terms of which measures to implement, and how to drive actions forward in the local setting. Östersjöinitiativet ("The Baltic Sea Initiative") is one such example, where 13 Swedish municipalities are cooperating in order to accelerate the local actions of municipalities, organizations, and businesses, as well as to raise public awareness.

Cooperation can also be a lever to strengthen the resource base, as several municipalities can share staff dedicated to certain tasks, making processes more efficient. For example, the Kalmar Sound Commission in Sweden, an organization created by neighboring municipalities, coordinates Baltic-Sea-related efforts in the region. Instead of having all municipalities apply for funding individually, the coordinator can streamline the process, as well as identify areas of synergy and cooperation.

Secure funding and resources

Municipalities must secure funding and resources, both internal and external, to successfully initiate actions. In order to make sure nutrient reduction becomes an integrated part of the municipal strategy on long-term basis, internal budget and resources are often preferable to more temporary project funding. It is important that the local strategy set the overall direction, and that available project funds are not steering what measures are implemented. Furthermore, a municipality can use the Baltic Sea as a resource by implementing measures that generate revenues, as shown in examples presented earlier, such as the commercial mussel cultivation project in Kalmar and TechMarket's solution for removing sediment and converting it to biogas, fertilizers, and other commodities (see Exhibit 8).

External funding can be an important addition to internal resources, and can support the local municipal strategy, both for larger investment projects and smaller projects. A municipality can leverage a broad scope of funding sources. These are only a few of many possibilities:

- Bank loans: Loans for larger infrastructure investments such as municipal wastewater treatment upgrades, provided by the European Investment Bank, Nordic Investment Bank, (NIB), and Nordic Environment Finance Corporation (NEFCO), among others.
- International and national grants: Various EU funds (such as cohesion and structural funds, EUSBSR Seed-Money Facility, Life+), as well as Council of Baltic Sea States, Swedish Institute, national grants from ministry of environment for each of the coastal states, etc.

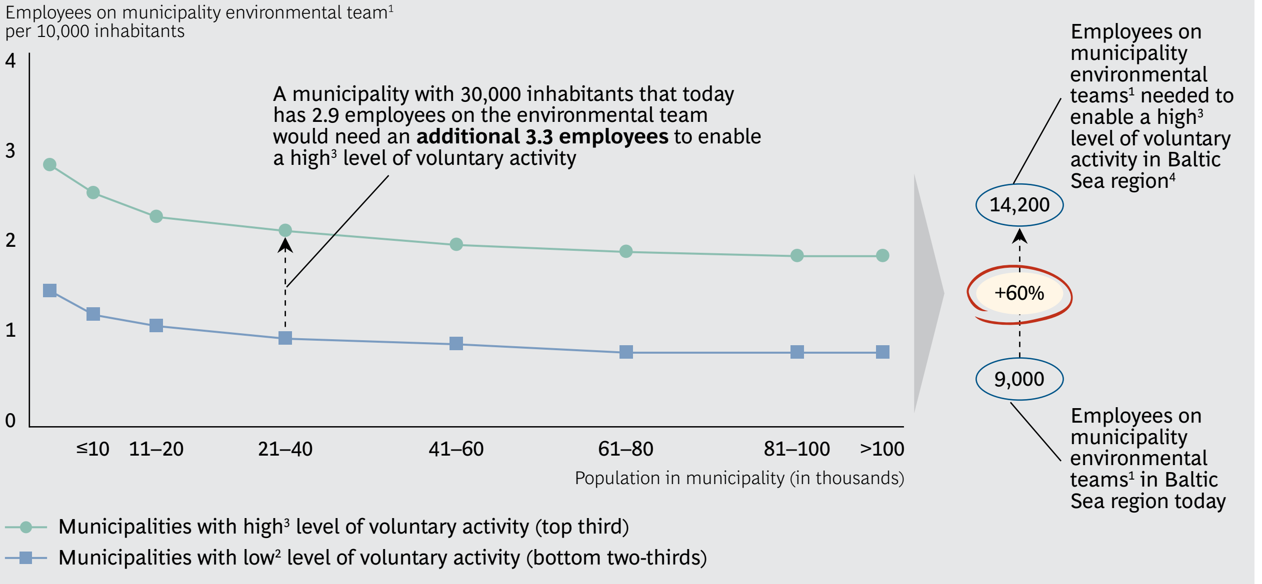
- Taxes/fees: Municipalities and cities can, in some countries, levy regional or local taxes or fees on companies and individuals. A tourism tax can be used by cities to promote sustainability in the sector; or such funds can be earmarked for specific purposes, such as environmental projects or maintenance. For example, in the German city of Hamburg, a culture and tourism tax was introduced in 2013, and 100 percent of the revenue is invested in tourist, cultural, and sporting projects. Also, as described previously, Växjö has introduced a stormwater fee for property owners (see Exhibit 13).

- Social financing: Social financing mechanisms such as crowdfunding are a way for initiatives, projects, and ventures to secure funding by collecting contributions from the public. The Million Meters Stream Project is such an initiative launched in October 2014, with the aim of using environmental crowdfunding to restore 1 million meters of New Zealand's polluted waterways.

While internal budget and external funding sources are important, the municipality employees are essential because they initiate, plan, drive, and coordinate the local actions. Also, since many of the municipal measures to reduce nutrients are voluntary and not required by law, the personal engagement and passion of municipal employees has proven to be key.

However, today, many Baltic Sea municipalities lack sufficient numbers of employees dedicated to addressing environmental problems like eutrophication. To understand how large this gap is, two groups of municipalities were identified based on their level of voluntary activity (such as activities to reduce nutrients from areas other than wastewater): the one-third of municipalities with highest activity level and the two-thirds of municipalities with the lowest activity level (see Exhibit 20). The analysis shows, that there is a clear link between level of voluntary activity and size of the municipality environmental team. This implies that municipalities must consider re-

EXHIBIT 20 | Clear Link Between Level of Voluntary Activity and Size of Municipality Environmental Team — A 60 Percent Increase Would Lift Voluntary Activity



Sources: National statistics; BCG Baltic Sea Survey 2014; BCG Analysis.
Note: Russia not included in calculations. Based on 167 answers in BCG Baltic Sea Survey 2014. Activity level refers to activities to reduce nutrient load in areas other than wastewater, i.e. voluntary activities.
[1]Employees in municipality environmental team = full-time equivalents working with environmental issues in municipality, excluding inspection personnel.
[2]Low activity level refers to activity level of the 2/3 of municipalities having the lowest share of activities in areas other than wastewater.
[3]High activity level refers to the activity level of the 1/3 of municipalities having the highest share of activities in areas other than wastewater.
[4]Size of environmental team if all municipalities should reach high activity level, hence same number of employees in environmental team/10,000 inhabitants in bottom 2/3 of municipalities as employees in environmental team/10,000 inhabitants in the top 1/3 of municipalities.

cruiting employees or reallocating their resources to execute their strategy.

For example, the analysis shows that a municipality with 30,000 inhabitants and a low level of voluntary activity has, on average, 2.9 fulltime equivalent workers (FTEs) on their environmental team (see Exhibit 20), compared with 6.3 FTEs — 120 percent higher — for the municipalities with a high level of voluntary activity. Lifting all municipalities to the same activity level as the top third of municipalities would require a 60 percent increase, or 5,200 additional employees, on municipality environmental teams over the entire Baltic Sea region.

In addition, municipalities can collaborate with universities in order to gain access to resources, including academic and expert opinions and current thinking. Universities can provide expertise and advice on implementation of specific measures, measure environmental status (nitrogen and phosphorous levels) in polluted waterways, and conduct environmental and economic calculations. For example, despite the fact that Västervik, Sweden, is 350 km from Swedish University of Agricultural Sciences in Uppsala, the environmental team has traveled in past years to speak about the problems the municipality currently faces. University students then spend several weeks searching for solutions as a part of their coursework and present their suggestions to the municipality. However, today only about 35 percent of municipalities collaborate with universities.[1] There is obviously great potential to expand the exchange of resources and information between municipalities and universities in the Baltic Sea states.

Note
1. BCG Baltic Sea Survey 2014

CLOSING THOUGHTS

The primary objective of this report is to highlight the critical role that municipalities have in restoring waters in the Baltic Sea region and demonstrate the benefits that can be captured in that process. We conclude that municipalities should not only view the state of Baltic Sea waters as an environmental problem, but also as an opportunity to grow and sustain the local economy, especially within water technology industries and tourism. The difference between the two scenarios is considerable; almost 3,000 fulltime jobs over the course of 15 years for an average municipality. To capture this opportunity, municipalities must embrace a long-term plan to reduce the local nutrient load. There is a broad set of proven measures that can be taken, both in terms of targeted investments and policies. Moreover, for maximum impact, municipalities must adopt a structured approach for prioritizing proven measures.

Regardless of current and upcoming national laws and regulations, municipalities must actively work to reduce nutrient discharge; waiting for others to take action is simply not an option. It is also of great importance that international, national, and regional parties collaborate with, and support, municipalities on this journey. We encourage further debate on how local actions in the Baltic Sea region can be accelerated, and what support is needed on regional, national, and international levels to make this happen.

In order to restore the waters and to accelerate change at the local level, all municipalities in the Baltic Sea region can start by asking themselves the following three questions:

1. *What is our municipality starting point (including our contribution to the nutrient load), and what is our goal and strategy going forward?* Do we have an ambitious and clearly defined strategy and plan in place to substantially reduce the load locally? What benefits could such a strategy yield for us economically and for our citizens?

2. *When we commit to addressing eutrophication in our municipality, who will be the key stakeholders we should engage?* Across the business community, political landscape, and key institutions, who are the key decision-makers locally who must become partners in executing a much more ambitious strategy and action plan? Internally, how do we identify individuals throughout the municipality organization who can become champions and support the work from goal to concrete actions?

3. *How do we ensure that we have sufficient funding and resources to execute a more ambitious action plan?* Compared with leading municipalities across the Baltic Sea region, are we prepared with the right resources and expertise to implement a

more ambitious plan? In terms of funding, have we exhausted available external funding options and public-private partnerships, as well as taking a collaborative approach with the local business community?

Municipalities have an important role to play in initiating local measures, but the strength of working both top-down with national and regional regulations and bottom-up with local measures simultaneously, should not be underestimated. Therefore, regional, national, and international bodies must support municipalities and local actions to the largest extent possible. The following three additional questions should be addressed:

4. *How can the Baltic Sea Action Plan, nutrient reduction targets, and implementation programs be translated from a national to a local level?* What support is needed from national and regional stakeholders in order for municipalities to access tangible targets on a municipal level?

5. *How can national cross-sector collaborations within areas such as agriculture, facilitate cooperation among local stakeholders?* Just as municipalities must collaborate with farmers to identify win-win solutions, cooperation among the Ministry of Environment, water authorities, and national stakeholders within agriculture and other sectors is needed.

6. *How can national bodies, together with local stakeholders, develop the region to become a hub for water technology innovations?* Eutrophication is a global challenge, and by raising the number and speed of innovations and the commercialization of ideas, the Baltic Sea region can become a leader and global exporter of water technologies. Taking inspiration from Singapore's national strategy from 2006 to become a global hub for water technology, the Baltic Sea states can also attract water technology businesses and jobs by developing and implementing a clearly defined strategy.

In this report, we want to communicate a sense of urgency to the 1,500 municipalities involved, but we also want to highlight the monumental opportunities these communities face in creating a favorable outcome for the region's economic, environmental, and social future — and leave a healthy Baltic Sea for coming generations.

APPENDIX
IMPACT-MODELING METHODOLOGY

The section "Demonstrating local benefits," quantifies the economic benefits a municipality can capture. The aim is to showcase the potential difference in job engagement and economic impact between the clear waters state and shipwrecked state scenarios with regards to eutrophication. The economic values are discounted and aggregated to reflect economic impact in terms of real gross output during a 15-year period from 2015 to 2030. The impact is calculated for an average Baltic Sea municipality based on estimates for average inland and coastal municipalities with 45,000 inhabitants each.

Figures include direct impact (change in demand), indirect impact (supply-chain impact), and induced impact (household consumption due to increased payroll) using multipliers based on standard economic theory. The different types of impact can be explained by using a simplified example for a wetland investment. First, the investment will have a direct impact on contractors in the water technology industry who are being paid to construct the wetland. In order to complete the task, the contractors must order materials and equipment from suppliers — an indirect economic impact. Finally, workers getting paid for contributing to the wetland will consume more due to the extra payroll — an induced impact.

For job creation, the calculated number of fulltime jobs relates to fulltime equivalents engaged per year in aggregate during the 15 years. Since the results represent an average municipality, it is assumed that all services requested from different industries can be supplied from within the municipality. Similarly, it is estimated that all needed employees with sufficient knowledge can be found within the municipality. In reality, the impact for a single municipality will vary by what industries and types of employees are available.

As described in the section, "Demonstrating local benefits," the difference in economic impact between the clear waters state and the shipwrecked state within water technology industries is generated by investments in nutrient-reducing equipment and water technology within the municipality. This value represents investments in municipal wastewater treatment, private wastewater treatment, and agricultural, stormwater, and restoration measures. The level of investment is based on the cost of the measure, excluding internal costs for the municipality, such as inspections and administrative work. The estimated level of investments is based on municipality data from the BCG Baltic Sea Survey 2014 as well as published reports estimating the total cost of reaching BSAP targets by region or country, or for the entire Baltic Sea.

Differences in economic impact and number of fulltime jobs from tourism and recreational fishing industries determine estimates on algal bloom impact and increased fish stock. For example, the number of tourists is expected to drop up to 30 percent[1] from 2025 to 2030 due to the substantial algal blooms. The impact on inland municipalities will, however, be lower than for coastal municipalities.

For the real estate industry, the differences in economic output between the clear waters state and the shipwrecked state are based on estimates of increased property values due to enhanced green areas in cities[2] in the clear waters state as a result of investments in green stormwater infrastructure, as contrasted with decreased property values for holdings close to waters due to substantial algal blooms[3] in the shipwrecked state.

Again, the direct impact will further affect supporting industries such as retail and construction due to a ripple effect through indirect and induced values, as explained above.

Total economic impact on a municipality will differ depending on the country and the local setting. In the business case, tourism represents the largest share of direct economic impact for an average municipality, and hence direct tourism spending is a key driver to understanding how this relates to an individual municipality. Table 1 shows an overview of total economic impact for different levels of tourism spending based on the same assumptions as presented in the business case in this report.

For example, if tourism spending in an inland municipality amounts to €50 million in 2015, the municipality can potentially experience a difference in total economic impact between the two scenarios of €320 million, in aggregate, over 15 years. For a coastal municipality with same level of tourism spending, the economic impact is almost 50 percent higher, €470 million, mainly driven by the fact that coastal municipalities are affected by severe algal blooms to a larger extent than inland municipalities. The economic impact from tourism and recreational fishing will also vary depending on the country, mainly driven by a difference in daily spend per tourist.

Notes

1. Swedish Environmental Protection Agency, 2008; Foghagen, 2011; Municipality case examples and interviews
2. See Philadelphia Water Department, 2009
3. See Swedish Environmental Protection Agency, 2008

Table 1. Difference in Total Economic Impact Between Clear Waters and Shipwrecked State Per Municipality Type and Tourism Spending

	Difference in total economic impact between clear waters and shipwrecked state (€ million)	
Direct tourism spending in municipality 2015 (€ million)	Inland municipality	Coastal municipality
100	580	860
75	450	660
50	320	470
25	180	270

FOR FURTHER READING

Key reports referred to and used as sources herein can be obtained from the following web pages:

"Turning Adversity into Opportunity — A Business Plan for the Baltic Sea" (2013)
A report by The Boston Consulting Group, August 2013
http://www.bcg.dk/documents/file142393.pdf

"WWF Counter Currents: Scenarios for the Baltic Sea Towards 2030" (2012)
WWF Baltic Ecoregion Programme
http://wwf.panda.org/what_we_do/where_we_work/baltic/publications/?206013/WWF-Counter-Currents-Scenarios-for-the-Baltic-Sea-Towards-2030

HELCOM PLC-5 (2011)
HELCOM Pollution Load Compilation 5
http://www.helcom.fi/Lists/Publications/BSEP128.pdf

HELCOM Initial Holistic Assessment (2010)

HELCOM Ecosystem Health in the Baltic Sea 2003-2007, BSEP 122
http://helcom.fi/Lists/Publications/BSEP122.pdf

"Ecosystem services provided by the Baltic Sea and Skagerrak" (2008)
Swedish Environmental Protection Agency, Report 5873
http://www.naturvardsverket.se/Nerladdningssida/?fileType=pdf&downloadUrl=/Documents/publikationer/978-91-620-5873-9.pdf

HELCOM Baltic Sea Action Plan (2007)
http://helcom.fi/baltic-sea-action-plan/action-plan/

NOTE TO THE READER

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