Manual for Performance-Based Contracting by Water Utility Companies in Brazil

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Manual for Performance-Based Contracting by Water Utility Companies in Brazil

Prepared by GO Associados for International Finance Corporation

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Abbreviations and Acronyms

ADA - Águas do Amazonas S.A.
AG - Águas Guaríroba S/A
AGESPISA - Águas e Esgotos do Piauí S/A
AI - Águas do Imperador S/A
CAEMA - Companhia de Águas e Esgotos do Maranhão
CAER - Companhia de Águas e Esgotos de Roraima
CAERD - Companhia de Águas e Esgotos de Rondônia
CAERN - Companhia de Águas e Esgotos do Rio Grande do Norte
CAESA - Companhia de Água e Esgoto do Amapá
CAESB - Companhia de Saneamento Ambiental do Distrito Federal
CAGECE - Companhia de Água e Esgoto do Ceará
CAGEPA - Companhia de Águas e Esgotos da Paraíba
CAJ - Companhia Águas de Joinville
CAN - Águas de Niterói S/A
CAP - Águas do Paraíba S/A
CASAL - Companhia de Saneamento de Alagoas
CASAN - Companhia Catarinense de Águas e Saneamento
CEDAE - Companhia Estadual de Águas e Esgotos
CESAMA - Companhia de Saneamento Municipal
CESAN - Companhia Espírito-Santense de Saneamento
COMPESA - Companhia Pernambucana de Saneamento
COPASA - Companhia de Saneamento de Minas Gerais
CORSAN - Companhia Rio-Grandense de Saneamento
COSAMA – Companhia de Saneamento do Amazonas
COSANPA - Companhia de Saneamento do Pará
CVU – Compensation Value Unit
DAE - Departamento de Água e Esgoto
DAEJUNDIAI - DAE S/A Água e Esgoto
DAERP - Departamento de Água e Esgotos de Ribeirão Preto
DEAS - Departamento Estadual de Água e Saneamento
DESO - Companhia de Saneamento de Sergipe
DMAE-MG - Departamento Municipal de Água e Esgotos de Uberlândia
DMAE-RS - Departamento Municipal de Água e Esgoto de Porto Alegre
ECOSAMA - Empresa Concessionária de Saneamento de Mauá
EEP – Energy Efficiency Program
EMBASA - Empresa Baiana de Águas e Saneamento
1. Introduction

The objective of this manual is to offer a practical and useful tool for both public and private managers of water utility and sanitation companies (hereinafter called water utility companies) to develop contracts to reduce both apparent and physical water losses, with the ultimate aim of increased energy efficiency in the water sector. Notwithstanding the technical rigor, the text is simple and the main points are geared mainly to managers. Technical language and legal and economic jargon were deliberately avoided; specific points and technicalities can be found in the sources listed in the references section. It is important to highlight that this manual is applicable outside of Brazil. It is hoped that this work will become a useful tool for managers in other countries, especially in developing ones.

The current situation regarding water loss and energy efficiency for Brazil’s water utility sector is quite problematic. The average water loss in water utility companies in Brazil is approximately 40 percent (including both physical and apparent losses), and in some companies, losses exceed 60 percent\(^1\). Expenditures on electricity represent the main cost of water utility companies after expenditures on labor. As such, water utility companies can do a great deal to enhance their energy efficiency.

The high level of water losses reduces companies’ revenues, and consequently, their ability to obtain financing and invest in improvements. Additional damages are generated to the environment when water utility companies are forced to seek out new springs or water sources to compensate.

The International Finance Corporation (IFC) is supporting the promotion of a performance-based contract with the intention of helping water utility companies improve their operational efficiency levels, and consequently, the quality of the public services rendered.

The manual has seven sections. Section 2 offers a brief description of the current situation regarding Brazil’s water utility companies’ water losses and energy use. Section 3 explains why it is advantageous to use performance contracts as a means to reduce water losses and to foster energy efficiency in water utility companies. Section 4 demonstrates how to conduct a technical evaluation of the water losses and use of energy by water utility operators.

Section 5 prescribes how to carry out an economic-financial feasibility study, enabling water utility operators to verify if the benefits of undertaking a water loss reduction program justify the costs. Section 6 offers details on the legal aspects of a performance contract. Finally, Section 7 presents a brief summary and some conclusions.

\(^1\) According to Gomes (2009), it is not economically feasible to invest in the further reduction of losses when they reach 10 percent (the ideal level). Nevertheless, it should be noted that states such as California, some Nordic cities, and Singapore have losses as low as 2-6 percent.
2. Brief Description of the Water Losses and Energy Efficiency of Brazilian Water Utility Companies

Water losses are quite steep in Brazil and have maintained levels close to 40 percent over the last ten years (Figure 2.1). The level of losses dropped from 39 percent in 2000 to 37 percent in 2009, a marginal reduction. It should be noted that a large number of water utility companies do not measure their water losses in a consistent manner, so the figure should be interpreted with caution. Although there has been a slight downward trend in the last few years, these losses continue to be excessively high. More efficient production and distribution would clearly help to reduce water losses in Brazil.

Compared to various developed countries, the room for improvement in Brazil’s water utilization is even more noteworthy. According to Gomes (2009), cities in Germany and Japan have water losses of 11 percent, while Australia’s loss is about 16 percent. The expectation is that Brazil will be able to reduce its losses and, at the very least, achieve the lower levels associated with developed countries.

Water loss and energy efficiency indicators for water utility companies in Brazil show that there is still a great degree of inefficiency in the production of water and the use of energy. Figure 2.2 and Figure 2.3 demonstrate the levels of losses over billing for the 52 largest Brazilian water utility companies in terms of the population serviced, using SNIS data from 2009. Figure 2.2 shows the losses over billing of a variety of state-owned2 water utility companies in Brazil. COSAMA (State of Amazonas) and SANEPAR (State of Paraná) are the least and the most efficient state-owned companies in terms of water losses in Brazil, with 80.7 percent and 21.2 percent of losses over billing, respectively. The average loss of all state-owned companies is 43.7 percent.

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2 In the group of state-owned companies, there is one private company called Sanatins (Iguaçu Falls in Brazil).
Figure 2.3 shows comparable data for Brazil’s municipal water utility companies. Of these, SAERB (Rio Branco) and SANASA (Campinas) are the least and most efficient in terms of losses over billing, with losses of 76.5 percent and 18.0 percent, respectively. The average loss for Brazilian municipal utilities is 39 percent.

Figure 2.4 and Figure 2.5 show the energy efficiency of the same state-owned and municipal water utility companies. The indicator shown is the kWh/m³ of water produced, or the amount of energy that a specific company uses to produce one cubic meter of water.
Among the state-owned companies, the average energy expenditure to produce a cubic meter of water is 0.71 kWh. DESO (State of Sergipe) and COSAMA (State of Amazonas) are the least and most efficient companies, using 1.28 kWh and 0.39 kWh, respectively, to produce one cubic meter of water.

Among municipal companies, the average energy used to produce one cubic meter of water is 0.83 kWh. SAAE-GUARU (Guarulhos) and SAERB (Río Branco) are the least and most efficient companies, using 2.74 kWh and 0.31 kWh, respectively, to produce one cubic meter of water.

It is important to highlight that energy efficiency is highly dependent on the topographic conditions of the site on which the water distribution installation of the operator is located; therefore, the comparison among water utility companies is subject to some distortion. Because of this, to evaluate the energy efficiency of a specific water utility company, a comparison of its performance over the years should be carried out, rather than comparing the company’s performance to that of other water utility companies.

**Demand for water loss reduction and energy efficiency enhancement services**

If Brazil were to undertake a nationwide effort to reduce water losses and enhance energy efficiency for water utility companies, significant gains could be realized. The following subsection describes the estimated potential gains due to water loss reduction and energy efficiency enhancements under three scenarios, assuming a time horizon to 2025.

The benefits generated by a reduction in water losses in Brazil are estimated for a period of 17 years (2009 up to 2025) (Table 2.1). The base scenario considers a 38 percent decrease in water losses, from 37.4 percent to 23.2 percent. The optimistic and conservative scenarios consider decreases of 50 percent and 25 percent, respectively.

**Table 2.1: Estimated gains associated with three water loss reduction scenarios**

<table>
<thead>
<tr>
<th>Scenario</th>
<th>Losses in 2009</th>
<th>Losses in 2025</th>
<th>Reduction (%)</th>
<th>Potential Gains (Billion R$)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Scenario 1 – Optimistic</td>
<td>37.4%</td>
<td>18.7%</td>
<td>50%</td>
<td>37.27</td>
</tr>
<tr>
<td>Scenario 2 – Base</td>
<td>37.4%</td>
<td>23.2%</td>
<td>38%</td>
<td>29.93</td>
</tr>
<tr>
<td>Scenario 3 – Conservative</td>
<td>37.4%</td>
<td>27.9%</td>
<td>25%</td>
<td>20.91</td>
</tr>
</tbody>
</table>

Under the base scenario, the gross potential gains are estimated to be R$29.93 billion. If it is assumed that 50 percent\(^4\) of that total is reinvested in water loss reduction programs, the net estimated gains for a 38 percent decrease in water loss in Brazil are R$14.97 billion over 17 years, or an average of R$880 million per year. This represents approximately 12 percent of the investment in Brazil’s water and sewage system in 2011 (R$7 billion).

A similar exercise was carried out for energy efficiency enhancements, again with an assumed horizon of 17 years (2009-2025) and three alternative scenarios (Table 2.2). The base scenario considers a program that would achieve a 20 percent decrease in energy expenditures. The optimistic and conservative scenarios consider decreases of 25 percent and 15 percent, respectively.

**Table 2.2: Estimated gains associated with three energy efficiency enhancement scenarios**

<table>
<thead>
<tr>
<th>Scenario</th>
<th>Expenditures in 2009 (Billion R$)</th>
<th>Expenditures in 2025 (Billion R$)</th>
<th>Reduction (%)</th>
<th>Potential Gains (Billion R$)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Scenario 1 – Optimistic</td>
<td>2.20</td>
<td>1.65</td>
<td>25%</td>
<td>6.25</td>
</tr>
<tr>
<td>Scenario 2 – Base</td>
<td>2.20</td>
<td>1.76</td>
<td>20%</td>
<td>4.90</td>
</tr>
<tr>
<td>Scenario 3 – Conservative</td>
<td>2.20</td>
<td>1.87</td>
<td>15%</td>
<td>3.67</td>
</tr>
</tbody>
</table>


Under the base scenario, the gross potential gains are estimated to be R$4.90 billion. It is assumed that 30 percent of this total will be reinvested to implement further energy efficiency programs. The net estimated gain for a 20 percent decrease in the energy expenditures of Brazil’s water utility companies would then be R$3.43 billion over 17 years.

There is therefore a promising path to be tread by Brazilian water utility companies that take actions to increase their operational efficiency. The following sections suggest practical ways to undertake this successfully.

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\(^4\) This percentage is based on the water loss reduction program of SABESP.
3. Advantages of Performance Contracts for Water Utility Operators

The objective of this section is to provide theoretical and empirical references that will form the basis of the selection of performance contracts by both public and private water utility company managers. Performance contracts are established as a useful tool to manage programs associated with water loss reduction and energy efficiency enhancement. Section 3.1 presents a brief review of the international literature on experiences with water loss reduction and energy efficiency enhancement, presenting some models of performance contracts used in other countries. Section 3.2 provides some information on the basic features of traditional contracts versus performance contracts. Section 3.3 offers reasons why Brazilian water utility companies might want to develop performance contracts to implement water loss reduction and energy efficiency enhancement programs.

3.1 Review of International Literature
3.1.1 Literature related to reduction of water losses

One of the main challenges of water utility companies in developing countries is reducing water losses. The initial volume of water made available in the distribution system by water utility operators is mostly wasted during the distribution process (called physical or real water loss). Often, even when water reaches final consumers, water utility companies do not or cannot accurately bill consumers for the actual water consumed. This is called commercial or apparent water loss, which can be due to technical measurement problems or to fraud by consumers (Kingdom, Liemberger and Marin 2006).

In the international literature, losses in revenues (or billing) due to either physical or apparent water losses are called “non-revenue water” or “non-invoiced water”. Table 3.1 shows the various paths through which water can go as soon as it enters the system.

Table 3.1: Distribution of real and apparent water losses as water flows through system

<table>
<thead>
<tr>
<th>Water losses</th>
<th>Authorized and billed volume</th>
<th>Measured invoiced volume (includes exported water)</th>
<th>Unmeasured invoiced consumption (estimated)</th>
<th>Invoiced water</th>
</tr>
</thead>
<tbody>
<tr>
<td>Water entering the system (includes imported water)</td>
<td>Authorized consumption</td>
<td>Non-billed authorized consumption</td>
<td>Non-billed authorized consumption (uses per se, water tank trucks, etc.)</td>
<td>Non-billed water or Non-Revenue Water (NRW)</td>
</tr>
<tr>
<td>Apparent losses</td>
<td></td>
<td></td>
<td>Non-measured non-billed consumption (firefighting, slums, etc.)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Non-authorized use (fraud and registry failures)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Measurement errors (macro- and micro-measurement)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Real losses in raw water piping and in treatment (whenever applicable)</td>
<td></td>
</tr>
<tr>
<td>Real losses</td>
<td></td>
<td></td>
<td>Leaks in pipelines and/or distribution networks</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Leaks and spillovers in pipeline reservoirs and/or distribution</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Leaks in branch lines (upstream from the point of measurement)</td>
<td></td>
</tr>
</tbody>
</table>

Source: Public Private Infrastructure Advisory Facility (free translation).
The World Bank’s database on International Benchmarking Network for Water and Sanitation Utilities (IBNET) estimated the performance of water utility operators globally. Of the operators studied by IBNET, the average water loss was estimated to be 35 percent. As large developing countries were not included in the IBNET study, and as the statistics of such countries are generally not reliable,\(^5\) it is likely that water losses in developing countries are closer to 40-50 percent.

![Figure 3.1: Water loss scenario among water utility operators](source: IBNET)

It is not expected that all physical and commercial water losses will be eliminated, as this is neither economically nor financially feasible. Nonetheless, due to the significant water losses in developing countries, it is reasonable to expect that water losses in these countries could be reduced by half. Water loss reduction programs should always consider the tradeoffs between the value generated by the water volume saved (the water not lost) and the value of the investment needed to achieve the loss reduction, not only in infrastructure but also in the variable costs of commercial management and operations. At a certain point, when water losses are extremely low, the cost of additional loss reduction becomes ever higher, while the savings generated through investments become progressively lower.\(^6\)

Traditional approaches to reducing the physical loss of water in developing countries typically consist of awarding technical assistance contracts and outsourcing various parts of the water loss reduction project. Such approaches are presented in more detail below.

Technical assistance contracts are used to hire specialized private consulting companies that develop strategic projects geared to reducing water losses. These consulting companies merely structure a project that is carried out with the water utility company’s budget earmarked for this purpose, and work with the pre-existing personnel already hired by the water utility company.

This approach has some drawbacks. The main one is due to the fact that the compensation of the consulting company is fixed and not tied to the success of the water loss reduction program. Additionally, many water utility companies lack the technical knowledge to implement the water loss reduction programs designed, thus reducing the usefulness of the contracted technical assistance.

The literature also points to water utility companies’ lack of budgetary flexibility to cover large costs associated with water loss reduction programs. This is crucial, given the need to accurately estimate the cost of all actions required to identify a specific problem and finance the actions to achieve loss reduction.

Outsourcing some of the services in water loss reduction projects is appropriate for some field activities, such as detecting leaks in the water distribution system, changing water meters, updating registries of end consumers, and identifying fraud. Outsourcing presents some advantages compared to technical assistance contracts, such as lower costs for rendering the service through a tender process, greater flexibility for work at night, and greater flexibility in capturing additional resources.

\(^5\) The percentage of water losses among utility operators in developing countries cannot be estimated in a reliable fashion. Many operators do not have information systems and adequate control to infer this data, and even if they are able to measure the percentage of water loss, they decide not to disseminate the figure because it is very high. Companies that do divulge this information generally are the ones that have lower water loss rates.

\(^6\) The literature finds that in the case of commercial losses, programs for the reduction of commercial water losses are financially attractive, as they generate a speedy financial return. However, programs for the reduction of physical water losses are financially attractive at the beginning of their execution, especially in developing countries that have high levels of water loss. Nevertheless, after a significant reduction in water loss, investments in programs geared to the reduction of physical water loss cease to be attractive. This can be explained through the law of decreasing returns, which suggests that the more we invest, the lower the additional return on each unit of investment compared to the previous one. In the case of water loss, if a worker is sent to look for leaks in the distribution network, this person will find, say, ten pipes with leaks per day. The law of decreasing returns implies that if five workers are sent to look for leaks, they will not find 50 leaky pipes, as might be expected, but will find a number lower than 50. This happens because the workers will likely look for leaks in the same places as their colleagues, thus decreasing the efficiency of the search.
The traditional approaches are largely aimed at reducing physical water loss. Regarding commercial water loss, water operators tend to reserve for themselves all stages of the water bill collection procedure, as well as the maintenance of hydrometers.

As a counterpoint to the traditional approach, the literature unanimously sets forth the model of the performance contract for dealing with physical and commercial water loss. As opposed to the traditional approach, all of the activities relating to the reduction of water losses are transferred to a private partner under a performance contract. The essence of performance contracts is that the private agent is not compensated merely for delivering services, as would happen in outsourcing, but also for complying with the water reduction goals set forth in the contract.

The performance contract is based on the idea of compensating the private sector for the delivery of results, not only for executing a series of tasks. To compensate for the risks undertaken, the private agent is granted the necessary flexibility to carry out the tasks in accordance with what the agent deems best, based on its experience in that field.

The practical application of performance contracts depends on the level of risk the private agent is willing to accept, which is linked indirectly to the political-economic situation of the country, the specific conditions of the water utility company, and the peculiarities or specificities of each contract.

### 3.1.2 Literature related to energy efficiency

According to Geller (1991), actions to enhance energy efficiency in water utility companies generate several benefits. First, increasing efficiency decreases costs, as it is cheaper to save and redistribute energy than to invest in producing more. Normally, investments in building generation plants and distribution and transmission lines are more expensive than simply investing in efficiency improvements. Second, greater energy efficiency reduces demand and the risk of scarcity without hampering the development of economic activity. Third, an increase in efficiency in the energy sector can help industries and Brazilian products become more competitive. Products like aluminum and steel alloys use a great deal of energy in their production; as such, greater efficiency in the use of energy may signify a considerable cost reduction.

Finally, Geller (1991) argues that reducing energy consumption via energy efficiency enhancement programs results in lower environmental and social impacts relative to those incurred when energy production is expanded.

In water utility companies, the issue of energy use is not trivial. According to Gomes (2009):

> “Losses in energy are not less significant and they take place principally in the pumping stations of the water distribution systems and those of sanitary sewage. These are losses that happen, mainly because of the low efficiency of electro-mechanic equipment, due to inadequate operational procedures or due to a flaw in the conception of projects.”

Given this, Energy Service Companies – known as ESCOs – play an important role in the reduction of water utility companies’ costs. ESCOs are private companies that render energy conservation services, receiving their compensation primarily through performance contracts.

According to Stoner (2003), there are benefits to carrying out energy efficiency enhancement projects based on performance contracts. Energy performance contracts offer greater credibility to consumers and more comfort to those who fund the project. This is because the ESCOs, specialized in this type of project, are motivated to honor the deadlines and the objectives of the performance contract or they will not be compensated.

According to the Manual for Development of Municipal Energy Efficiency Projects (MDMEEP), developed for the Indian market, a performance contract should contain not only the legal provisions but also the regulatory specificities to which each of the parties are subject, the conditions for the rescission of the contract, and the establishment of parameters for eventual indemnities, among other provisions (IFC 2007).

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7 This happens because the performance contracts guarantees an adequate cash flow for the project; provides the necessary calculations to verify the feasibility of the project; and guarantees that investments will be geared to comply with their true purpose and not to alternative ends.
At present, energy efficiency enhancement projects are largely funded by public benefit charge (benefit funds). These funds have been used in several countries after their institutional reforms, with the aim of fostering public-private partnerships, beginning in the 1990s. A public benefit charge collects resources to support energy efficiency enhancement projects. In Brazil, the Energy Efficiency Program (EEP) coordinated by the National Agency on Electrical Energy operates like a public benefit charge. Nevertheless, the literature finds that there are several obstacles to the appropriation by independent ESCOs of the financial resources granted by public benefit charges. Considering this, there is still a great deal to be done to ensure that adequate funding levels are maintained in commercial banks and that investors can be reached.

According to the MDMEEP and Stoner (2003), there are two basic models for energy performance contracts:

1. Guaranteed Savings Model – the loan goes to the water utility company’s balance sheet. In this model, the ESCO assembles and implements the project for the water utility company, which pays the ESCO compensation. The water utility company pays this compensation using the financing obtained. Figure 3.2 presents a scheme of this model.

![Figure 3.2: Guaranteed savings model](source: Stoner 2003)

2. Shared Savings Model – the financing goes to the ESCO’s balance sheet. The difference from the previous model is that the bank’s interaction is with the ESCO, not the water utility company. The ESCO helps finance the project and receives compensation for the energy saved; i.e., for the effectiveness of its services. Figure 3.3 shows how this model works.

![Figure 3.3: Shared savings model](source: Stoner 2003)
Table 3.2 provides a comparison of the two models:

**Table 3.2: Comparison between guaranteed savings and shared savings models**

<table>
<thead>
<tr>
<th>Guaranteed savings model</th>
<th>Shared savings model</th>
</tr>
</thead>
<tbody>
<tr>
<td>ESCO takes on the risk for modeling and performance</td>
<td>ESCO takes on the leveraging, modeling, and performance risks</td>
</tr>
<tr>
<td>Operator takes on the leveraging risk</td>
<td>Normally out of the operator’s balance</td>
</tr>
<tr>
<td>Performance based on the energy saved</td>
<td>Performance based on the cost of the energy saved</td>
</tr>
</tbody>
</table>

**3.2 Why Hold Performance Contracts in Brazil?**

Brazil’s water utility companies are not accustomed to using performance contracts for water loss reduction or energy efficiency enhancement programs. However, while performance contracts are not a panacea, they could be an effective tool for overcoming specific barriers commonly faced by these companies.

Very generally, it is possible to group these barriers and solutions into four topics: (i) financing capacity; (ii) technical knowledge of how to structure programs; (iii) reduced transaction costs; and (iv) increased positive incentives for the private contracted party.

**3.2.1 Financing capacity**

Water utility companies’ limited capacity to access finance is one of the main problems associated with the low investment in the Brazilian sanitation sector. This limitation is due to the precarious economic-financial conditions that characterize water utility companies, who self-report low operational and management efficiency. High operational costs and limited capacity to generate revenues diminish water utility companies’ ability to obtain the financial resources necessary for investment and operational improvements (such as water loss reduction programs). This vicious cycle is depicted in Figure 3.4.

![Figure 3.4: Vicious cycle in the management of water utility companies](source: GO Associados)
A survey by the Investment Fund of the FGTS (Guarantee Fund for Time of Service) indicates that of the 26 state-operated water utility companies in Brazil, only seven have the necessary conditions to obtain financing.8

Performance contracts could represent an important solution to the limited capacity of water utility companies to leverage resources. In a performance contract, the contracting party (i.e., the water utility company) can considerably reduce its contribution of financial resources (or even not invest at all) to a water loss reduction or energy efficiency enhancement program.

As already noted, the contracted party (i.e., the ESCO) must make all of the investments and render the necessary services (for example, change pumps and water meters, policy for water cuts) before receiving any payment from the contracting party. As opposed to a traditional contract, with a performance contract, there is an obligation for the contracting party to pay the contracted party for finishing the stages of a specific previously established physical-financial plan, the compliance of which is assessed by means of results measurements. Payments are made with the additional resources generated through the reduction of water losses or through a decrease in energy expenditures (based on the increase in billing achieved). Thus there is no need for indebtedness on the part of water utility operators to finance interventions in water loss reduction.

3.2.2 Technical knowledge to structure programs

Another difficulty associated with the reduction of water loss and energy efficiency enhancement is the technical capacity of water utility companies to plan and structure a global and integrated water loss reduction project. That is, the reduction of physical and/or apparent water losses entails a series of activities that need to be developed in an integrated manner, but these may not be known to water utility companies. For example, it is common for water utility companies to implement hydrometer substitution programs (reducing commercial losses), but not to invest in the renewal of the water distribution networks, which may have high physical losses. Energy efficiency enhancements often suffer the same problem: specific equipment is replaced, but structured and systematic actions for operational improvement are not undertaken.

One reason for this is that specific sections or departments within a company are often not responsible for the implementation of a water loss reduction and or an energy efficiency enhancement program. Actions to reduce losses involve a variety of departments within a water utility company (e.g., procurement, works, maintenance, accounts, and marketing, among others). The absence of a unit focused on structuring and following up the water loss reduction and energy efficiency enhancement program scatters and disperses efforts and leads to a lack of coordination.

This is also reflected in the budgeting. If there is no budget specifically dedicated to all of the actions needed to implement a water loss reduction and energy efficiency enhancement program, then due to lack of resources, not all of the actions needed for the success of the program will be implemented. This lack of central coordination can be explained by the lack of technical training of water utility companies in how to structure an adequate program for water loss reduction or energy efficiency enhancement. There is a paucity of technical knowledge regarding how to set up basic projects, structure calls for bids, price services, and define the best technical and technological solutions.

The performance contract, through a single instrument, makes it possible to allocate the responsibility for planning and executing all actions needed to enhance operational efficiency to a private contracted party. The water utility operator does not need to specify every step of the intervention in the performance contract; in fact, doing so could actually reduce cost-effectiveness. The performance contract provides a built-in incentive for the private contracted party to use the most cost-effective technology by tying the provider’s compensation to achievement of a specific result rather than simple fulfillment of a series of tasks.

This transfer of risks relating to the design and implementation of water loss reduction and energy efficiency enhancement programs allows operators with less capacity and knowledge to still implement such programs and, based on the interaction with the private contracted party, to absorb the knowledge and know-how regarding the implementation.

8 Available at: http://www.fgts.gov.br/trabalhador/fi_fgts.asp
3.2.3 Reduced transaction costs

As mentioned in the previous subsection, performance contracts are designed to cover a series of actions which many times are contracted independently. Disaggregated or piecemeal contracting substantially increases transaction costs, especially for public companies or autarchies.

Public agencies are obliged to conduct a request for bids before contracting out works or services. This process is lengthy and often more costly than private procurement or hiring. Managers are forced to negotiate and monitor a diversity of contracts with different deadlines, commercial conditions, and players that need to be coordinated to attain the desired results. Thus, coordination of a series of contracts with different validity dates and different service providers is highly complex, incurring significant managerial costs and supervision.

In contrast, in performance contracts, the private contracted party is responsible for all of the actions needed to fulfill a specific goal for water loss reduction or energy efficiency enhancement. The water utility company interacts exclusively with a service provider, demanding from the latter that specific and measureable goals be attained.

3.2.4 Increasing positive incentives for private contractors

The fourth advantage of performance contracts refers to the positive incentives provided to the private contracted party to carry out services in the most efficient and cost-effective manner. As the private contracted party is paid only upon the attainment of results from the implementation of activities set forth in the contract, incentives are provided so that his interventions are efficient and generate the best possible outcomes.

When a contracted party is paid based only on the execution of a number of works and services rather than on the results of these interventions, there is little incentive for him to invest in more efficient operational solutions. In practice, the contracted party strictly complies with specifications provided by the water utility company; after finishing his service and receiving his payment, he is no longer interested in whether his interventions generated effective benefits to the water utility company. In other words, the performance contract produces incentives for the contracted party to attain operational improvements because only then will he be paid.

Box 3.1: Key Concepts and Discussion Points for Chapter 3

Key concepts:
- Performance contracts
- Physical water loss
- Commercial water loss
- Financing capacities

Points for discussion:
1. What are the main advantages of using performance contracts to reduce water losses over the traditional approach of outsourcing and service contracts?
2. What are the benefits of increased efficiency of water utilities?
3. What are the main characteristics of the three models of performance contracts to increase energy efficiency?
4. Technical Aspects: Defining the Scope of the Intervention and the Baseline

This section addresses the technical aspects of water loss reduction and energy efficiency enhancement programs. Subsection 4.1 outlines how to obtain data to carry out the baseline. Subsection 4.2 focuses on defining the project area. Subsection 4.3 describes the necessary information needed to create the project model. Subsection 4.4 presents criteria that can be used to define the baseline. Finally, subsection 4.5 identifies the minimum scope of work that should be included in the performance contract and conducted by the contracted party.

4.1 Obtaining Data for the Baseline

To be successful, development of a water loss reduction or energy efficiency enhancement program must be based on a reliable information source. The availability and reliability of information is essential for performance contracts, because the private contracted party’s compensation will be based on it. In Brazil, few water utility companies currently have reliable information with which to create a baseline. A company cannot determine if a cost reduction program has succeeded if its expenses before the beginning of the program are unknown. Likewise, it is not possible to develop a water loss reduction or energy efficiency enhancement program without information on the volume of water lost (or the volume not billed) or the baseline amount of energy consumed.

Thus, before implementing a water loss reduction or energy efficiency enhancement program, it is essential to obtain data regarding: the macro and micro measured water volume; the volume of water loss; the amount billed; the amount collected; the amount of energy consumed; and the amount paid for energy, among others. The baseline should be calculated so as to enable measurement of the rates of both apparent and physical losses, as well as the real cost of electric power. If these data are not available, an audit in the intervention area should be conducted to calculate the following: the volume of water lost or not billed, the actual billed volume, the actual collections, and the amount paid for energy. The outcome of this diagnosis is called the “water balance.” (see also Figure 3.2).

A detailed water balance diagnosis may require a reasonable period of time to be carried out, as well as significant investments. Operators with low-quality controls will certainly need a very detailed water balance and verification of the information collected. Under those circumstances, it is essential to choose between either initially investing in a more detailed water balance or defining the performance contract’s baseline based upon the most reliable data available.

A detailed water balance diagnosis enables a company to define its baseline on several criteria (e.g., macro or micro measured volume; billing volume; or input consumption, among others). In certain situations, it may be convenient to develop a performance contract (even if it is for a smaller area) with the available information so as to be able to demonstrate the model’s advantages and to begin to eliminate losses and inefficiencies as quickly as possible. The first performance contract may even include an obligation by the contracted party to provide a consistent water balance after a certain period of time.
4.2 Establishing the Intervention Area

The first and likely most important stage in preparing a successful performance contract is defining the project coverage area. Criteria that may help to define the intervention area include:

(a) High rates of losses: The first and most obvious criterion is the level of losses (physical or commercial). Although accurate data are not always available regarding the level of losses in a certain area, it is essential to prioritize those areas with the highest loss levels. It will be more attractive for the private sector to contract work in areas with the greatest reduction potential; this will generate further efficiencies and/or increase billing for the water utility company as well.

(b) Water isolation: One of the main objectives of a water loss reduction program is to increase the available water volume, so it is essential to be able to measure this increase effectively. Areas with greater water isolation should be prioritized or selected over areas with less water isolation (see Box 4.1).

(c) Socio-economic characteristics: It is essential that the chosen area has socioeconomic characteristics representing all other areas operated by the contractor. This representativeness will enable a proper verification of the effectiveness of water loss reduction actions in the system as a whole.

(d) Number of connections: An area with at least 10,000 connections is recommended. Water loss reduction programs require teams and skilled labor, and the transaction costs associated with performance-based projects do not justify projects with less than 10,000 connections; the private sector will usually not mobilize teams and resources to undertake smaller projects. As the main private companies that provide water loss reduction services are located in the Southeast of Brazil, training and displacement of teams to other regions are only justified in larger projects of longer duration.

(e) High production costs, the system distribution or expansion: One of the major advantages of a water loss reduction program is the possibility of postponing investments to expand water production. Therefore, it is advisable to develop water loss reduction programs in systems that are already running at maximum water production capacity and have high levels of losses.

(f) High distribution cost: An aggressive loss reduction program may help to reduce high distribution costs, as well as enhance revenues to offset these costs. Thus areas with high distribution costs should be selected over those with lower costs.

(g) Economies of scale: A water loss reduction program that covers a whole municipality (or more specifically a full supply system) is an interesting alternative for a water loss reduction program because it implies economies of scale and lowers the risk of system isolation. Thus, those areas with greater potential for economies of scale should be prioritized over those with less potential. Similarly, the possibility of using the project as an example to be multiplied in other company departments should be considered. Thus, areas that have the potential to influence the company’s water loss reduction as a whole should be preferred to those with more limited influence.
Defining the scope of an energy efficiency enhancement project performance contract

It is usually less complex to determine the baseline for performance contracts that involve only energy efficiency enhancement in water utility companies; the baseline is based on the average energy consumption of the facilities to be improved. Such facilities include: lift stations, water treatment stations, sewerage treatment stations, administrative buildings, and other similar facilities. Normally, the average energy consumption for the last 12 months is calculated in facilities that underwent improvements, and the contracted party’s compensation is calculated based on the savings obtained through energy consumption reduction in those facilities.

To prevent distortions, it is sometimes advisable that the baseline is bound to a rate improvement. For instance, if a water treatment station undergoes an intervention that results in the station treating a higher water volume (resulting in higher energy consumption), this fact must be taken into account to prevent the private contracted party from being penalized. That is, while the unit cost of treatment drops, the absolute level of water treated increases, possibly masking the greater energy efficiency achieved. In this scenario, the ideal baseline would be measured, for instance, by the kilowatts used per cubic meter of water treated.
4.3 What Data Should be Collected to Design the Project and Establish a Performance Contract?

To properly model the technical and financial aspects of a proposed project and to carry out an economic-financial assessment (see Section 5 for more detail), it is essential to collect the basic information that will be used to estimate both the investment and operational costs of the private contracted party, as well as to determine the best size for the project. As already mentioned, information quality and reliability are more important than quantity.

The following information on the selected project area must be available. Data should refer to the last 12 months at a minimum. Information should be obtained directly from the water utility company. Three types of data should be collected:

(i) Commercial system data:
- Number of connections per category
- Amount of savings per category
- Number of active, inactive, and feasible connections and the associated amount of savings
- Monthly billing volume
- Monthly collection volume
- Debt portfolio by category
- Micro measured monthly water consumption per category, and if possible, stratification by consumption range
- Debt portfolio by category, stratified by debt age, if possible
- Number of connections with and without water meters
- Water meter distribution profile by age and capacity, if possible
- Commercial system used
- Pricing rule and present tariffs
- Procedures for reading meters and issuing bills

(ii) Operational data: Some operational data are indispensable for setting up a performance contract. Other data, if available, may greatly aid the project design while not being indispensable.

(a) Fundamental information:
- System sketch with a topographical map
- Delimitation of the geographic area covered by the project
- List of the existing operational units in the area covered by the project, their location and technical information, and in particular their capacities (water abstraction, lift stations, treatment stations, reservoirs, boosters, wells, flow meters and pressure reducing valves)
- Electricity bills of each of these operational units from the last 12 months, if possible, and of the last three months at a minimum
- Documentation of complaints of lack of water, and/or existence of areas with flashing or rotating supply

(b) Important information (not indispensable):
- Cadastral plan with contour lines of the project area
- Documentation of the history of leaks
- Network extension
- A profile of the distribution of branches by type (PEAD, PVC, galvanized)
- Macro measured volumes of the last 12 months

(iii) Energy efficiency data: For energy efficiency enhancements, the necessary data refers mainly to energy consumption by each facility undergoing improvement, preferably from the last 12 months.
4.4 What Criteria Are Used to Define the Baseline?

Definition of the baseline is one of the major challenges for specifying and evaluating a project’s performance. The baseline is a parameter or set of parameters that will be used to measure the results obtained under the performance contract. If the baseline is not properly determined, contract risks will increase: the contracting party may pay compensation but not obtain the expected outcomes, or the private contracted company may not receive adequate compensation if the parameters used to determine the baseline are not reliable.

4.4.1 Factors that may impact the baseline’s accuracy

When setting the baseline, it is essential to take into consideration the several variables that can interfere with the criteria used to establish the contracted party’s compensation. Certain goals and objectives can only be achieved if the initial technical assumptions are maintained. In addition to setting the base to calculate compensation, it is fundamental to identify the factors that could eventually interfere with this base.

If the base for measuring performance is the volume of additional water available, it is important to clarify in the performance contract that a specific target volume available will only be reached if the initial pressure conditions of the system do not experience large changes. For instance, if a public notice announcing the commissioning of a new water production system will significantly increase the distribution system pressure, it is important that the baseline setting considers this change by taking into account any losses generated by this increased pressure.

Likewise, in energy efficiency enhancement projects, it is important that the baseline enables managers to take account of eventual energy consumption increases related to, for instance, increased water pumped by a certain lift station or more sewerage treated by a sewerage treatment station.

4.4.2 Alternatives to defining the baseline

As there are different ways to measure the results of the services defined in a performance contract, the compensation for services can consequently be defined differently as well. The criterion used should be easily audited by the contracting party, by the private contracted party, or by third parties. Often, the lack of data or inaccurate data prevent the adoption of certain criteria normally recommended by the international literature (such as the available water volume). Given this, four alternatives are assessed:

(i) Volume saved baseline

Regarding contracts for water loss reduction, whose aim is to decrease physical losses, an alternative is to define a compensation value unit for every m³ effectively saved. Generically, compensation will be expressed as follows:

\[ \text{Compensation value unit (CVU)} = \text{Volume saved (m}^3\text{)} \times \text{Compensation per m}^3 \text{ (R$)} \]

The volume saved can be calculated in two steps. First, the total volume of the system’s physical loss is calculated as: (i) the macro measured volume at the entrance of the area set forth in the performance contract (for instance, water volume measured at the outlet of a certain reservoir) less (ii) the micro measured volume of each consumer. Second, volume saved is calculated as the difference between the monthly average volume lost over a certain period (for instance, 12 months) before the beginning of the performance contract and the monthly volume lost after the performance contract begins.

Under this alternative method, it is essential that both the micro and macro measurements of the area under intervention are reliable, that there is compatibility between the commercial and operational data, and that the system is guaranteed to be without leaks. If these conditions are met, the volume saved baseline is a reliable criterion. This method can be used to handle seasonal effects (with enough data over the long run).
(ii) Operational cost reduction baseline
Operational cost reduction is the most commonly used baseline in energy efficiency enhancement programs. Nevertheless, it can also be used for physical water loss reduction programs, particularly when there is a lack of reliable data to calculate a baseline based on volume saved.

Reduction of energy or chemical products consumption takes place when volume consumption drops, as volume production drops consequently, too. This is clearly not the best alternative method for calculating the baseline; however, when there is a lack of reliable data, energy and chemical products consumption may be an interesting substitute for establishing the baseline, as most companies keep reliable records of these costs (e.g., energy bills and the volume of chemical products used).

(iii) Collection and billing baseline
In apparent water loss reduction programs, the use of collection and billing data is the most common method for establishing the baseline. Unlike the volume saved method, collection and billing data are relatively reliable, as they are recorded by bank deposits and the issuance of water bills.

Events that could distort the program’s collection and billing outcomes should be identified early on. For instance, if an area is being developed as a tourist site, an increase in water consumption in the tourist season should be expected. The revenue growth associated with this must also be anticipated and taken into account. Likewise, eventual tariff increases, mismatching of bills between a water utility company and the state or municipal government, or collective mobilization to decrease delinquency must be identified and stipulated in the performance contract to ensure that the private company does not benefit from collection level changes associated with events outside of its control.

(iv) A combination approach
Even if it is possible to allocate the total volume of losses between real and apparent losses, actions to reduce one component have a direct impact on the other component, so it is recommended that both components be addressed. In those situations, billing growth in connection with volume saved are two important criteria for establishing the baseline. However, when volume data are not reliable, billing growth can be used along with operational cost reduction. The data for these two criteria are normally reliable; if they are applied together, it is feasible to assess both apparent and physical water loss reduction.

As for measuring the baseline for physical water losses, an interesting combination is to use both the volume saved and operational cost reduction methods. This double baseline encourages the contracted party to use more efficient technical solutions to reduce losses from an operational standpoint, because in addition to reducing physical losses, the contracted party will be paid based on the reduction in energy consumption. Use of the volume saved method exclusively can discourage the contracted party from looking for efficient solutions in terms of reduced energy and input consumption.

4.5 Minimum Scope
Finally, an important technical aspect to consider in the performance contract is inclusion of a minimum scope of work to be carried out by the contracted party. For instance, the performance contract may represent an opportunity to modernize certain facilities that have an impact on water loss levels.

The performance contract may have a list of interventions that are mandatory for the contracted party to carry out, even if they will not have an impact on water loss reduction. One example is to include an obligation to upgrade the billing and collection systems with complete online access and the capacity to produce reports and process other data essential to monitoring the system. Other examples can encompass reforms of reservoirs or other facilities linked to water loss reduction or energy efficiency enhancement programs.
Box 4.2: Key Concepts and Discussion Points for Chapter 4

Key concepts:
- Defining the baseline
- Collection of data
- Calculating the water balance
- Water isolation
- Socio-economic characteristics
- Number of connections

Points for discussion:
1. How important is it to have a well-defined baseline? What are the alternatives for defining the baseline?
2. Which criteria must be applied to define the coverage area of a water loss reduction project?
3. What information is needed to be able to model the project and carry out an economic-financial assessment?
5. Economic Aspects: Parameters for an Economic-Financial Feasibility Study

The objective of this section is to provide a simple script for an economic-financial assessment of a water loss reduction or energy efficiency enhancement project. The economic-financial assessment can be done using a discounted cash flow model, as is done in other similar analyses. Subsection 5.1 presents an overview of some frequently used financial concepts. Subsection 5.2 shows how a discounted cash flow model can be used to inform the design of a performance contract. Subsection 5.3 compares the basic features of performance contracts to traditional contracts, while subsection 5.4 indicates the basic aspects of carrying out an economic-financial assessment for a performance contract.

5.1 Review of Financial Concepts

5.1.1 Discounted cash flow model

A discounted cash flow model is a method used to assess projects, companies, or assets. Cash flow refers to the projection of a company's: (i) revenues; (ii) operational costs; and (iii) investments. The cash flow comprises accounts receivable (positive amounts or cash inflows) and accounts payable (negative amounts or cash outflow). In a typical project, the first years are characterized by larger cash outflows than cash inflows due to large upfront investments. In the later years, cash inflows are typically larger than cash outflows.

To conduct a discounted cash flow assessment, all of the future cash flows – both positive and negative – are estimated and then updated to present values based on the interest rates that represent the value of money over time. The following variables are used in the subsequent discussion:

\[ FC_t = \text{net cash flow in period } t \]
\[ R_t = \text{gross revenue in period } t \]
\[ C_t = \text{cost in period } t \]
\[ I_t = \text{investment in period } t \]
\[ T_t = \text{tax in period } t \]
\[ r = \text{discount or required rate of return} \]
\[ T = \text{period in which project ends} \]

5.1.2 Net present value

A project’s net present value (NPV) is the sum of the present values of the cash flows from each year of the project’s life, both positive and negative (Damodaran 2004). NPV represents the sum of updated cash flows minus any initial investment.

The discount rate used should be compatible with the opportunity cost of capital. To be attractive to an investor, the NPV should be at least zero. An NPV of zero is a necessary condition for minimum and proper compensation for the investor’s opportunity cost of capital. NPV is calculated as follows:

\[ NPV = \sum_{t=0}^{T} \frac{FC_t}{(1+r)^t} \]
This formula enables the comparison of values over different moments in time. When NPV = 0, r is called the internal rate of return (IRR).

### 5.1.3 Internal rate of return

A project's IRR is the discount rate which makes the project's NPV equal to zero. (Damodaran 2004). Altogether, the IRR can be defined as the interest rate that makes two sets of capital (cash inflow and cash outflow) have the same NPV (Gittman 1997). Mathematically, the IRR can be written as the rate that sets the cash flows’ NPV equation equal to zero.

\[
NPV = 0 = \sum_{t=0}^{T} \frac{FC_t}{(1+IRR)^t}
\]

IRR is the compounded, effective, and annualized return rate that indicates the project's profitability. If two projects have the same initial investment but two different IRRs, the project with the higher IRR is the more profitable of the two.

### 5.1.4 Payback term

The discounted cash flow assessment uses negative inflows (investments, costs, and expenditures) and positive inflows (revenues). The time it takes for the sum of negative inflows to equal the sum of positive inflows is called payback (or the recovery period). Payback is expressed in number of periods (usually months or years) and can be calculated based on nominal values or on cash flows discounted to the present value.

A project's payback measures how fast cash flows generated by that project cover the initial investment. Projects that cover their investments earlier can be considered more attractive, all else equal (Damodaran 2004). In principle, the lower the payback, the more attractive the project.

Payback is expressed mathematically as follows:

\[
Payback = \sum_{t=1}^{T} \frac{FC_t}{(1+r)^t}
\]

According to a study carried out by Kingdom, Liemberger and Marin (2006), most activities to reduce commercial water losses, such as changing water meters and updating consumers’ cadastre, have a short payback. These activities require low investments and generate profits quickly for water utility companies. However, conditions are more complex when it comes to activities to reduce physical water losses, as the investments required are higher and involve, at least partly, investment in long-term assets.

The payback for physical water loss reduction depends directly on the unit cost of water that ceases to be lost per cubic meter a day and the present water cost. Furthermore, according to Kingdom, Liemberger and Marin (2006), in developing countries, which have high levels of losses and a low cost of water saved, payback takes approximately four to eight years, which makes investments on physical water loss prevention less attractive.
5.1.5 Comparison among the three financial indicators

Deciding whether or not to invest in a certain project or whether to invest in project A or project B involves an assessment of the returns of each project. The three economic indicators presented in this section – NPV, IRR, and payback – are tools that can be used to help make this kind of decision. While decision making regarding investments also involves several other elements that transcend this manual’s scope, the concepts reviewed in this section can still help managers assess performance contracts to reduce water losses and increase energy efficiency. But a careful look is necessary, because each indicator has both advantages and disadvantages.

By and large, the NPV is the most complete measurement for assessing investments. Table 5.1 compares the three indicators based on two parameters: (i) whether the indicator works in all kinds of projects; and (ii) whether the indicator can be used to compare two projects from the standpoint of maximizing the company's value.

Table 5.1: Comparison of rules for decision making on investments

<table>
<thead>
<tr>
<th>Economic and financial indicators</th>
<th>NPV</th>
<th>IRR</th>
<th>Payback</th>
</tr>
</thead>
<tbody>
<tr>
<td>Works in all kinds of projects</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td></td>
<td></td>
<td>It requires, at least, an indication of change of the cash flow.</td>
<td>It only works with projects where there is an initial period of investment, followed by positive cash flows.</td>
</tr>
<tr>
<td>Maximizes the company's value</td>
<td>Yes</td>
<td>Yes, when comparing projects</td>
<td>Not necessarily</td>
</tr>
<tr>
<td></td>
<td>However, requires that company has access to capital to invest.</td>
<td>Nevertheless, there are projects which do not have an IRR or have more than one IRR. In these cases, comparison is not possible.</td>
<td>By and large, it takes into account the project period only, in which investments are covered. Benefits can be greater if possible postponements of investments are considered.</td>
</tr>
</tbody>
</table>

Source: Damodaran 2004.

5.2 Cash Flow Assessment Applied to Performance Contracts

The discounted cash flow assessment can be used to inform performance contracts to reduce water losses or increase energy efficiency. Cash flow is the base, using estimates of: (i) revenues; (ii) operational costs; and (iii) investments. In this case, there is a peculiarity: the contracted party's compensation is calculated based on gains obtained over the contract, measured by energy efficiency gains (e.g., a reduction of energy costs) or loss reduction (e.g., reduction of material costs, or a billing increase, among others).

5.2.1 Costs and benefits involved in water loss reduction and energy efficiency enhancement contracts

Estimation of a project's cash flow depends on identifying all of the costs and revenues involved. These data will enable an economic assessment of the project.
Costs and benefits of water loss reduction projects

Economic analysis of water loss reduction projects requires evaluating involved costs. Costs may be distinguished as fixed costs, which occur during the specific implementation period, and variable costs, which occur over the whole project.

The costs of water loss reduction projects can include:

- Equipment and facilities (pipelines, valves, pumps, motors, accessories, connection parts, control and automation elements, electric power equipment, and substations);
- Civil works (structuring of capture, pump houses, digging, and pipeline fitting); and
- Indirect costs (includes project expenditures, management and work inspection, and consultancy services, among others).

The life cycle of the assets involved is another important aspect. Physical equipment usually has a life cycle over which its efficiency drops. When a water loss reduction or energy efficiency enhancement project is being prepared, it is essential to know the useful life span of each asset. For instance, consider a 10-year water loss reduction project, in which a change of water meters is one of the planned actions. As water meters have a five-year life cycle, the project must plan on at least two complete changes of the water meters. Table 5.2 suggests the life cycles of some equipment typically used in water loss reduction projects.

Table 5.2: Life cycle of assets in water loss reduction projects

<table>
<thead>
<tr>
<th>Material and Equipment</th>
<th>Average years of life</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cleaning or coating of pipelines</td>
<td>3</td>
</tr>
<tr>
<td>Drive and inverters</td>
<td>5</td>
</tr>
<tr>
<td>Water meters</td>
<td>5</td>
</tr>
<tr>
<td>Motors</td>
<td>10</td>
</tr>
<tr>
<td>Pumps</td>
<td>10</td>
</tr>
<tr>
<td>Valves</td>
<td>10</td>
</tr>
<tr>
<td>Automation</td>
<td>10</td>
</tr>
<tr>
<td>Pipelines</td>
<td>30</td>
</tr>
<tr>
<td>Reservoirs</td>
<td>30</td>
</tr>
</tbody>
</table>

A water loss reduction project may have various benefits. By reducing physical water losses, the company can produce less water to supply the same number of people. By producing less water, the water utility company reduces expenditures on several items, such as:

- Chemical products
- Electric power
- Purchase of raw water (when they pay for the use of water)
- Labor
- Other inputs

By reducing apparent water losses resulting from illegal connections, consumption not billed, lack of water meters, or measurement issues, among others, the main outcome is increased billed consumption and consequently, revenue growth.

Additionally, the company can postpone investments. A hypothetical example shows how this can take place. In this example, assume the following parameters:

- Population served: 100,000 inhabitants
- Forecast of total population in the next 10 years: 120,000 inhabitants
- Total water production: 200 liters per second
- Real water losses: 80 liters per second

9 This case assumes that there are no apparent losses, for simplicity.
As the city population is expected to grow 20 percent over the next ten years, it is assumed for simplicity that water consumption will also grow by 20 percent in this period. The water utility company has two alternatives: (i) increase the water production capacity from 200 liters per second to 240 liters per second; or (ii) reduce water losses.

The second alternative will, in many cases, be more appropriate from an economic-financial and environmental standpoint. By reducing water losses, the same volume produced serves more people. In the example, the necessary volume to serve the entire population is 120 liters per second, which is the subtraction of total production (200 liters per second) from lost production (80 liters per second). If the population increases by 20 percent, the necessary volume to serve the entire population would be 144 liters per second (120 liters per second x 1.2). If losses diminished from 80 liters per second to 56 liters per second, a 30 percent drop, it would be feasible to serve the entire population without actually increasing water production.

Gains with water loss reduction may have impacts in terms of revenues, costs, and investments as summarized in Table 5.3.

Table 5.3: Benefits of loss reduction

<table>
<thead>
<tr>
<th>Losses</th>
<th>Apparent losses</th>
<th>Real losses</th>
</tr>
</thead>
</table>
| Gains  | Revenue growth  | Cost reduction  
|        |                 | Postponement of investments |
| Benefits | Increase in measured and billed consumption | Lower expenditures on chemical products, energy, and other inputs |
| Actions involved | Change of water meters and other meters; elimination of illegal connections | Water production reduction, serving the same number of people |
|        | All of the savings effectively measured (residential, commercial, and public) | Water supply to more people using the same volume produced |
| Cadastre improvement | Improvement of the network pressure control | Improvement of leaks detection |
| Improvement and change of pipelines, connections, valves | |

In addition to the gains shown in Table 5.3, there also are intangible benefits linked to the water utility company’s image as a company focused on efficiency and the preservation of natural resources.

**Costs and benefits of energy efficiency enhancements**

Water utility companies are electricity intensive, such that electric power is one of their main inputs. According to the Programa Nacional de Conservação de Energia Elétrica para o Saneamento (PROCEL SANEAR), over 2 percent of the total electric power consumption in Brazil is consumed by water utility companies. The main factors that can lead to energy inefficient consumption are:

- Incorrect contractual clauses
- Inadequate operational procedures
- Water waste
- Wrong sizing of systems
- Old equipment
- Technologies used incorrectly
- Conceptual design errors
- Poor maintenance
Actions to minimize the effects of these factors can be divided into administrative actions and operational actions. Administrative actions refer particularly to possible errors in the contracts with electric power utility companies, and can be summarized as follows:

- Correction of billing class
- Demand regularization
- Change of tariff structuring
- Deactivation of facilities not used
- Verification of electricity bill
- Negotiation to reduce tariffs

Operational actions involve:

- Power factor correction
- Supply voltage modification
- Improvement of motor-pump yield
- Pumping and reservoir alteration
- Use of frequency inverter
- Water supply system automation
- Load loss reduction
- Geometric height reduction

There are synergies between water loss reduction and energy efficiency enhancement actions. For instance, water loss reduction leads to a decreased need for water production; in turn, the energy consumed in water production drops, reducing energy costs, as highlighted in Figure 5.1.

![Figure 5.1: Synergies between water loss reduction and energy efficiency enhancement](source)

Direct benefits from energy efficiency actions result in lower energy costs. Additionally, it is possible to achieve indirect benefits. For instance, spending on maintenance reduces the need to generate energy. Based on ABES (2005), every R$1 spent on energy preservation saves R$8 in generation. Besides, efficiency increases enable companies to have more resources to invest in the expansion of water and sewerage systems.
5.2.2 Example of a performance contract for energy efficiency enhancements

For didactic purposes, a simplified performance contract example is presented, without using the economic-financial indicators of subsection 5.1. The water loss reduction example in the next subsection includes the economic-financial indicators. In both examples, the values used are merely illustrative, as the aim is to make clear the characteristics of this kind of contract.

From the viewpoint of the project’s cash flow, the performance contract sets forth that the contracted party is responsible for the implementation, investments, and operational costs of any actions taken. However, savings obtained during the period are shared between the contracted party and the water utility company. For instance, a water utility company that wants to reduce its monthly expenses on electricity signs a performance contract. The performance contract states that the service provider, usually an ESCO, is responsible for all of the expenses and investment. The ESCO is responsible for carrying out a diagnosis of the situation, purchasing material and equipment, and implementing the associated energy efficiency measures.

The simple parameters defined for the performance contract for this example are assumed to be as follows (and are shown graphically in Figure 5.2):

- The water utility company’s monthly expenses on electricity before remedial actions: R$100,000.
- The water utility company’s targeted monthly expenses on electricity after remedial measures: R$70,000.
- Shared savings with the private contracted party: R$15,000 if target is effectively reached.
  - The term “shared savings” represents the amount of total savings net of consumables and is transferred to the service provider.
  - Shared savings will necessarily be lower than the total savings generated in that period.
  - The value transferred to the private contracted party should be lower than R$30,000 to enable the water utility company to reduce its expenses from the moment that the energy efficiency measures are implemented. This is written mathematically as:

\[
\text{Cost of electricity }_t + \text{ Shared savings }_t < \text{ Cost of electricity }_{t - 1}
\]

- After the end of the contract period, the entire savings (R$30,000) are absorbed by the water utility company.
- Performance risk is totally borne by the ESCO. The water utility company’s maximum monthly expense after the implementation period and during the contract will be R$85,000. If the ESCO does not achieve the total target, its compensation will drop; if it exceeds it, its compensation will increase.
- The ESCO is held responsible for all investments and expenses involved in developing the energy efficiency measures. The water utility company does not incur any cost.

![Figure 5.2: Example of performance contract for energy efficiency enhancements](Source: Moreno 2012)
If savings are lower than the target, this does not jeopardize the water utility company. For instance, if savings were instead 25 percent (resulting in a new monthly electricity bill of R$75,000), the water utility company's expenses remain R$85,000. The difference is that the shared savings would be only R$10,000. Not meeting the goal only affects the service provider.

If savings are higher than the target, exceeding the goal still leaves the water utility company unaffected. For instance, if savings were 35 percent (resulting in a new monthly energy bill of R$65,000), the water utility company's expenses again remain R$85,000. In this case, the shared savings would be R$20,000. Table 5.4 illustrates how the water utility company's expenses do not change, regardless of whether the target is reached or not.

Table 5.4: Gains of the water utility company and the ESCO in different energy saving scenarios

<table>
<thead>
<tr>
<th>Savings achieved</th>
<th>Amount of new monthly electricity bill</th>
<th>Total amount paid by the water utility company</th>
<th>Shared savings given to the private partner</th>
</tr>
</thead>
<tbody>
<tr>
<td>Savings of 30% (target)</td>
<td>R$70,000</td>
<td>R$85,000</td>
<td>R$15,000</td>
</tr>
<tr>
<td>Savings of 25% (below target)</td>
<td>R$75,000</td>
<td>R$85,000</td>
<td>R$10,000</td>
</tr>
<tr>
<td>Savings of 35% (above target)</td>
<td>R$65,000</td>
<td>R$85,000</td>
<td>R$20,000</td>
</tr>
</tbody>
</table>

It is important to note that after a certain point in time, all of the savings generated will be kept by the water utility company. For instance, if the performance contract's term is five years, all savings achieved will be shared with the service provider over this period of time, after which all savings revert only to the water utility company. The savings obtained by the water utility company over ten years, based on this performance contract, would be calculated as:

\[
\text{Savings of water utility company} = 10 \times \text{Cost of electricity}_t - 5 \times \text{Shared savings}_t
\]

Take the previous example of the water utility company whose original monthly energy expenses were R$100,000 versus R$70,000 per month after the energy efficiency measures were implemented. Assume that the shared savings with the service provider are R$15,000. The total savings over ten years in the case of a five-year contract can be calculated as follows (without including the inflation rate).

Shared savings each year of the first five years will be:

\[
\text{Savings of water utility company} = 12 \times (R$100,000) - 12 \times (R$70,000) - 12 \times (R$15,000) = R$180,000 \text{ (year)}
\]

Savings (not shared) each year from the fifth to the tenth year will be:

\[
\text{Savings of water utility company} = 12 \times (R$100,000) - 12 \times (R$70,000) = R$360,000 \text{ (year)}
\]

Thus total savings over ten years will be:

\[
\text{Savings of water utility company} = 5 \times (R$180,000) + 5 \times (R$360,000) = R$2,700,000 \text{ (10 years)}
\]
5.2.3 Example of a performance contract for water loss reduction

This subsection presents a hypothetical example of a performance contract for water loss reduction. The previous example did not take into account the project’s financial-economic aspects. In this example, the economic-financial concepts are introduced. The aim of this example is to assess the economic feasibility of a water loss reduction project (both real and apparent) as it relates to a performance contract. The main parameters are assumed to be as follows:

- **Population served:** 50 million inhabitants
- **Project duration:** Five years (60 months)
- **Objective:** Reduce physical water losses from 20 percent to 10 percent of total volume pumped by the system and reduce apparent water losses from 20 percent to 10 percent of billed volume
- **Operational actions:** Changing 3,000 water meters; hydraulic modeling of system and mounting of pressure reduction valves; monitoring; and conducting a leak reduction campaign
- **Costs:**
  - Production cost of distributed water = R$0.35/m³
  - Unit cost of a water meter = R$75
  - Initial cost of pressure control equipment in the network (valves) and macro measurement = R$775,000
  - Monthly cost (steady) of operation maintenance = R$6,000
- **Consumed volume and billing:**
  - Average flow of raw water pumped by the system = 0.145 m³/s
  - Monthly volume billed = 0.24 million m³
  - Average per capita consumption by population = 200 liters/inhabitant/day
  - Water tariff (average net value without taxes) charged by the water utility company = R$1.00/m³

The example analysis has seven stages, as follows.

i. Estimation of both apparent and real water losses
ii. Estimation of the produced volume decrease, taking into account reduction of real water losses
iii. Estimation of billed consumption growth by reducing apparent water losses
iv. Estimation of benefits
v. Estimation of costs
vi. Calculation of the project’s economic indicators (IRR, NPV, payback)
vii. Use of the project’s economic indicators in a performance contract

**i. Estimation of real and apparent water losses**

The first step is to calculate water demand and the resulting average monthly flow. The estimated volume \( V \) (monthly average) demanded by population consumption is written as:

\[
V = \frac{50,000 \text{ inhabitants} \times 0.200 \text{ m}^3}{\text{inhabitants}} \times 30 \text{ days} = 300,000 \text{ m}^3
\]

Assuming a 30-day month and 86,400 seconds per day, the average estimated flow demanded by population consumption is:

\[
Q_{\text{total}} = \frac{300,000 \text{ m}^3}{30 \times 86,400 \text{ s}} = 0.1157 \text{ m}^3/s
\]
Assuming a monthly billed volume of 0.24 million m³, the flow billed will be:

\[ Q_{\text{billed}} = \frac{0.24 \times 10^6 \text{ m}^3}{30 \times 86,400 \text{ s}} = 0.0926 \text{ m}^3 / \text{s} \]

**Real water losses**

The system's real water losses are equal to the average flow pumped by the system less the average flow demanded by the population:

\[ \text{Real losses} = 0.145 - 0.1157 = 0.0293 \text{ m}^3 / \text{s} \]

In percentage terms, real losses will be:

\[ \text{Rate of real losses} = \left( \frac{0.0293/0.145}{} \right) \times 100\% = 20\% \]

**Apparent water losses**

Apparent water losses are calculated based on the difference between the average flow demanded by the population and the flow corresponding to the volume billed:

\[ \text{Apparent losses} = 0.1157 - 0.0926 = 0.0231 \text{ m}^3 / \text{s} \]

In terms of total monthly volume, apparent or commercial water losses are thus:

\[ \text{Apparent losses} = 300,000 - 240,000 = 60,000 \text{ m}^3 / \text{month} \]

In percentage terms, apparent losses are:

\[ \text{Rate of apparent losses} = \left( \frac{60,000 / 300,000}{} \right) \times 100\% = 20\% \]

**Total water losses**

Total water losses are calculated by adding real and apparent water losses. Therefore:

\[ \text{Total losses} = \text{real losses} + \text{apparent losses} = 20\% + 20\% = 40\% \]

**ii. Estimation of consumption savings from reducing real water losses**

As real water losses will be reduced by 10 percent of pumped flow, savings will be 10 percent (20 percent - 10 percent) of adduced flow, meaning that:

\[ \text{Flow savings} = 0.10 \times 0.145 \text{ m}^3/\text{s} = 0.0145 \text{ m}^3/\text{s} \]

**iii. Estimation of consumption growth billed from reducing apparent water losses**

Following the example presented, apparent water losses should be reduced by 10 percent of volume billed:

\[ \text{Expected value from apparent losses:} \ 0.10 \times 240,000 = 24,000 \text{ m}^3/\text{month} \]

The increase in the monthly billed volume will be expressed by the difference between the volume not billed before the water loss reduction actions (60,000 m³/month) and the expected value of the apparent water losses.

\[ V = 60,000 - 24,000 = 36,000 \text{ m}^3/\text{month} \]
**iv. Estimation of benefits**

Based upon savings resulting from real and apparent water loss reduction, the water utility company will measure financial gains obtained from two sources. First, there will be an increase of revenues because the water utility company will bill volumes that were available but not billed previously. Second, there will be a cost reduction due to the drop in real water losses such that the water utility company can produce less water to serve the same number of people. Thus, expenditures on inputs such as chemical products and electricity, among others, also decrease.

**Benefits from the increase in billed consumption (commercial benefit)**

The first benefit is the water utility company’s revenue growth, as it is now able to measure the water being used by its clients in a more accurate fashion. This results mainly from water meter installation. In this case, the higher monthly value billed by the water utility company (tax free) will be:

\[
\text{Commercial monthly benefits} = \text{Increase of volume billed} \times \text{water tariff}
\]

\[
\text{Commercial monthly benefits} = 36,000 \text{ m}^3 \times R$1.00/\text{m}^3 = R$30,600
\]

**Benefits from the reduction in treated pumped water**

The second benefit is from the cost reduction due to less water needed to serve the same number of people. The monthly volume of savings will be:

\[
\text{Volume saved} = \text{Daily flow saved} \times 30 \text{ days} \times 86,400
\]

\[
\text{Volume saved (m}^3\) = 0.0145 \text{ m}^3/\text{s} \times 30 \times 86,400\text{s} = 37,584 \text{ m}^3
\]

The monthly benefit coming from the volume saved will be:

\[
\text{Benefits from monthly volume saved} = \text{Volume saved (m}^3\) \times \text{Water production cost/m}^3
\]

\[
\text{Benefits from monthly volume saved} = 37,584 \text{ m}^3 \times R$0.35/\text{m}^3 = R$13,154
\]

**Total monthly benefit**

The water utility company’s total benefit will be expressed as the sum of increased revenues (commercial benefit) and those obtained from cost reduction (the volume saved benefit) as follows:

\[
\text{Total monthly benefit} = \text{revenue growth (commercial benefit)} + \text{cost reduction (volume benefit)}
\]

\[
\text{Total monthly benefit} = R$30,600 + R$13,154 = R$43,754
\]

And the annual benefit will be:

\[
\text{Total annual benefit} = 12 \text{ months} \times \text{total monthly benefit}
\]

\[
\text{Total annual benefit} = 12 \times R$43,754 = R$525,048
\]

**v. Estimation of costs**

Costs may be split up into two investments made in the first year: (i) purchase of 3,000 water meters at R$75 per unit (total cost of R$225,000); and (ii) initial cost of the network pressure control equipment (valves), a macro measurement of R$775,000. Besides these costs, there are monthly operation maintenance costs of R$6,000. To simplify the exercise, all calculations are presented in annual terms. The initial cost of investment, which takes place at the beginning of the first year, will be:

\[
\text{Investment cost} = \text{pressure control equipment cost} + \text{water meter cost}
\]

\[
\text{Investment cost} = R$775,000 + (3,000 \times R$75) = R$1,000,000
\]
Operation and maintenance costs will be:

\[ \text{Maintenance and operation costs} = 12 \text{ months} \times \text{monthly cost} \]

\[ \text{Maintenance and operation costs} = 12 \times \text{R$6,000} = \text{R$72,000} \]

The total cost over five years will be:

\[ \text{Total cost} = \text{investment cost} \times \text{1 year} + \text{maintenance and operation costs} \times \text{4 years} \]

\[ \text{Total cost} = (\text{R$1,000,000} \times 1) + (\text{R$72,000} \times 4) = \text{R$1,288,000} \]

Figure 5.3 presents a cash flow for the project's costs over the first five years.

**vi. Hypothetical project economic indicators achieved without a performance contract**

After estimating the project's costs and benefits, the economic indicators (IRR, NPV, payback) presented at the beginning of the section can be calculated.

The first example assumes that the water utility company makes investments of its own. As previously discussed, in practice, few companies are able to carry out actions to reduce losses because they lack cash or the ability to do budget planning, because they do not know the proper technology, or because there are management issues. The second example shows that the performance contract is an adequate solution to these problems.

The project's cash flow will have the following characteristics:

- Year 1: Outflows of R$1,000,000 (investment cost)
- Year 2 to Year 5: Inflows of R$525,048 (total benefits) and outflows of R$72,000 (maintenance and operation costs), resulting in net inflows of R$453,048.

Table 5.5 provides the economic-financial calculations obtained when the water utility company makes investments of its own.

**Table 5.5: Economic-financial indicators for the water utility operator implementing the project on its own**

<table>
<thead>
<tr>
<th>Year</th>
<th>Revenues (R$)</th>
<th>Cost (R$)</th>
<th>Flow</th>
<th>Effective and Annual Interest Rate (%)</th>
<th>IRR</th>
<th>NPV</th>
<th>NPV Accumulated</th>
<th>Payback</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>-</td>
<td>1,000,000.00</td>
<td>- 1,000,000.00</td>
<td>12.00</td>
<td>-1,000,000.00</td>
<td>-1,000,000.00</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>525,048.00</td>
<td>72,000.00</td>
<td>453,048.00</td>
<td>12.00</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>525,048.00</td>
<td>72,000.00</td>
<td>453,048.00</td>
<td>12.00</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>525,048.00</td>
<td>72,000.00</td>
<td>453,048.00</td>
<td>12.00</td>
<td>28.89%</td>
<td>361,167.09</td>
<td>-234,325.77</td>
<td>3.69</td>
</tr>
<tr>
<td>5</td>
<td>525,048.00</td>
<td>72,000.00</td>
<td>453,048.00</td>
<td>12.00</td>
<td>322,470.62</td>
<td>88,144.85</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Figure 5.3: Cash flow of the project's costs, years 1-5**

R$ 1,000,000  R$ 72,000  R$ 72,000  R$ 72,000  R$ 72,000
vii. Hypothetical project economic indicators achieved with a performance contract

The second example demonstrates the benefits of using a performance contract vis-à-vis the economic indicators. The first restriction a water utility company may face is lack of technical knowledge about water loss reduction. It is expected that in a country like Brazil, where some water utility companies have losses of over 40 percent (and some above 70 percent), not all of them have technical knowledge on this subject, or at least it is not widespread. The service providers are experts on this topic, however, and there may be a fruitful transfer of knowledge gained by using performance contracts.

A second hindrance is the possible budget constraint to implement the project. The water utility company may not have the resources available for the initial investment of R$1,000,000 or for the annual investments of R$72,000. In a performance contract, these investments are made by the private sector. The water utility company does not disburse any additional resources over the contract period.

In this example, the main terms of the performance contract are assumed to be that:

• The private partner will take responsibility for all the investment, operation, and maintenance costs over the five-year contract;
• Gains over the contract period will be shared: 80 percent will go to the private partner and 20 percent to the water utility company;
• All of the gains in the post-contract period will belong to the water utility company; and
• The private partner will only be entitled to 80 percent if he reaches the reduction target over the contract period.

It is important to note that the water utility company will obtain gains through the loss reduction actions during and after the contract period; however, it will not expend any additional resources. The performance contract is thus a “win-win” solution for companies that have financial constraints to implementing water loss reduction programs.

The first step is to understand the cash flow of this arrangement, under which costs are paid by the private partner while benefits are shared during the contract period. Thus, the private partner disburse R$1,000,000 in the first year of the contract and R$72,000 per year for the next four years for project maintenance. Of the annual benefit flow of R$525,048, 80 percent will go to the private partner (R$420,038) and 20 percent to the water utility company (R$105,009). Given this, the economic-financial indicators are recalculated, again assuming an annual and effective interest rate of 12 percent. The NPV for the private partner will be R$57,114, while the NPV for the water utility company will be R$318,950.

The project’s IRR can only be calculated for the private partner. In this case, the IRR is 14.69 percent, higher than the 12 percent interest rate, indicating that the project is advantageous. The project payback is calculated in the same way as in the previous example. This project’s payback for the private partner is calculated to be 4.74 years.
The project is therefore worthwhile undertaking for both the water utility company and the private partner. The water utility company has a NPV of R$318,959 without any investment, and enjoys a future annual benefit of R$525,048 due to the project’s continuing benefits.

Table 5.6 presents a summary of the private partner’s costs and benefits, the cash flow, the IRR, the NPV, and the payback.

Table 5.6: Economic-financial indicators for the private partner under a performance contract

<table>
<thead>
<tr>
<th>Year</th>
<th>Total Revenues (R$)</th>
<th>Private Partner Revenue (R$)</th>
<th>Cost (R$)</th>
<th>Flow</th>
<th>Flow Annual and Effective Interest Rate (%)</th>
<th>IRR</th>
<th>NPV</th>
<th>NPV Accumulated</th>
<th>Payback</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>-</td>
<td>-</td>
<td>1,000,000.00</td>
<td>- 1,000,000.00</td>
<td>12.00</td>
<td>-1,000,000.00</td>
<td>-1,000,000.00</td>
<td>4.74</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>525,048.00</td>
<td>420,038</td>
<td>72,000.00</td>
<td>348,038.00</td>
<td>12.00</td>
<td>310,749.00</td>
<td>-689,251.00</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>525,048.00</td>
<td>420,038</td>
<td>72,000.00</td>
<td>348,038.00</td>
<td>12.00</td>
<td>277,454.00</td>
<td>-411,797.00</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>525,048.00</td>
<td>420,038</td>
<td>72,000.00</td>
<td>348,038.00</td>
<td>12.00</td>
<td>247,727.00</td>
<td>-164,070.00</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>525,048.00</td>
<td>420,038</td>
<td>72,000.00</td>
<td>348,038.00</td>
<td>12.00</td>
<td>221,185.00</td>
<td>57,114.00</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 5.7 summarizes the project’s benefits to both the private partner and the water utility company.

Table 5.7: Summary of economic indicators achieved under a performance contract

<table>
<thead>
<tr>
<th></th>
<th>Annual gain during contract* (SR)</th>
<th>Expected annual gain after contract (SR)</th>
<th>NPV</th>
<th>IRR</th>
<th>Payback (years)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Water utility company</td>
<td>105,009</td>
<td>525,048</td>
<td>318,950</td>
<td>n.a.</td>
<td>n.a.</td>
</tr>
<tr>
<td>Private partner</td>
<td>420,038</td>
<td>0</td>
<td>57,114</td>
<td>14.69%</td>
<td>4.74</td>
</tr>
</tbody>
</table>

Note: * After second contract year.
5.2.4 Case study: SABESP’s performance contract to reduce real water losses in the Vila do Encontro Sector – Municipality of São Paulo

This subsection provides a practical case study of a performance contract carried out by SABESP at the São Paulo Municipality, Vila do Encontro Sector. The contract scope was: “technical services rendering to carry out studies, projects and implementation of work plans to optimize water supply in the Vila de Encontro Sector with the aim to reduce real losses.”

The performance contract’s objective was to foster savings equal to or higher than 112,852 m³/month on water distributed by the supply sector. The baseline value was 1,010,618 m³/month – the July 2008 to June 2009 average – and the aim was to reduce this value to 897,766 m³/month, an 11.2 percent reduction.

A call was issued for a technical- and price-based tender, with 70 percent of the score based on the technical proposal and 30 percent on the commercial proposal. The commercial proposal was based on the proposed water saving volume (PWSV). Thus, the larger the PWSV, the higher the score for the bidding participant. In this case, the PWSV of the tender winner was 115,938 m³/month.

The contract is valid for four years (March 2010 to February 2014) and has three stages: (i) pre-operation (18 months); (ii) performance assessment (6 months); and (iii) fixed compensation (24 months). Table 5.8 presents the characteristics of each stage. In Stage 1, all of the actions to reduce losses set forth in the technical proposal are implemented. Stage 2 (performance assessment) restricts itself to managing the supply sector. Compensation takes place according to the results of the previous period. Stage 3 (fixed compensation) occurs when operation is transferred to SABESP. In this case, compensation will be based on the average distributed volume (DV) obtained in Stage 2.

As in any other performance contract, expenses for investments are paid by the contracted party. In this stage, compensation is paid only if the DV remains below the baseline, meaning that the company is paid only if it has effectively obtained water loss reduction.

Table 5.8: Stages of the SABESP performance contract – Vila do Encontro

<table>
<thead>
<tr>
<th>Stage</th>
<th>Pre-operation</th>
<th>Performance assessment</th>
<th>Fixed compensation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Activity</td>
<td>Implementation of proposed scope</td>
<td>Management of supplying sector</td>
<td>SABESP operation</td>
</tr>
<tr>
<td>Period</td>
<td>18 months</td>
<td>6 months</td>
<td>24 months</td>
</tr>
<tr>
<td>Compensation</td>
<td>Partial</td>
<td>Variable</td>
<td>Fixed</td>
</tr>
<tr>
<td>Compensation conditions</td>
<td>DV below baseline is a necessary condition</td>
<td>Compensation according to previous period, but the average result of these 6 months will be the calculation base of fixed compensation</td>
<td>Fixed compensation based on the average DV obtained in previous period</td>
</tr>
</tbody>
</table>

Source: Berenhauser 2012.
Here, the scope of work proposed encompassed the following actions:

- **Initial assessment**: analysis of macro measurement conditions; sector tightness and micro measurement;
- **Sector operational diagnosis**: takes into account collection of information, pressure measurements, and hydraulic simulation of the supplying sector; subdivision of sector through implementation of DMCs and VRPs (see Figure 5.4);
- **Leaks research**: includes detection of leaks in the net (at nighttime) and research of leaks;
- **Leaks repair**: repair of all detected and not visible leaks (see Figure 5.5); and
- **Branch change**: preventive change of 2,000 residential branches through a non-destructive method.

**Figure 5.4: Implementation of DMCs and VRPs – Vila do Encontro**

**Figure 5.5:Leaks repair SABESP – Vila do Encontro**

Figure 5.6 highlights the main implementation outcomes of actions to reduce real water losses based on the SABESP performance contract for Vila do Encontro. The loss rate measured in liters per connection/day went from over 900 liters in July 2008 to less than 400 liters in January 2012.

**Figure 5.6: Results of the SABESP performance contract– Vila do Encontro**

Source: Berenhauser 2012.
5.3 Performance Contracts Versus Traditional Contracts

Table 5.9 provides a comparison between traditional contracts and performance contracts for water loss reduction and energy efficiency enhancement projects. Five aspects are assessed: (i) implementation investments and expenses; (ii) capital needs; (iii) the contracted party’s compensation; (iv) risk; and (v) technology.

Table 5.9: Features of traditional contracts versus performance contracts

<table>
<thead>
<tr>
<th>Feature</th>
<th>Traditional Contract</th>
<th>Performance Contract</th>
</tr>
</thead>
<tbody>
<tr>
<td>Implementation investments and expenditures</td>
<td>Made by the water utility company</td>
<td>Made by the contracted party</td>
</tr>
<tr>
<td>Capital needs</td>
<td>Water utility company must have capital available to invest</td>
<td>Contracted party supplies capital for investments and expenses</td>
</tr>
<tr>
<td>Compensation of contracted party</td>
<td>Depends on work completed, not on effective achievement of goals</td>
<td>Performance contract for efficient achievement of goals</td>
</tr>
<tr>
<td>Risk</td>
<td>Borne by water utility company</td>
<td>Borne by contracted party</td>
</tr>
<tr>
<td>Technology</td>
<td>Company must have know-how to develop necessary actions in detail</td>
<td>Technology can be brought by the contracted party</td>
</tr>
</tbody>
</table>

With regard to investments and capital needs, the possibility of negotiating a performance contract may overcome the financial barrier faced by many water utility companies. In a traditional contract, the operator must invest its own resources, and thus needs capital available. In fact, most water utility companies shy away from energy efficiency enhancement or water loss reduction projects at the outset, because they either do not have capital available or they think that it is better to undertake other investments with their resources, such as providing more water and sewerage connections. Under performance contracts, investments are made by the contracted party so that the water utility companies do not need upfront capital to carry out projects. The contracted party is responsible for the required expenditures.

Another key feature of performance contracts is the incentives they provide to effectively fulfill water loss reduction or energy efficiency enhancement goals. In most traditional contracts, a service provider is hired to carry out certain work. Compensation is linked to completion of that work. There is not necessarily a relationship between the work done by the contracted party and the desired results. If the results are not achieved, the contracted party still receives its compensation as long as it finishes the work or services set forth in the contract.

However, performance contracts present a different situation. The performance contractor has every incentive to implement measures necessary to achieve efficiency, as its compensation depends on reaching the goals. If the contracted party does not achieve the targets, it is penalized through lower compensation. In this way, risks are allocated to and borne by the contracted party.

Lastly, use of the best technology is another key feature associated with performance contracts. Most water utility companies do not know the best practices to reduce water losses and increase energy efficiency. Thus, there is a positive exchange when the service provider brings a new technology, unknown to the water utility company, to increase efficiency.
5.4 Economic-Financial Aspects of Setting Up Performance Contracts

From an economic-financial standpoint, setting up a performance contract involves the following four stages:

- **Stage 1**: Definition of physical and financial objectives and actions needed to achieve these objectives.
- **Stage 2**: Survey of investments and expenditures needed to reduce losses or increase energy efficiency.
- **Stage 3**: Survey of benefits achieved by these actions.
- **Stage 4**: Economic-financial evaluation of project, setting parameters to specify in the performance contract.

In Stage 1, it is essential that the water utility company establish the central objectives involved. Thus, it will need a diagnosis and recommendations for the most appropriate actions to correct its shortcomings. With regard to water loss reduction, an evaluation should be carried out to find out whether it is more appropriate for the company to invest in real water loss reduction, apparent water loss reduction, or both. It should also evaluate if it is worth jointly conducting a water loss reduction and an energy efficiency enhancement project.

After the diagnosis, the water utility company should define the necessary actions, within a minimum scope, for the stages to be developed to achieve desired goals. (Recall that Section 4 specified the technical issues involved in performance contracts, including the need to define the baseline.)

In Stage 2, the costs of any actions identified in Stage 1 are estimated. The water utility company should have an estimate of service and equipment prices. The ideal situation is to have a database containing the unit prices of all inputs and services. If the water utility company does not have such a database or its database is incomplete, one alternative is to look for a cooperative agreement with another water utility company that already has a structured price database. Subsection 6.4 describes in detail a cooperative agreement between water utility companies, using SABESP-CASAL as a case study.

Stage 3 estimates the program’s benefits both in terms of expenditure reduction and revenue growth. The estimated benefits are used in the cash flow analysis in Stage 4, which encompasses the economic-financial assessment based on the estimates of the costs and benefits obtained in Stages 2 and 3. Based upon the project’s cash flow, its NPV, IRR, and payback will be established. This information will enable an assessment of whether the project is profitable or not and whether it is feasible to set up a performance contract with shared savings between the water utility company and a service provider.

One of the most relevant aspects of economic-financial modeling is to define criteria to measure performance. Measurement is usually carried out by considering the distributed volume (DV) and the area undergoing water loss reduction intervention. In certain cases, expenditure reduction of electricity and chemical products may also be chosen to measure performance. Subsection 5.2 addressed these aspects in detail.

With respect to water loss reduction performance contracts, one alternative is to define a compensation value unit (CVU) for every m³ actually saved. Generically, compensation is expressed as follows:

\[
\text{Compensation Value Unit (CUV)} = \text{Volume Saved (m}^3\text{)} \times \text{Compensation for m}^3\text{ (R$)}
\]

The compensation mechanism may vary according to the contract stage. Sometimes water utility companies adopt three stages in the contract. In the first stage, partial compensation is paid only if the DV is below the baseline. In the second stage, a performance assessment verifies whether the water loss reduction (or efficiency growth) has been effective. In that case, compensation is usually variable, too. The third stage sets up a fixed compensation based on the average values obtained during the assessment period.
Box 5.1: Key Concepts and Discussion Points for Chapter 5

Key concepts:
- Cash flow
- Net present value
- Payback
- Apparent losses
- Real losses
- Shared savings
- Traditional contract
- Performance contract

Points for discussion:
1. How can discounted cash flow analysis be used in performance contracts?
2. What are the main topics of an economic-financial assessment for a performance contract?
3. What stages are involved in setting up a performance contract from an economic-financial standpoint? What particularities does each stage have?
6. Legal Aspects: Contracts Within the Law for Tenders

This section presents the main legal aspects for the specification of performance contracts. Subsection 6.1 describes the legal framework in Brazil for these contracts. Section 6.2 presents in more detail the aspects regarding tenders and judgment criteria. Section 6.3 discusses the main legal issues related to the terms of performance contracts. Finally, Section 6.4 provides a case study of the first public-public partnership signed between two state-owned water utility companies, and notes the advantages to using this kind of mechanism.

6.1 Legal Framework for Performance Contracts

Efficiency or performance contracts are considered as specialized, professional technical services in accordance with Article 13 of Law 8.666/93. They differ from continuous and standardized services provided for in paragraph II of Article 57.

It is important to note that specialized, professional technical services are not limited to planning, scheduling, and preparation of studies and projects, but also include actual execution or service provision, such as the services associated with water loss reduction and energy efficiency enhancements. Such services require specific knowledge and know-how acquired in the development of previous projects, and in connection with the best operational practices, using higher skills than is usual or common. Nevertheless, this specialization does not justify direct contracting without a tender. Direct contracting is only feasible when there is no competition, as established in Article 25, Law 8666/93.

This is not the case for water loss reduction and energy efficiency enhancement services. There is a small group of companies able to render these kinds of services; therefore, a tender to select the best proposal to the government should be carried out. However, as shown in the previous section, it is essential that the bidding process allows this knowledge to be evaluated to prevent unqualified companies from participating.

Although Law 8666/93 provides all of the legal mechanisms to fully specify performance and efficiency contracts, it is interesting to note that Law 12462/11 – which establishes the Differential Public Procurement Regime (Regime Diferenciado de Contratações- RDC) applicable to the Olympic Games and the World Cup – provides the possibility of specifying efficiency contracts that generate higher economic returns to the contracting party. §1º of Article 23 states the following:

§1º The objective of the efficiency contract shall be to render services, which could include execution of works and supply of goods, in order to provide savings to the contracting party by reducing present expenses, and the contracted party shall be compensated based on the percentage of the economy achieved.

This is an important improvement in the Public Procurement Regime. Clearly, it cannot be concluded that the absence of a similar provision in the General Bidding Law 8666/93 excludes the possibility of performing this kind of contract in projects not linked to the Olympic Games and the World Cup. The Brazilian legislation is clear in stating that contracts (or inclusion of new forms of compensation) not expressly considered in the law are allowed. Ultimately, decision making about the form of the contract should be linked to the benefits and savings provided to the government, rather than to the legal provisions.
6.2 Tenders and Judgment Criteria

As mentioned in subsection 6.1, performance contracts in which a state agency (direct or indirect administration) is involved should usually be preceded by a tender. Development of a water loss reduction or energy efficiency enhancement program requires special knowledge and know-how, but these programs can be carried out by more than one company, necessitating a competitive tender process.

6.2.1 Tender modality

Given that the aim of a performance contract is to encourage the private contracted company to deliver a more efficient operational system to the contracting party, it is recommended that more risks are transferred to the contracted party.

To do so, the contract should not be based on unit price (Article 6, VIII, b Law 8.666/93) but should be a “turnkey” contract for the complete work. This would encompass delivery of all of the works, services, and necessary facilities, and would place them under the responsibility of the contracted party until the entire project is delivered to the contracting party. The delivered project should be ready to start operations and should comply with all technical and legal requirements needed to operate safely, with the appropriate characteristics for the purposes for which it was contracted.

This modality provides more freedom to the contracted party to implement the technological solutions and plans it deems appropriate to reach the targeted reduction of losses or energy consumption. It also increases the risks allocated to the private contracted party because the provider cannot claim interference or design errors if it does not reach the targets.

Additionally, the tender should be competitively awarded (Article 22, Law 8666/93), because (as mentioned below) it is essential that the bid takes into account both technical and price proposals. Besides, it is difficult to justify the complexity of setting up a performance contract equal or lower than R$1,500,000, which is the established limit for the implementation of other tender modalities for works and engineering service.

6.2.2 Judgment criteria

It is not simple to establish the judgment criteria for a performance contract. In the past, some state audit courts and municipal or state attorneys recommended reducing the weighting criteria for the technical proposal and increasing them for the commercial proposal. In some situations, it was even suggested that the selection be based exclusively on price, relegating the technical evaluation to the qualification phase (technical certification and previous background). According to Maurer and Barroso (2011), when a baseline has not been established properly, higher weight should be assigned to the technical proposal. If the baseline has been set up properly, so that all participants are able to understand the system conditions, selection based on price preceded by a rigorous technical selection is the best practice.

Although this is the most preferred practice of the Brazilian courts, the Brazilian jurisprudence does not specify higher or lower weights for the technical and commercial proposals, regardless of whether the baseline is correctly established.

This guideline aims to reduce the subjectivity in judging proposals. Additionally, it decreases the risk of questioning by bidders. However, as stated above, a loss reduction and/or energy efficiency enhancement program involves high specialization and technical knowledge. Further, interventions at the contracting party’s facilities should be scheduled and well executed, so as not to compromise the regularity of water supply to the population.

Thus, it is essential that the selection of the private contracted party is based on both technical and commercial proposals. State-owned companies wishing to deploy this kind of program should sensitize their control authorities about the importance of the technical proposal in the bidding process. Eventually, they should build judging criteria that simultaneously address concerns about the excessive subjectivity in the judging criteria and guarantee that the company with the most technical knowledge is selected.
6.2.3 Criteria to judge a proposal: a case study of Vila Cacilda, SABESP, Sao Bernardo do Campo Sao Paulo State

A variety of criteria can be used to judge a proposal. Experience indicates, however, the importance of valuing a bidder’s ability to diagnose the reasons for water losses or energy inefficiency, as well as its ability to plan and find the best solutions to address the problems.

SABESP (Companhia de Saneamento Básico do Estado de São Paulo) has been a pioneer in developing performance contracts within the water and sanitation sector. Its expertise and positive results serve as an important model for new projects of this nature. SABESP has some criteria, already submitted and approved by the Court of Auditors of São Paulo State, for selecting both technical and commercial proposals. The public notice to bid on the water loss reduction project implemented in Vila Cacilda sector, São Bernardo do Campo Municipality, Metropolitan Region of São Paulo, is an important example.

Description of the Vila Cacilda project and judgment of technical criteria

The Vila Cacilda sector integrates the water supply system of the São Bernardo do Campo Municipality and is operated by SABESP. In 2008–2009, it supplied water to 26,518 people and had 6,305 connections and 90,655 savings. The billing loss rate was 55.07 percent. Total water losses in distribution were 1,085 liters/connection per day and real water losses were 41 percent.

The contract scope included: (i) development of studies and engineering projects for water recovery and operational optimization of the water distribution system; (ii) studies and projects to implement measurement subsectors throughout the Vila Cacilda sector area; (iii) creation of a scanning program to detect leaks not visible; and (iv) implementation of work plans to optimize the sector through works aimed at providing uniformity of supply.

The judging criteria for the technical proposal used by the Vila Cacilda Project can be categorized into three groups:

1. **Problem Awareness**: A description and analysis of phases, studies, and diagnostics that will be developed over the contract period. The contracted party should describe stages and methodologies to be used and anticipated problems to be faced, as well as a qualitative and quantitative forecast of savings. In addition, the contracted party should present a detailed flowchart of activities stage by stage. It should also demonstrate knowledge about the demographic and demand elements of the sector that will be the object of intervention.

2. **Team**: The team qualification implies appointment of a general coordinator and a technical manager with experience in water loss reduction projects. Professionals who demonstrate they have worked in five loss reduction projects will have the highest score. The other members of the team should also prove previous experience, the highest score assigned to proof of experience in ten projects. Each team member must prove having participated in at least one project. A score is also assigned to the bidding company’s experience. In addition, the public notice scores the team’s level of organization.

3. **Schedule of Works**: The bidder who proposes to perform the activities in the shortest schedule, taking as reference the public notice schedule, will obtain the highest score.

It is worth noting that, with some alterations, the technical criteria applicable to loss reduction programs can also be used in contract tenders for energy efficiency enhancements. By and large, it is possible to summarize the technical proposal criteria scores as follows:

<table>
<thead>
<tr>
<th>Item</th>
<th>Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>Problem Awareness</td>
<td>5.0</td>
</tr>
<tr>
<td>Team</td>
<td>3.0</td>
</tr>
<tr>
<td>Schedule of Works</td>
<td>2.0</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>10</strong></td>
</tr>
</tbody>
</table>
Commercial judgment criteria and weighting in the Vila Cacilda project

As discussed in the previous sections, the performance contract baseline can be set up through a set of criteria. After defining the baseline, it is feasible to define the commercial proposal judging criteria. In the Vila Cacilda project, the judging criteria used was the highest economic benefit offered to the contracting party.

Economic benefit was calculated using the highest proposed water savings; i.e., the highest target of water loss reduction to reach over the contract period. This water volume was multiplied by a unit value per cubic meter; the result (in R$) was used to rank the best proposals. The bidder who offered the highest result (in R$) received the maximum score.

In the Vila Cacilda project (and in other projects analyzed), the technical and commercial proposal weights were 70 percent and 30 percent, respectively. Valuation of the technical proposal has proven to be fundamental in this type of arrangement, ensuring a proper contract with a company that specializes in creating programs of water loss reduction and energy efficiency enhancement.

6.3 Main Clauses and Conditions Relating to Performance Contracts Within the Framework of Law 8.666/93

In terms of engineering works and services, Law 8666/93 (Tender and Public Bid Law) is mainly focused on contractor contracts and project development services, as well as those of a continuous nature, such as maintenance contracts. Performance contracts do not respond to the same incentive logic and allocation of responsibilities as contracts for engineering works and services. This is particularly the case for the following contractual conditions: (i) Basic project; (ii) Term; and (iii) Compensation. Each of these are discussed next.

6.3.1 Basic project

§ 2o of Article 7º establishes that works and services can only go through a bid if there is: (i) a basic project approved by the competent authority and available for analysis, particularly, by companies interested in taking part in the tender; (ii) a detailed budget in worksheets that presents the composition of all unit costs; and (iii) a forecast of resources that will ensure payment of obligations resulting from the execution of works and services in the current fiscal year, according to the respective schedule.

On the other hand, item IX Article 6, Law 8666/93 defines the basic project as a set of necessary and sufficient elements, with an appropriate level of accuracy, to characterize the work or service, or set of works or services, object of the tender.

The basic project should encompass, among other requirements: (i) development of the selected solution to provide an overview of the work and clear identification of all of its components; (ii) technical, global, and local solutions, sufficiently detailed, so as to minimize the need for reformulation or variants during the executive project development and execution and assembly of works; (iii) identification of the types of services to be carried out and of the material and equipment to be included in the work; and (iv) a detailed budget of the work's total cost based on the number of services and supplies, properly assessed.

To condition the existence of a basic design to the opening of a tender and the requirement of detailed information regarding unit costs, methodology, among other specific conditions linked to the engineering works, aims at preventing the “amendments industry”, through which poorly developed projects generate a significant cost increase, and encumber the contracting public entity.

It is interesting to note that although the abovementioned Articles describe situations in connection with contractor contracts, it is commonly the intention to apply this to any contract developed according to Law 8666/93. This generalization causes difficulties in developing contracts where compensation is based on success. Similar to public-private partnership and concession contracts, performance contracts transfer responsibilities to the contracted party to manage and allocate both physical and financial resources in any way it considers best to comply with the contract. This provides an incentive for the contracted party, who will only be paid if the targeted results are achieved. Thus, it is not necessary or cost-effective for the contracting party to specify in the basic project how the contracted party should reach its targets or to indicate the unit prices of items to be included in the services.
It is important to note that concerns about eventual contractual amendments are mitigated in performance contracts because any additional costs are borne exclusively by the contracted party. Additionally, the resources used to compensate the contracted party do not increase the expenses of the state-owned company. Compensation is given as the promised results are achieved and the contracting party does not disburse any resources during the contract additional to those foreseen.

## 6.3.2 Term

The service contract terms according to Law 8.666/93 are informative as they relate to performance contracts. It is commonly understood that administrative contracts are largely limited to the duration of the budget, according to Article 57, Law 8.666/93:

Term of contracts regulated by this Law shall stick to their respective budget, with the exception of:

1. projects whose products are included in targets established by the multiannual plan may be extended if the Public Administration is interested on it, and as long as this had been foreseen in the call;

2. Services to be rendered continuously, may be extended for equal and successive periods of time in order to provide more advantageous prices and conditions to the public administration, limited to sixty months.

Sometimes, interpretation is based on Article 57, such that the contract term is limited to the 12-month budget term. Because of this, it is common to interpret that service contracts (even those not continuously executed) could be for up to 60 months, the exception as stated above in item II of Article 57.

However, the above interpretation seems to be wrong. The law does not intend to limit the contract term to the budget term; in fact, item I admits a longer term as long as the contract term is included in the multiannual plan. In that sense, item III § 2 Article 7º of Law 8.666/93 sets up a condition for opening a tender:

3. Forecast of budget that ensure payment of obligations resulting from works or services to be carried up during the fiscal year in course, according to the respective schedule.

The budget forecast is only required to ensure compensation for works and services executed in the fiscal year of the tender opening. Therefore, there is need to reserve resources in the public budget to face all payments foreseen in the contract. This is especially necessary for contracts related to infrastructure works and services, which often take more than 12 months to complete due to their complexity. For instance, hydroelectric plants may take over six months to construct; other services in the sector may take more than one year and, in some situations, over five years.

The legislation only requires that in these situations the respective projects (and not necessarily the contract itself) are included in the multiannual plan (in accordance with item I, Article 57). One limitation that may exist in terms of contract terms refers to the enforcement of the Complementary Law 101/10 (Fiscal Responsibility Law) and the eventual impact on indebtedness by the state-owned company. Nevertheless, such limitations are not applicable in independent state-owned companies and joint stock companies, which characterizes most state-owned water utility companies in Brazil. Accordingly, in principle, there is not a term limitation for performance contracts developed by independent entities.
6.3.3 Compensation

As discussed in previous sections, in performance contracts, compensation is based on a logic different from traditional service contracts. It is essential to highlight that Law 8.666/93 does not prohibit this type of compensation. The legal provisions in terms of payment of contractual obligations only establish that the “contract should have a payment term that does not exceed thirty days, from the final deadline of payment of each portion” (Article 40, XIV, a). Therefore, the contracting party does not have to pay the contracted party as works and services are carried out. Actually, this procedure is the current market practice, but it is not imposed by law. Therefore, there are no obstacles to having payments made only after total completion of services and interventions and verification of the results.

6.4 Public-Public Partnerships

The use of public-public partnerships to implement water loss reduction programs is not widespread in Brazil. Two reasons may explain this situation. First, few state-owned water utility companies are able to render services outside their own state (because of legal restrictions or lack of financial capacity). Second, the few companies able and authorized by legislation to develop activities outside of their state and abroad still face great resistance locally, as they are constantly under pressure to invest resources and efforts to reduce service shortfalls in their own states.

Nationalization and internalization are generally considered a second stage in a company’s entrepreneurial strategy, undertaken only after services in its operational area are fully provided. However, public companies that operate outside their states and even internationally can improve their management and generate additional revenue.

Management improvement is attained as expansion exposes the company’s workers to competition with other companies and requires them to develop new skills. In a competitive market, the company will no longer operate as a monopoly, which will allow benchmarking exercises. From an economic standpoint, a company’s decision to operate outside its own state enables it to commit to more highly profitable projects and to generate faster returns on investment. This is because the company need not only comply with public functions of sanitation in its operational base, actions that generate lower revenues. Further, additional resources obtained outside the state help fund the company’s investment plan, and prepare it for competition with private providers within its own state.

6.4.1 History of the CASAL-SABESP project

Within this context, SABESP and CASAL engaged in the first public-public partnership in Brazil’s water and sanitation sector. In 2009, SABESP had expanded its area of business to look for new opportunities inside and outside the State of São Paulo through partnerships with the private and public sectors. At the same time, CASAL was undergoing a significant management change process, bringing important results to the company. Nevertheless, it still faced considerable operational and management difficulties.

In 2007, the States of Alagoas and São Paulo signed a cooperative agreement to exchange experiences and share the best practices. Likewise, SABESP and CASAL signed a cooperative agreement to identify topics of common interest, such as the serious difficulties CASAL was facing due to high rates of water loss.

6.4.2 Institutional modeling

After several meetings and studies, the two parties signed a specialized technical services and technology transfer contract on November 24, 2009. The contract was registered at the Instituto Nacional de Propriedade Industrial (INPI) in accordance with Article 211, Law 9279/96:

Art. 211. INPI will register contracts that imply technology transfer, franchising and similar contracts that produce impacts in third parties.
It is important to note INPI's definition of technology supply/transfer, and the rendering of technical and scientific services:

**Supply of Technology:** the contract that sets up conditions to acquire knowledge and techniques not protected by rights, including knowledge and techniques not protected by industrial property filed and granted in Brazil (Know-How).

**Technical and Scientific Services:** include techniques obtained to carry out projects or studies and specialized service rendering.

That was precisely the scope of the contract, through which SABESP agreed to: (i) help CASAL implement a water loss reduction program and transfer technology so that CASAL could continue with this program after the contract expiration. The contract included public notice modeling (and respective reference terms) to hire service providers, train technicians, and develop and specify projects and studies. The contract was issued based on item II, Article 25, Law 8.666/93:

A tender will not be required when there competition is not feasible, in particular:

II – hiring of technical services described on item 13 of this Law, of singular nature, from professionals or companies with remarkable specialization. Advertising and disclosure services are required.

§ 1º of same Article interprets “remarkable specialization” as the professional or company whose ability (demonstrated by previous activities, studies, experiences, publications, organization, equipment, and technical teams or other requirements related to their activities) enables it to prove that its work is essential and undoubtedly the most adequate to fully meet the contract’s objectives. In this case, SABESP appeared to be the most suitable company to create a successful water loss reduction program that would fully comply with the contract’s objectives.

This meant that other companies (private companies, particularly) were not able to structure a water loss reduction program. However, CASAL could not specify and structure a performance contract to reduce water losses because it did not have the technical knowledge to do so. On the other hand, the private sector perceived a high risk of default. SABESP’s participation in the project would mitigate this risk, given the existing institutional relationship between the States of Alagoas and São Paulo.

### 6.4.3 Contract

The two parties agreed that the contract would encompass an intervention period of 18 months (until May 2011), with total investments by SABESP of R$20,000,000. SABESP subcontracted several services, but remained responsible for the program’s overall success and technology transfer. Thus SABESP’s professionals were transferred to Maceió to coordinate the contract activities.

SABESP’s compensation was calculated based on CASAL’s effective increase of revenues during the contract term. SABESP was entitled to receive 55 percent of the revenue increase during the first three months of the contract, and 45 percent in the last two years of the contract, until its accumulated and adjusted compensation reached a total of R$25,008,392 (the “total initial value”). Thereafter, SABESP would be entitled to 20 percent of revenues until its accumulated and adjusted compensation reached the total initial value plus 20 percent.

The contract resulted in important outcomes, among them, regularization of water supply at the Bairro de Benpublic noticeo Bentes (a needy area of Maceió) that due to its high rate of losses prevented distribution of more water to the seaside, where large consumers are concentrated (hotels and restaurants). From the moment it was able to supply a larger volume of water to the seaside area, CASAL was also able to supply to large consumers, thus increasing its billing. In addition, consumers stopped using water trucks, whose water quality is not controlled, thus posing health risks to the population.
6.5 Warranty Structures

A critical aspect of developing performance contracts in Brazil is public companies' ability to pay the contracted parties. As most public water utility companies have low creditworthiness, private companies that provide water loss reduction and energy efficiency enhancement services are hesitant to engage in performance contracts because of the high risk of delinquency.

In a performance contract, the contracted party carries out all of the activities and investments before receiving its compensation, whereas in traditional contracts, expenditures and investments are concurrent with service provision. In the event of lack of payment, the contracted party can interrupt services as leverage until payment is made.

One alternative to mitigate that risk is to issue, in parallel with the performance contract, a fiduciary assignment of receivables as collateral, linked in an escrow account. Fiduciary assignment of receivables assigns fiduciary credits of water and sewer bills to the private contracted party. Fiduciary assignment is established by Law 9514/17, which regulates the real estate financial system. When the Civil Code was enacted in 2002, fiduciary assignment was expressly provided for in Article 1361 and subsequent Articles:

Article 1,361. It is considered fiduciary property to the not fungible movable property that a debtor, transfers, as a collateral, to a creditor.

In practice, the contracting party continues to hold the legal rights to credits generated by the water and sewer bills. However, in case of delinquency or bankruptcy of the contracting party, the contracted party becomes the definitive owner of such credits. It is essential that the fiduciary assignment identifies each credit assigned to provide a guarantee to the contract as a non-fungible, transferable asset.

In addition to the fiduciary assignment of receivables, it is recommended that an escrow account be created that enables the contracted party to block the resources of the contracting party in case of default. The escrow account may be structured in several ways. Figure 6.1 provides a simple example.
As shown in Figure 6.1, the contracted party, the contracting party, and the bank sign a contract, through which the contracting party authorizes that part of the receivables in its centralized account (the account where all water and sewerage bills collected from users are deposited) are transferred to an escrow account. Resources are then transferred to the contracting party’s bank account from the escrow account in the event of a default on payment. The contract must establish that a certain value must circulate daily through the escrow account (or alternatively, the escrow account must always have deposits of an amount equivalent to “X” times the monthly payment estimation owed to the contracting party).

If the contracting party does not pay the contracted party, the contracted party is entitled to request the bank to block resources deposited in the escrow account and to transfer them to the contracted party directly. The contracting party can neither interfere with nor oppose this procedure. An irrevocable mandate grants the bank the authority to transfer resources to the contracted party.

This type of warranty mechanism is widely used in funding (particularly by public banks, such as Caixa Econômica Federal and BNDES) and provides sufficient warranty to enable private companies to engage safely in performance contracts with public companies.

**Box 6.1: Key Concepts and Discussion Points for Chapter 6**

**Key concepts:**
- Tender
- Public-private partnership
- Public-public partnership
- Law 8666/93 – Tenders Law
- Law 12462/11 – Differential Public Procurement Regime
- Tender based on competition
- Contracting the whole work

**Points for discussion:**
1. Considering the cases presented, which judgment criteria must be used to assess technical and commercial proposals to issue a performance contract?
2. In light of Law 8666/93, what are the main legal issues regarding performance contract provisions?
3. What alternatives exist to mitigate risk related to the payment capacity of water utility companies in terms of the contracted party’s compensation?
7. Conclusions

This section sums up the main points covered by this manual. Water loss and energy inefficiency within Brazil’s water and sanitation sector are significant problems. The average water loss in Brazil is approximately 40 percent, including both real and apparent losses. After labor costs, expenditures on electricity represent the main cost of Brazil’s water utility companies.

Several strategies can be used to reduce water losses and increase energy efficiency. Brazilian water utility companies usually make use of technical service contracts and outsourcing of activities related to water loss reduction programs. Although widely used, these choices present some limitations. This manual suggests the use of performance contracts by public and private managers as a more appropriate tool to mitigate water loss and promote energy efficiency in the water and sanitation sector.

7.1 Reasons to Adopt Performance Contracts

Performance contracts provide a new approach to the challenge of reducing water loss. The foundation of a performance contract is that private agents are not paid just for rendering services, as is the case when activities are outsourced. Rather, private agents are paid when they reach specific targets set forth in the performance contract. The performance contract compensates the private sector based on delivery of results, not just the execution of several tasks. To balance the risks taken, private agents are granted the necessary flexibility to carry out their activities to achieve the best results in terms of water loss reduction and energy efficiency enhancements.

A performance contract’s success depends on a number of technical, financial, and legal aspects. The next subsections sum up the main aspects of each of these topics.

7.2 Technical Aspects

The manual explains in practical terms the main technical aspects involved in issuing a performance contract, including: obtaining data and defining criteria that can be used to create a baseline; defining the project area; collecting information necessary to model the project; and including a minimum scope to be reached by the service provider as set forth in the performance contract.

To create a valid baseline, it is essential to obtain data about the macro and micro measured water volume, water loss volume, value collected, value received, energy consumption, and value paid for energy, among others. The rate of apparent and physical losses, as well as the real cost of electricity, can be measured once the baseline is established. Defining the project area is essential to determining both the scope and the project’s success. Finally, it is fundamental to obtain basic information to calculate the investment and operational costs of the private contracted party, as well as to size the project properly.

7.3 Economic Aspects

The manual provides a simple script for carrying out an economic-financial evaluation of a water loss reduction or energy efficiency enhancement project. In that sense, it presents a review of essential financial concepts and demonstrates how a discounted cash flow analysis is the most appropriate assessment for performance contracts.
7.4 Legal Aspects

The manual addresses the main legal aspects involved in specifying performance contracts. First, it details the legal framework for these contracts. According to Law 8666/93, performance contracts are considered specialized, professional technical service contracts.

Next, it describes in detail the aspects associated with a tender and judgment criteria. Issuance of performance contracts that involve a state-owned company must usually be preceded by a tender. The manual also details the main legal issues regarding the performance contract’s provisions, in particular, the basic project, the contract term, and compensation mechanisms.

Another possible arrangement for reducing water losses in the Brazilian water and sanitation sector is public-public partnerships. The manual presents a case study of the first public-public partnership signed by two state-owned water utility companies, showing the advantages of replicating this model (adapted to the specific characteristics of other regions and domestic companies).

Finally, the manual provides the caveat that performance contracts are neither a magic solution for water utility companies nor a panacea for operational inefficiency. Nevertheless, provided that they are correctly formulated, they offer a powerful tool to bring short-term benefits, mainly in terms of increased cash availability and investment capacity for state-owned water utility companies.
References


