MEIF

(Method of Evaluation of Investment needs, Financing strategies and consequences on water pricing)

WP2: The factors determining investment needs

Deliverable 2

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Notice

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Deliverable 2: Identification of key variables for investment needs and proposal for a typology of territories (see sections 1, 2 and 3).

The project MEIF (Evaluation Methods for Investments in the Water Sector: Forward-looking financial strategies and water pricing) is conducted by a consortium led by PricewaterhouseCoopers (www.pwc.com/sustainability) in cooperation with the International Office for Water (www.oieau.fr) and the consultancy BIPE (www.bipe.fr).

More information on the MEIF project is available from the project website (www.meif.org).

Content

1 Key objectives and method

1.1 Key objectives of WP2

The objectives of the work package are twofold: to identify the drivers for investment needs, in the water sector, in a given territory; to propose a typology of territories as regards the key factors.

The hypothesis is that key factors depend on the type of territory under study. It is most likely that, given a set of factors, the weight of each factor depend on the features of each territory. For instance, in a rural region, with sensitive areas (such as costal areas), population growth will not have the same impact as in urban areas, with dense vertical housing.

1.2 Expected results

Two sets of results are expected from the tasks undertaken in this work package: a structured list of selected variables that determine investment needs in the water sector; and a typology of territories based in these variables.

The list of variables will be most valuable to evaluate the methods used to assess investment needs in the different countries, and to elaborate methodological principles that will apply to any kind of country and territory. The list has to be robust enough to meet this general goal; it has to be limited, so as to remain practical, even in the face of poor statistic sources.

The typology of territories will be used to select key determining factors, in a heuristic way, when considering a particular area.

1.3 Method

The organisation of network construction and renewal, and infrastructure investment over time can only be defined at a local level, based on local criteria, relating to the condition of the pipes and equipments. However, the amount of capital required urges to assess, at least roughly, the amount of money involved at a larger level (region or country), for a wide time span (century ?). Such an endeavour should identify the key deadlines and the materials that should be considered first for renewal.

The method implemented was designed to meet this objective, while taking into account the availability of data in the ten countries. The work was organised in four succeeding stages.

1. First, the existing literature was reviewed, in order to select a preliminary list of variables. The literature includes reports by research institutions and governing bodies, and financial models developed by such institutions (eg OECD and the World Bank). A selected bibliography is appended.

   The review allowed for the identification of a extensive list of variables. However, it failed to account for the actual weight of each variable. Moreover, it was impracticable, in particular in the face of the variety of data sources in he ten countries considered in MEIF.

For instance, if academic research confirms that investment needs are related to the history of network construction, including the materials used, terrain observation shows that network inventories are lacking most of the time and very few agencies have a robust knowledge of their network and equipments.

This is illustrated by the research recently undertaken by GEOPHEN in France. The research aims at identifying the drivers of investment needs at the national level. The approach relies on an in-depth inventory of existing networks, that includes the length of the pipes, the material used, and the time of construction. The same research has confirmed that knowledge of infrastructures and networks is very poor. Most cities do not know the length of the pipes that are used on their territory, the material used, the age of these pipes, and their quality. Moreover, some existing equipments are not used, such as reservoirs. Hence the need for extensive data collection, be it on a sample territory. Experience shows that such a survey requires some 10 to 20 man*month for a French department (nuts 2), including 1 or 2 days for each local water service (nuts 3).

Therefore, investment assessment cannot rely only on network inventories, since, most of the time, such inventories do not exist or are not reliable. Alternative factors should be identified.

Accordingly, for the list to be operational, key variables had to be extracted from this original material, where “key” refers to both the actual weight of the variable, and to the availability of data to monitor this variable.

2. Second, the list was confronted to the experience of a wide array of experts, through face to face interviews. The experts include members of research institutions, of financing agencies, and of operating services (in both private and public organisations) in charge of the management of water services with an international experience; the list of experts is shown in appendix 2.

   Experts were confronted to the original list, and were invited to pinpoint the most relevant variables. In addition, they had the opportunity to add new ones, which we had failed to identify, or to propose synthetic indicators, that account for general features and are readily documented.

   At this stage, variables were taken out of the list. For instance, we originally suggested that the breakdown of water uses by industry was a determining factor for investment in drinking water; experts argued that in practice, such a variable had little impact on the level of investment.

   Some experts insisted that climate, in particular the risk of long period of dryness, determines the nature and size of infrastructures (such as reservoirs). They also suggested that the existence of equipments did not mean that such equipments were actually operating; hence the need for a more synthetic appreciation of the state of the infrastructure, rather than an in depth inventory of existing facilities.

   Such discussions were very helpful to elaborate on the typology of territories. For instance, they identified regional or local policies as factor that divides territories into homogeneous classes.

3. Third, selected variables were organised in a structured framework, according to their extension, and their dynamic character (static *vs* dynamic variables). We propose to organise the list of variables according to which part of the water cycle they apply best:

- Some variables should be considered as general features, relevant for any aspects of the water services; this is the case for geographical items (such as the nature of the soil), or items related to the quality (an sustainability) of water resources;
- Other variables more aptly determine drinking water investment; drivers for demand certainly illustrate this category;
- Finally, variables such as urban organisation or the intensity of rain falls are more directly connected to waste water related investments.

4. A typology of territories was designed on the basis of these variables.

2 Identification of key variables for investment needs

2.1 Key variables (general features)

2.1.1 Geographical, topographical features, and the climate

- ✓ Area (km²) of the territory
- ✓ Nature of the soil, including permeability (limestone, argillaceous, other)
- ✓ Existence of sensitive areas (as defined by UWWTD 91/271/EEC, in % of the area)
- ✓ Hydrologic network

2.1.2 Population and the economy

- ✓ Million inhabitants and equivalent (for industrial uses)
- ✓ Age and revenue (as they determine consumption behaviour)
- ✓ Rate of population growth
- ✓ Permanent *vs.* seasonal inhabitants (%)
- ✓ Population density (inhabitants per km²)
- ✓ GDP/km² (indicates density, and financial resources)

2.1.3 The organisation of territories

The experience of water services shows that the extension of the water service across a larger territory allows for economies of scale, in particular as regards the number of water treatment plants (for both drinking and waste waters); investments are supported by a larger population and consumption.

France is a clear instance of this feature. Municipalities tend to join larger organisations at an intercommunal level, to mutualise equipments and investment. It has established that intercommunal services are more capital effective than municipal ones: for a given level of production and of population, they require a lower level of investment than the addition of smaller services. In England and Wales, water services were organised at a larger level, so as to maximise capital efficiency.

2.1.4 Quality of water resources

- ✓ Nature of pollutions
- ✓ Distance between water resources, the first water treatment plant, and areas of consumption; it should take into account the declivity of the land (gravitational advantage)

- ✓ Sustainability of the resources (defined as the % of renewable water)

2.1.5 Intensity and dispersion of rainfalls

These are drivers of levels of stocks required to meet with the event of dryness (from 90 days of consumption in the city of London to 5 years in Sidney), and hence of the size of reservoirs. They impact on the size of waste water networks as well, to collect and to drain rain fall flows and to prevent floods.

2.2 *Key variables for drinking water investments*

2.2.1 Detailed network related features

Terrain observations have identified the following drivers to define a sequence of investment needs at a national level. They are considered as detailed network related features.

- ✓ The material used;
- ✓ The age of the network;
- ✓ Technical considerations; these include the nature and the quality of joints, and related features;
- ✓ Expected life span of the network. It results from the quality of the original material, the geological nature of the soil (and its interaction with the material), and the quality of the civil works. It ranges from 50, to 75, and 100 years. Specific deadlines (2015) are due when plugging is in lead, or when materials contain asbestos.

Note that these variables account only for network renewal. Extension and construction of new networks have to assessed from other sources, just as the construction of new equipments (such as plants, or reservoirs).

Moreover, it assumes that physical inventories are available; which obviously is not the general case; hence the need for alternative indicators. Our research has identified the following ones.

2.2.2 Synthetic network related features

- ✓ % of population connected to public services
- ✓ % of lead pipes
- ✓ availability of reservoirs (impacts on cost and access to water resources)
- ✓ Opinion of a local expert on the rate of network that would need immediate repair

2.2.3 Drivers for demand for drinking water

These include:

- ✓ Technology,
- ✓ Demography (including the age of the population),
- ✓ Culture, as it defines water related behaviour. The wealth of the population (revenues) also impacts of the same features.

2.2.4 Water abstraction

- ✓ Global water abstraction (million m3)

- ✓ Ground water, spring and surface water withdrawal (million m3)
- ✓ Supply rate (%)

2.2.5 Municipal water production and delivery

- ✓ Production (million m3)
- ✓ Delivery (million m3)
- ✓ Losses (losses due to network, water distributed but not paid for)
- ✓ Consumption (l/day per head)
- ✓ Population metered

2.2.6 Drinking water quality

- ✓ Quality of drinking water
- ✓ Level of treatment of the drinking water treatment plants (% of total treatment flows, nature of treatment)

2.3 Key variables for waste water investments

2.3.1 Urban organisation

- ✓ Size of cities
- ✓ Rate of population connected to sewer systems
- ✓ Rate of population with autonomous waste water treatment

2.3.2 Industrial waste water

- ✓ Part of autonomous treatment

2.3.3 Rain falls

- ✓ Intensity of rain falls

2.3.4 Synthetic network related features

- ✓ Types of networks (combined *vs*. separate)
- ✓ Opinion of a local expert on the rate of network that would need immediate repair

2.3.5 Level of treatments

- ✓ Depollution rate
- ✓ Technologies in use
- ✓ Alternative treatments (industries and households, *lagunage*)
- ✓ Quality of final discharge

3 Proposal for a typology of territories

Based on the preceding considerations and on the expertise of the people we met during WP2, we propose to design a typology based on 5 variables.

Such variables certainly devise types of territories which share strong similarities. Moreover, they vary to a great extent in the ten countries under study. However, this typology can only be considered as a proposal, and it should be tested in a later stage of our research.

3.1 Overall water policy

Water policy at the local level is linked to environmental, social and economic goals.

Most of the general water policy that applies to a particular territory is set by Directives at the European level. However, territories regard these directives in specific ways, that connect to local features. If most territories consider these directives as a compelling regulatory framework, some may wish to put these regulations into perspective and adapt the pace of their implementation.

Hence, all territories do not share the same objectives, nor the same deadlines. Such discrepancies impact on investment strategies and needs, at a given moment in time.

The following objectives should be considered as determining factors:

- ✓ As regards drinking water: the quality of service and the use of available resources
  - Rate of population connected to public service (up to 100%),
  - Consumption,
  - Quality of distributed water; the framework directive sets an overall target, but local administration may adapt them to local constraints and opportunities, and set particular objectives or deadlines.
- ✓ As regards waste water: rate of population connected to public service
  - Quality of the collected water,
  - Depollution rate and technologies used for treatment.

Other objectives should be considered, such as incentives for autonomous production and sanitation, for households and industries. For instance, in Flanders, households are urged to collect rain water; this impacts on the level of investment for public services. The level of pre-treatment required for industries also impacts on investment needs for public services.

3.2 Existence of sensitive areas

Among geographical features, the existence of sensitive areas certainly is a key driver. It impacts on water policy and generates a set of constraints that should be considered as priority.

3.3 Quality of available resources

In Europe, it is fair to say that water is not a scarce resource. However, if raw water is available, the quality of the resource varies extensively across territories. Here, quality should be defined in a general way, including pollution and access to alternative water resources.

Quality of water resources determines the level of treatment required to produce drinking water.

3.4 Population density and economic development

Population density is defined in two ways:

- ✓ The average number of inhabitants per km²;
- ✓ The dispersion around this average number (e.g. existence of a core city).

In the same way, economic development is defined as the level and the concentration of economic activity.

Population density and economic development have similar and additive impacts on such features as water consumption and the production of waste water, the cost of waste water treatment and depollution, the availability of financial resources.

3.5 History of water services

In-depth inventories of the length, pace, and age of water pipes in 8 French departments (nuts 2) show two types of territories:

a) In rural areas, with disperse housing, networks were constructed fairly recently. The pace of network construction was particularly high in the 1960s and early 1970s, than slowed down in the 1980s, when adduction was mostly completed;

b) In more urban areas, where housing is more dense, networks were built earlier: 20% of the pipes existed before the 1940s; network extension is slow, and the pace is stable until the 1970s, where most of the population is connected.

It is noteworthy that the materials used are strongly related to the history of the network. Cast-iron pipes are more likely to be found in dense areas, where adduction was early, whereas plastic pipes (PVC) are more common in rural areas, with more recent networks. However, cast-iron pipes can still be found in recent networks of large dimension. Such broad and general results should be considered with caution, since regional habits and contextual features may prevail in some areas.

Such observations are in line with the experience of water services interviewed in the second step of the WP2. Water services confirm that the pace of investment in networks and infrastructures follows a three step history:

a) The early stage. The focus is on construction of the network and infrastructures. The main tasks to be undertaken include search for water resources, construction of water plants and of communal networks. At this stage, mutualisation across larger territories (such as intercommunality in France) reduces investment needs, since it facilitates concentration on fewer (but larger) equipments.

b) The extension stage. The focus is on connecting disperse housing and remote areas, since the bulk of the population is already connected to water services. It is also on the quality of the water that is produced and distributed.

c) The consolidation stage. Investment is directed towards the consolidation and interconnection of existing networks, and the search for alternative or secondary water resources. It is also on renewal, as the oldest parts of the network get old. Extension is related to economic growth and the location of new industries.

Note that such a sequence works well for drinking water. It is less relevant for the collection and treatment of wastewater, for which two modes of organisation prevail:

a) Either a linear approach, where investment follows a city by city approach;

b) Or a pollution approach, where specific issues are considered in turn, at a global level.

The latter is probably more cost effective.

It follows that the history of the water services on a given territory partly defines the main objectives of water policies and the nature and extent of investment programmes.