STRATEAU

Decision support tool

Strategic analysis and foresight tool for the balance demand/availability of water resources

Methodological note

Summary

Introduction

Since 2009 Energy Tomorrow insures mastering the work of **Strategic analysis and foresight tool for the balance demand/availability of water resources** detonated to be unfolded to the surrounding countries of the Mediterranean.

This tool has an objective to offer the locals a reflection base for **the establishment of a political public water management.** It is then about a **decision assisting tool** designated to clarify choices for the decision makers in all political strategy linked to **water demand management (WDM)** or having an impact on water offer.

Strategic usages of the tool

STRATEAU is developed for the purpose of **quantifying demands and resources in water in a territory** in order to place them towards each others. Then the users of the tool will be able to:

- **Localize pressures on water resources.** The tool allows visualizing on which territory and in which period of the year disequilibrium offer/demand takes place. The stakes linked to the management of water **resource look then clear to the user.**

- **Get a help for decision.** The tool offers a refined decomposition of the different instructions of use of the resource clarifying the structural actions to be implemented and the arbitrations needed to be done between the different water usages. Territorial strategies of management coherent to the resource could emerge from the clarification of the instructions of use. The implementation of scenarios authorizes the modeling impact of a development policy of any sector on the equilibrium offer/water demand.

- **Elaborate anticipation strategies.** Because of the tool, it would be possible to study the impact of future meteorological tendency through the scenarios implementation. We could then foresee action plans in order to avoid use conflicts.

It is then important to understand that **STRATEAU does not constitute of literally talking about an automatic generator of scenarios** since the anticipation will be generated by data entered by the users.

On the other hand, **STRATEAU does not allow carrying out virtual water calculations.** It provides information necessary for its calculation but it would not integrate essential elements for the restoration of virtual water as food chain.

At last, it is not about a modeling tool for hydrological behavior of tables and rivers, but about a **tool for modeling equilibrium offer/water demand on a territory scale.**

Specificity of the method

Modeling water demand and water resource involve calculation rules and homogeneous quantification representative of a territorial reality even before trying to define water management public policies.

The tool STRATEAU allows then working by:
- Integration the most precisely possible physical and chronological specificities of the considerate territory.
- Identifying the generated demands and their associated sourcing at the resource level.
- Taking into consideration the external multifactor influencing the water offer and demand.
- By offering the possibility of modifying hypotheses.
- By considering the water resource quantitative and the qualitative aspects all together.

By accounting for all these specificities, the tool responds for a **need for homogenous demands and territory water resources.** This homogeneity allows then comparing between different territories.
A method particularity lies in that we are looking to specifically assign a territory which depends on local political decisions and on the activity of the territory. The established parameter has to be brought closer to the **concept of responsibility of territories in respect to their water consumption.**
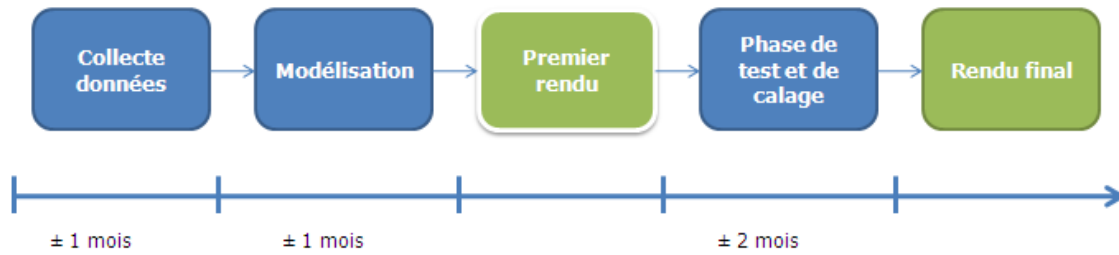
Different stages for the usage of the tool are the followings:

- **Data collection.** The phase of data collection is one of the most important stages. In fact, the most data is precise, the most the model results would be sharp. En effet, plus les données seront précises, plus les résultats du modèle seront fins. Articles such as function, irrigated surface land practices (usage rate, equipment rate, technological levels necessary for the modeling).. are also called data.
- **Modeling.** Modeling stage consists of integrating all collected data in the model, formatting all data being the most time consuming stage.
- **First copy.** A first copy is then available online. It is found as an Excel sheet document.
- **Fitting Phase and model testing.** After the online publishing of the results, a panel of 10 test users (people highly knowledgeable about the land) should be identified by the person in charge in order to compare the panel with facts at land level. Remarks are taking then into consideration in the model.
- **Final copy.** Once all remarks have been integrated into the model, final results could be revealed to all users.

Note that all lands' officials wishing to install the tool should get in contact with the Embassy of Water ambassadedeleau@orange.fr . They could find on the Embassy's website the list of needed data classified according to priority level for the tool establishment.
On the other hand, the Water Embassy is on the way to establish a data collection system performed by students through its partnerships with Engineering Schools of the Mediterranean basin.

Collecte données → Modélisation → Premier rendu → Phase de test et de calage → Rendu final

± 1 mois ± 1 mois ± 2 mois

(Plus les données sont précises et plus les résultats sont fins)

Time limits for the establishment of the tool are linked to:
- On the level of precision;
- land dimensions ;
- and the reactivity of test users.

On sites where all information are found and where the test users are reactive, the tool deployment could be fulfilled within less than 2 months. In contrary, sites where centralized statistical data is not available and where the young water ambassadors should highly interfere, then then the tool establishment could be extended to one year .

Note objectives

This document's objective is to show the used methodology in order to characterize lands. It describes how demands and resources are estimated and what are the data sourcing used.
This document only presents the calculation logics of the demands/water resources and not the algorithmic calculation of the final computing tool.

We will note the **innovative character of the proposed method**: It is about defining a method of compatibility and water resource being able to be deployed in a homogenous manner on all lands and satisfactory of the additive criteria, of coherence and being operational.

The kept methodology is the **methodology bottom-up descendent to the most refined stitch by default:** This choice of structuring allows the presentation of any level of acquaintance being statistical or issued from land inquiry. We structure our model with its physical description and the governing parameters group, insuring then the refined comprehension of the need generated by the nature's activity.

The demand modeling

Each possible use of water is indexed. We reconstitute then the demand according to the type of use of a given land for each of the six following sectors: Industry, energy, tertiary, agriculture, residential and environment. It is essential to point out that for each sector, **water demand is reconstituted,** data of the measuring sites are used only for the chock of the model and the checking of coherence of the results. Logic "bottom-up" is illustrated by figure 1:

Logiques de reconstitution de la demande

Maille nationale

Maille régionale

Maille communale

Secteur

Branche

Produit

Logique ascendante ou **bottom-up**

Logique descendante ou **top-down**

Agrégation d'informations

Reconstitution de l'information
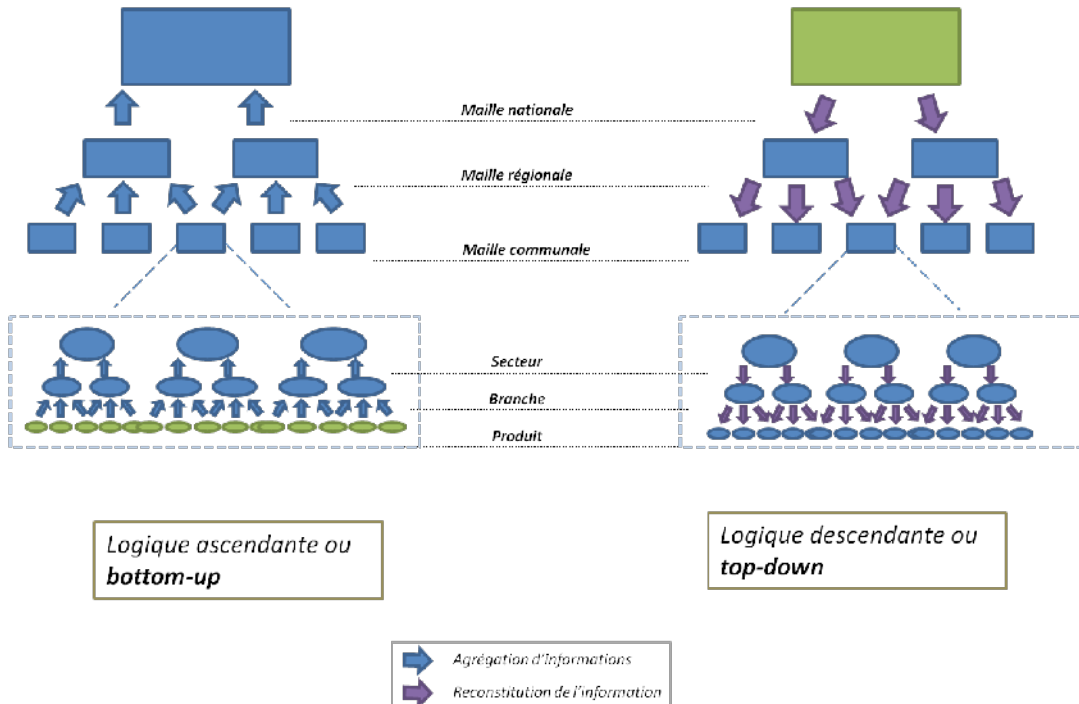
Figure 1 : comparison diagram of Bottom-up / Top-down

Modeling of the resource

Two types of natural resources are considered: **surface water** (rivers and lakes) and **groundwater** (water tables). These two reservoirs are naturally feed by infiltration and rainfall run off, and equally by some anthropogenic rejections. The model also allows the integration of **non conventional water resources,** such as water issued from sea water desalinization plants and reuse of wastewater.

Temporalization and territorialization

The resource is temporalized (resource available at seizing time) and territorialized (the most possibly precise place of seizing), also for the demand which varies with time and which is associated to a certain land.

Affectation rules

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Rules of affectation shall be implemented that will be able to precise the **taken part from this or that resource according to use.** The rejections are also affected either on surface water of on ground water.

This following figure summarizes the global process of the utilized methodology.
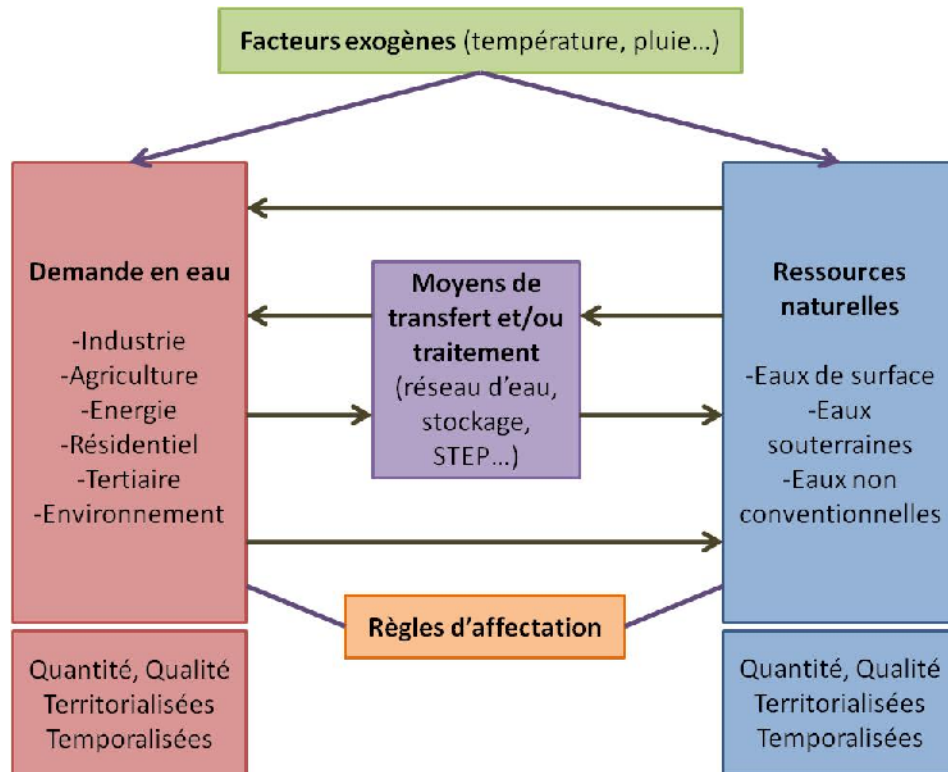

Figure 2: Global diagram of the methodology used

In order to model the demand, six sectors potentially water consumers and/or water withdrawers have been identified:

- The agriculture
- The industry
- The energy (electricity production)
- The tertiary
- The residential
- The environment (non cultivated land)

The tool takes a census of all water uses by the different **sectors** in a given land and at a given time. This cut up allows then to get water demand results by sector and in function of time, which will constitute an important information in order to help the local decision maker in the choice of the water demand management policies.

Each of the sectors is cut up into **branches,** then into **sub-branches** according to the codes of NAF (French activities index) and of INSEE (National Institute of Statistics and economical studies) in order to be complete and in coherence with other tools of Tomorrow's Energy. This index of words is distinctly French by the cut up is valid to all Mediterranean surrounding countries.

For each of the sub-branches, water use is segmented in **uses** called **primary**, that means the most refined uses possible. It is in order to get a well precise vision for the methods of use of the resource in the different sectors.

The model is the descendant of the most refined stitch to reconstitute the demand, but it also allows the whole unitary demand aggregation in order to obtain the most global results, on the branch or sector scale (see figure 1).

We will not describe here the branches, sub-branches, uses' families and identified uses due to a legibility concern: These shall be annexed.

Demand quantitative evaluation

In order to evaluate a land each sector's water demand, **a unitary water consumption is established for a final determinant proper to each sector.**

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For example, if we consider a bottle of soda as a final determinant, water has been needed at many levels in its manufacturing: for the raw material, for the employees' consumption (hygiene, drinking water), for cleaning… The tool user should only implement then the final determinant, here for example the number of soda bottles produced in its commune in order to obtain the water demand associated to the particular activity.

On the territories test, the final determinants have been implemented in the model; it is about production determinants for industry, employment of tertiary, number of inhabitants per resident… The user has no need to enter them, but he has the possibility to modify the final determinants, if for example he possesses more precise information.

The unitary consumption for each final determinant is provided by Energy Tomorrow, which is based on bibliographic researches but being able to be modified.

The industry

The industry sector is subdivided into branches, then into sub-branches according to NAF and INSEE codes.

For each sub-branch of the industrial sector water consumption by **final determinant** is established (how many tons of water are used for the production of 1 ton of lead, of one car…). Then we define an average production ratio used in France, to which an average water consumption is associated. As we dispose for each commune of the **manpower of the employees** in function of NAF codes, it is then possible to estimate water demand for each branch of industrial sector on the concerned territory.

On the territory where no data shall be disposed regarding the number of employees per sector or if it shows more pertinent for the user to enter directly the final determinant (i.e. production), this possibility is offered via the interface web.

The tertiary sector

The tertiary sector is equally cut into branches and sub-branches according to NAF and INSEE codes. The final determinants for this sector are the manpower: We consider an average water consumption per **employee**. This unit water consumption depends on the size of the considered company. As we dispose for each type of manpower in function of NAF codes, it is possible to estimate water demand for the different branches of the tertiary sector on the considered territory.

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Note that the consumption of the **visitors** of the branch « culture », the **students** of the branch education, sportsman of the branch « sports and leisure » and the **clients** of the branches « coffee, hotel, restaurant » shall be integrated. This data are available on INSEE site.

The Residential

For the sector residential, the final determinant is the **number of inhabitants per type of accommodation** (house or apartment). The type of accommodation modifies certain **equipment rate** (such those of swimming pools, gardens…) and consequently the final water consumption. Water demand for each resident is reconstituted by accounting for unitary water consumption for the kitchen, the hygiene, the cleaning etc… For each use, we also allocate an average **use level**, for example one shower per person per day.

The Energy

For the sector energy, the final determinant used is the number of **megawatt produced** by type of station (thermal, nuclear, etc…) found in the studied territory. Taking into consideration the particular stake of this sector and of the low number of stations, each station has been considered a subject for a deepened study.

The Agriculture

In the case of the agricultural sector, we distinguish two types of water demand: **Irrigation** water demand linked to cultivation type and water demand linked to **rearing**.

- Irrigation water demand linked to cultivation

In order to obtain water demand of irrigated crops, the model starts by calculating **monthly water need for each crop.**

Water need for the crops is then **compared to rainfall on the cultivated areas**. If rainfall rate is not sufficient to satisfy the crops' water need, then a supplementary water contribution is needed by **irrigation**.

Water volume which has been effectively supplemented by irrigation depends on the **irrigation system efficiency.** For a very efficient irrigation system (dripper) the supplied volume shall be close to the difference between crops' water need and rainfall. But for certain systems considered much less efficient (surface irrigation), water volume could be two times higher than the

effectively need. We consider that **the excess of irrigation water infiltrates** and returns to water tables.

Crops' water need calculation details :

Crop water need is assimilated to real evapotranspiration (ETR).

Real evapotranspiration (ETR) is calculated by multiplying potential evapotranspiration (ETo) by crop coefficient (Kc).

$$ETR = ETo * Kc$$

Potential evapotranspiration (ETo) is defined by Penman (1956) as being the needed water for a fresh green crop, of about the same color as grass, completely shading the ground, of fairly uniform height, and never short of water and never subjected to water shortage. It is calculated using Penman-Monteith formula and climatic data of the region.
The crop coefficient (Kc) is function of the type of cultivation and of its growth stage.

Illustration showing precipitation levels meeting crop water needs:
Illustration showing precipitation levels not completely meeting crop water needs:
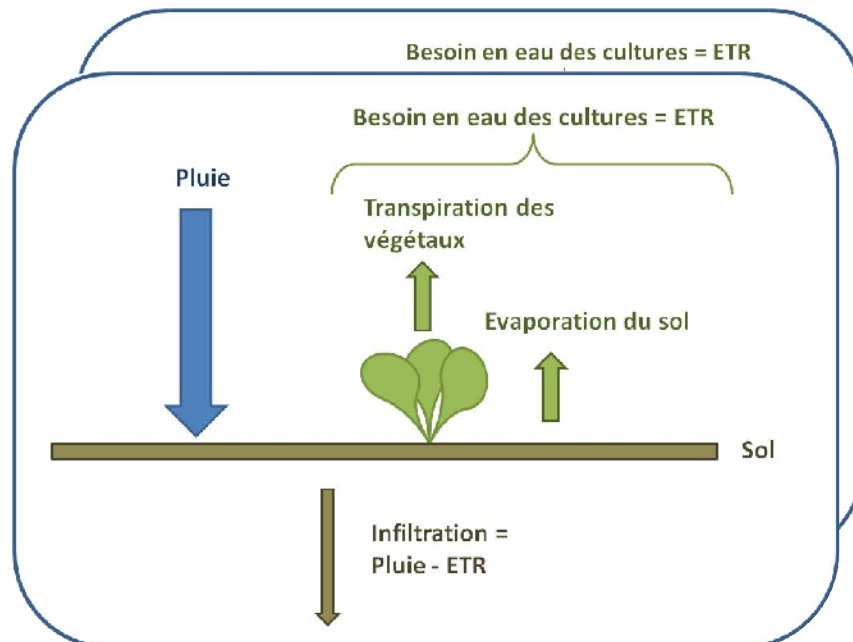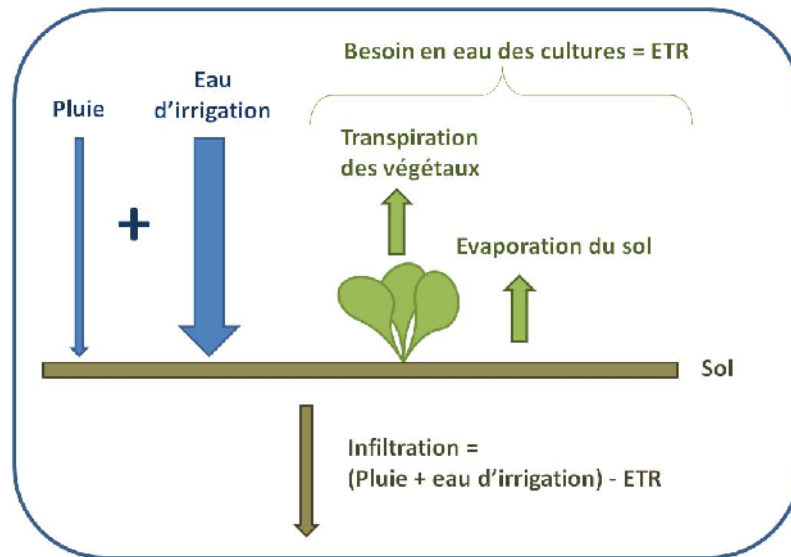
Necessary data for the reconstitution of irrigation water demand:

In Areas according to crop type

In France, in order to reconstitute agricultural areas per town, data were collected from Agreste, Statistics services the Ministry of Food, Agriculture and Hunting. First we relied on the Agricultural census (RA 2000) which provided information regarding agricultural ares of year 2000 as well as irrigated areas per crop. We have updated these information using Yearly Agricultural Statistics as well as investigations regarding orchards available at the departmental scale of Agreste scale. We shall also arrange the irrigated agricultural areas according to crops in 2006.

Irrigation methods

We got irrigation methods information using the same references (RA 2000, yearly agricultural statistics 2006 and orchards' investigation 2006). We allocate for each irrigation method, obtained using publications such as « Durable Irrigation » of MAAP in 2005.

Meteorological conditions

Plant needs vary in function of meteorological conditions. Accounted parameters are the followings: Precipitation level, temperature, relative humidity, sunstroke and wind. They allow evaluating ET0. We relied on Météo France years 2004, 2005 and 2006 data.

- Water demand linked to rearing

In order to calculate water demand linked to rearing in a certain territory, it is crucial to know **the size and composition of the herd** on the considered territory. From the unitary water consumption

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calculated for each type of animals (a technical sheet elaborated in 2007 by the Ministry of Agriculture, Food and rural affairs of Ontario shows daily water consumptions of different types of animals in function of their growth stage, their production and external temperature) it is possible to obtain the water sector's water demand.

Note that it is not about virtual water calculation, in fact water consumption for each animal does not account for water needed for its food.

The environment

The environmental demand is treated in the model as well. It corresponds to the **water demand of wooded areas in the territory.** Using the same type of calculation as for the crops, we reconstitute water demand for each type of forests. This environmental demand could be compared to precipitation levels on the territory, which allows the user to observe if the forest is subject to water stress in a certain period of the year.

Aquatic systems water demand is not directly treated in the demand part, but it will be possible to observe on the offer level is rivers' flow gets below a minimum reserved flow essential for the ecosystem's maintenance.

Territoralizsation and temporalization of the demand

The model is also capable of **temporalizing and territoralizing each demand**. This essential task is extremely dependant of the available data. If the final determinants allowing the reconstitution of water demand are available to the communal stitch, then the demand evaluation could be done on such a precise scale. If the user wishes to obtain the water demand on a larger territory, then water demand will be constituted of the commune water demands (that constitute it) aggregation. Thus we could rise to a sloppy basin scale as well as to the whole country.

In the case where evaluation's necessary information are only available on global scale, demand's evaluation will be done in a general way on this territorial stitch.

Territorialization

In France, demands are reconstituted on the commune scale.

For industrial and tertiary scales, territorialization is done globally using NAF codes' effectives given on the communal scale, then in function of the number of employees per sector. Note that for the

industrial sector, it is also possible to directly enter the final determinant to which a unitary consumption is associated.

For water demand linked to cultures and environment, territoralization is done using irrigated areas localization (Agrest) and forests' areas on each commune (Corine Land Cover).

Temporalization

Concerning temporalization, demands could be generated according to two time steps. All demands are evaluated on menstrual time scale and the user could choose via web interface the generation of temporary more refined outlets for the residential and industrial sectors.

Monthly demand

According to sectors, **the activity is plus or minus dependant on the period of the year.** Thus a monthly activity level is defined for each sub-branch.

For example, in the case of the principal residential, this percentage shall be less in summer than in winter (holidays period during which some people are out of their houses).

For the industry in France, the level of activity is calculated according to the yearly evolution of the industrial production index realized every year by INSEE.

This activity level is also territoralized in order to account for the differences between territories.

Note that for agricultural demands (crops), sowing and harvesting dates are considered instead of the activity level.

Off-season demand

The most delicate stitch is the off-season by which we define **hourly demands profiles for 3 standard days: day of the week, Saturday and Sunday.** The cut up of the demand according to this stitch is **pertinent for the residential and the industry.** For the other sectors, a temporary stitch is used due to the difficulty of getting more precise information.

In order to reduce the calculation time, we chose to perform off-seasons' outlets **only on user's special request.** That means that the user performs first the possible monthly extractions then the off-seasons by checking this functionality on the web platform.

For that, an hourly utilization level is implemented by default describing water utilization tendencies by hour and by standard day (for example, using toilets shows two peaks in the beginning and at the end of a day being visible on the outlet graphics). For the French industry, this utilization level is based on the employees' work rhythm of the industrial sector. These values are taken by default for the other basins shown the lack of information we dispose.

Equipment level and exogenous factors influence

Equipment level consideration

For each final determinant, **three unitary consumption values** are disposed by Energy Tomorrow: **an economical consumption, normal or high.** These three consumption values implemented by default are modifiable. If the user disposes of equipment levels, he could have access to the most possibly precise estimated demand.

To illustrate this equipment level, let's discuss the example of crops water consumption: The « high » equipment percentage corresponds to the share of the crops irrigated by gravity (water is transported to the border inside the parcels in canals laid out according to the natural slope), the « normal » equipment percentage corresponds to sprinkle irrigation, and the « weak » to trickle irrigation (dripper).

Exogenous factors' influence

Some exogenous factors (temperature, rainfall, pressure, etc…) are also taken into consideration in water demand modeling. These factors **modify unitary consumption of certain methods**: temperature and rainfall have influence of crops' irrigation. Temperature also has influence on residential water consumption (swimming pools and gardens…).

In the model, monthly average values of these different factors have been associated to the different territories. But these values are modifiable for a user disposing of more precise data on a territory.

Scenarios creation

The tool's consideration of the equipment level's influence and demand climatic data will be one of the means of realizing **prospective scenarios** by implementing obtained values by climatic models for example or by analyzing the influence of one technology crossing the other on water demand evolution.
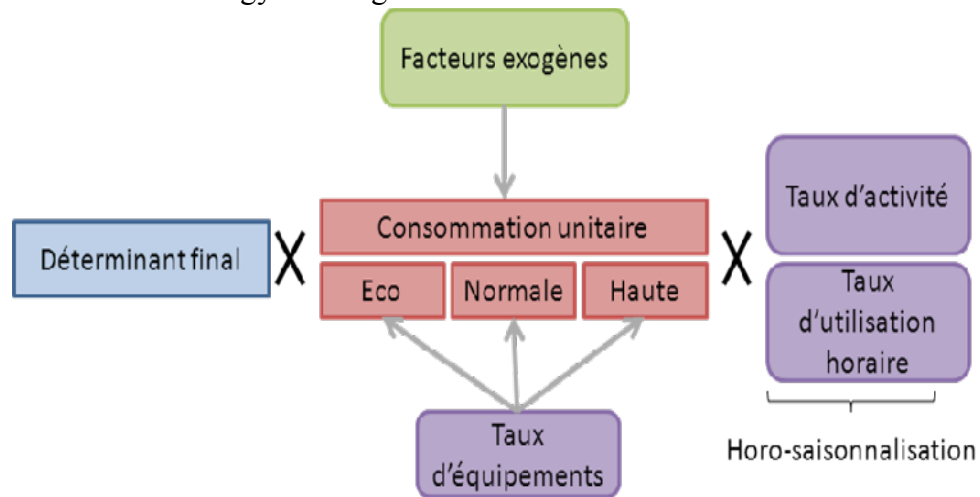
Figure 3 : General method of water demand calculation

The drawing here below recapitulates water demand calculation method for each sector:

Demand qualitative evaluation

The different uses do not require the same water quality: in fact it could vary from non drinking water for cooling to extra pure water for the electronic industry for example.

Shown the big number of pollutants and pollutants modeling complexity, we opt for **water quality brief evaluation**. Water quality is not quantified but evaluated at 3 levels (bad, normal, good) in each of the following categories: macro-chemical, micro-chemical and biological pollution. We distinguish **the necessary quality for a method for rejected quality all through the process.**

It is yet difficult to precisely measure the impact of these rejections on the resource when the different pollution levels are qualitative. It will be then uniquely possible to precise **the quality of the rejected water.**
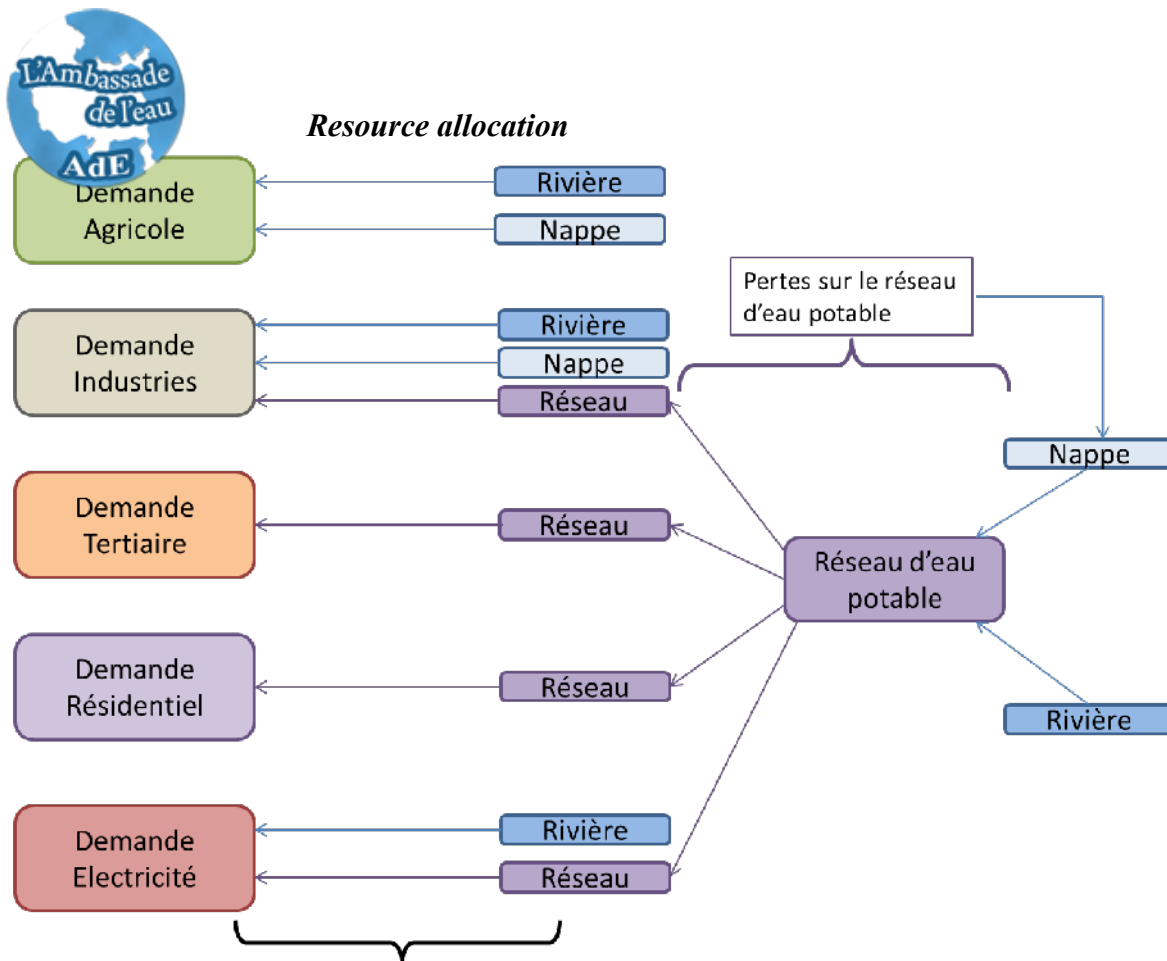
Resource allocation

- **Figure 4: Diagram of assignment between demand and available resources**

For each of usage types, **the demand shall be shared out between surface water, water tables and drinking water springs** respectively associated to the territory where the demand is generated. The drinking water network is drawn by itself into water tables and surface water. When water flows in drinking water networks, we introduce **network water losses.** The percentage of network water losses is changeable data.

For each sector, demand repartition between the different resources is very variable and could be modified in function of available information and accessible resources in each territory. In he model, the entered data by default correspond to the case study of France (the chosen reference document is «Water levy in France in 2001, version 3 », RNDE, Mars 2004).

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Demand rejections and network losses

For each type of water use, a certain percentage of levied water is rejected in order to satisfy the demand. Water could be **directly rejected** (in the case of certain industries, electrical stations and septic pits) or after crossing **a sewage plant** (STEP). The rejections are then allocated to different resources of the territory: ground water and water tables. We also take into consideration the part of the rejections on sea level for coastal territories.

Irrigation water part that has not been consumed by the crops could infiltrate and recharge water tables. This non consumed water volume depends on the irrigation system efficiency being as well a changeable parameter.

Network losses are also integrated in the model, there also could be losses on the level of drinking water distribution network. We consider that these losses infiltrate and recharge ground water.

- **Figu
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Volume d'eau potable prélevé à la source

Volume d'eau prélevé à la source pour les centrales électriques et les industries

Pertes du réseau de distribution

Volume d'eau distribué

% de rejet fonction du type de centrale

% de rejet en fonction du type d'utilisation de l'eau

Volume d'eau rejeté

Volume d'eau rejeté

Volume d'eau qui ne passe pas par la STEP

Volume d'eau qui passe par la STEP

infiltration

Ruissellement

Rejet direct

Rejet direct

Retour nappe

Retour rivière

Infiltration

Volume d'eau apporté pour l'irrigation - (consommation des cultures)

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Concerning water offer, the model takes into consideration **the natural water offer** as well as **non-conventional water resources**.

The natural water offer is calculated using precipitation on territories feeding surface water and ground water. Exchanges between water tables and between water tables and rivers are not yet integrated being full of complexes. Non-conventional water resources being in use by the model are water issued from sea water desalination plants and reuse of sewage water.

Attention, we recommend all users to interpret the actual status of the resources considering the **differential** values and not as modeled by STRATEAU. That means that the resource evolution over another in a month (or in a year) informs about the actual tendency. We could then observe if a resource is diminishing without being able to quantify the reduction level precisely.

Precipitations

For each of the treated territories, water resource is calculated using precipitations occurring on the territory. The model considers **monthly rainfall** volumes, it is then important to signal that **the model does not account for extreme phenomenon** such as a violent rainfall event.

Using rainfall occurring on the territory, the **fraction of infiltrated water** that is recharging water tables could be then determined as well as **runoff** fraction that is feeding surface water.

That's why it is essential to know first the **efficient precipitation,** which is the rainfall water fraction that will remain available on ground surface after subtracting evapotranspiration losses. **Real** e**vapotranspiration** corresponds to the total water quantity transferred from the ground to the atmosphere through soil evaporation and plants transpiration. Once we know efficient rainfall, it is essential to be able to allocate a part of this water to water tables and the other part to surface water. In the model, efficient rainfall is not recalculated except in the case of irrigated crops. For other surfaces, we directly utilize efficient rainfall monthly values provided by météo France.

For France, an index exists: the **IDPR** or Index of Development and Persistence of Networks, directly evaluating the intrinsic soil

capacity of infiltrating or running off surface water. This index allows us to access an infiltration percentage on a given territory. This percentage once applied on rainfall water quantity available on soil surface, gives access to water quantity joining water tables as well as runoff water.

We apply IDPR on all territory except in certain particular cases of soil occupation:

- In urbanized zones, we consider that a certain percentage of this zone is impermeable on this part. Water only runs on permeable parts.

- In irrigated agricultural zones, we calculate crops water need (ETR). If this need is lower than efficient rainfall infiltration (corresponding to precipitations to which crops' needs have been subtracted). If this need is higher than precipitation level, we calculate water volume needed for irrigation, and then the exceeding shall be infiltrated.

Groundwater

Amongst water tables, we distinguish the alluvial and the deep water tables.

Alluvial water tables are directly feed by soil infiltration originated from precipitation. Their reservoir being constituted from a porous rock lying on a permeable layer, alluvial water tables are sensitive to climatic and seasonal variations.

Deep water tables, or captives, are separated from soil fluxes by one or more impermeable layer. These reservoirs are only feed in particular zones called « refill zones », where part of the water table receives water from precipitation. These water tables being most of times protected from pollution and less sensitive to climatic variations, could be sometimes threatened by a quantitatively intensive mining.

The target of ground water modeling is to obtain a water quantity enough to be mined in a one month period on a given territory. That's why; it is suitable to have access on the monthly rechargeable part of the water tables. Water tables recharge depends on its type, its area and on the infiltrated water quantity.

Offer territorialization

In a first place, it consists to know whether it is possible to localize water tables using SIG software, in a way to physically localize infiltrated water volumes and to allocate a part of the territory water demand to water tables located under this one.

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In the case of France, an existing water tables map is not used since water tables' hydrological codes are not same as those of the CAT_Prelevement data base. We chose to localize water mass surrounding the CAT_prelevement data base sampling points having the same identifier « water mass » using a convex envelope and to consider that it is roughly about to water table's shape.

Here under, an example of a water table reconstituted by sampling points for AIN department:
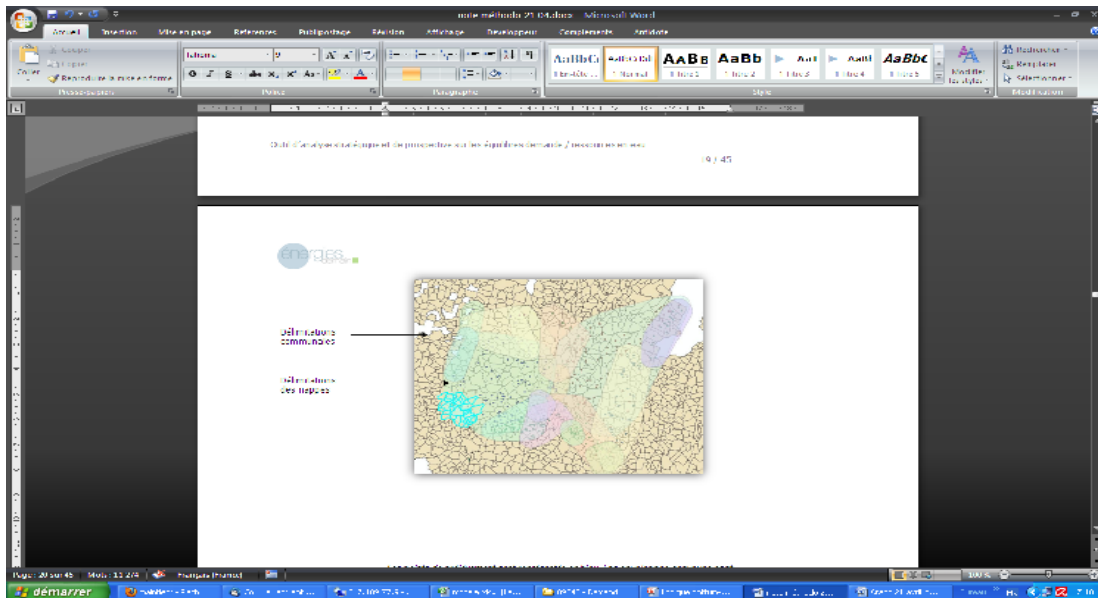
Figure 6 : Groundwater in the department of Ain

Sampling points are represented in blue. Convex envelops in color, water mass are situated at different depths.

For territories where ground water mass localization is impossible, infiltrated water volumes are allocated to the whole territory demand without any consideration of the physical fact of this allocation.

Offer quantitative evaluation

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Natural filling of water tables

Water tables are naturally refilled by infiltration of rainwater and by exchanges with the rivers. In this model, infiltration shall only be accounted for in water table refilling. Water exchange between water tables and surface water as well as exchange between water tables are not accounted for since no methodology could be applied on all exchanges.

Monthly natural filling will be then calculated using rainfall infiltration on a certain territory by distinguishing as mentioned earlier between irrigated agricultural zones, urbanized zones and the other zones.

Anthropogenic refilling on water tables

Rainfall water infiltration is not the unique water tables' refilling source, we also distinguish:

- Infiltration of rejections not being treated in sewage plants (rejections in septic pits).

- Infiltration of water distribution networks' leakages.

- Artificial refilling of water tables could also be considered monthly.

The drawing below synthesizes the used methodology to calculate refilling water tables' volumes:
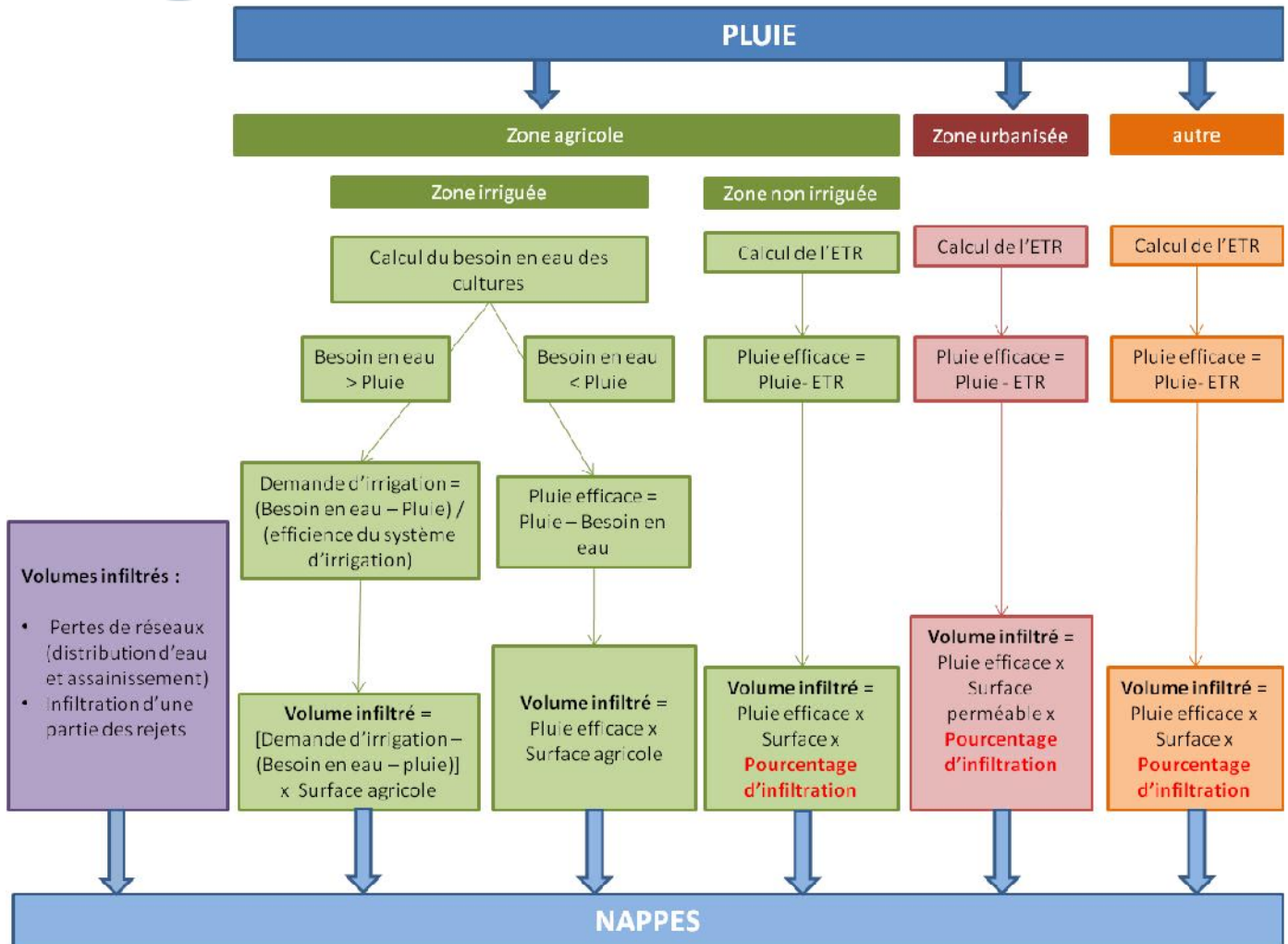
Figure 7 : Infiltration to the ground

Once we can reach the infiltrated water quantity on the territory, the monthly infiltrated water volume is equally subdivided between all water tables. We obtain then a renewable water quantity similar to the minable quantity on the studied territory.

Offer temporalization

Infiltration durations are different according to the type of water tables. For alluvial water tables (rivers accompaniment water tables), a little deep, we consider infiltration duration of one month. For the other water tables, infiltration duration is by default of 12 months unless more precise punctual information exists for certain water tables.

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Allocation with the demand

A certain part of the calculated water demand on the territory is taken from ground water. This demand is subdivided by the number of accessible water masses from this territory (by the number of all water masses if these are not localized) in order to equally distribute water demand between water tables.

Each month, a water table balance sheet will be carried out and reported for the next month, which means:

Balance sheet of the month (n)=Infiltration of the month (n)-Water demand of the month (n)+Balance sheet of the month (n-1)

We will have then the renewable volume balance of the water table every month, this balance being able to be negative in certain moments, when mining is temporary higher than the renewable volume of the considered month.

The main problem of this modeling is the obtaining of the initial status of the system: the information will be utilized when this latter will be available or estimable. We will start by a null balance in the contrary case.

Surface water

Surface water resources are constituted of rivers and lakes. They are naturally feed by rainwater runoff efficient for the soil and by water tables' exchanges, so it would be by anthropogenic contributions. That is to say by dams' rejections or water rejections after use.

Offer territorialization

For the case of France, we utilize Carthage® data base which refers all waterways of France. Each hydrologic entity is broken down into elementary hydrographic sections. Fro each section we dispose information regarding upstream section(s) and/or downstream section(s). By crossing these data with administrative maps, it is possible to associate for each commune basin correspondent hydrographic sections.

For certain sections, we dispose information regarding flows (hydro Bank source). By allocating a weight to each section, it is then possible to reconstitute the flow on the whole network due to the timing data.

Water volume entering into a section is equal to the sum of volumes leaving the upstream sections. Note that we balance volumes by the size of the river, the more a river is large (information found in Carthage base), the more its weighing coefficient is high.

For the sections with no upstream, we have reconstituted the sections' volume by going back to the closest downstream measuring stations in order to avoid aberrations such as in river having a null flow and being on the border of the basin.

For a given territory, we consider that the accessible surface water resource is uniquely the one situated on the territory.

The drawing here below summarizes surface water exchanges group that will be accounted for:
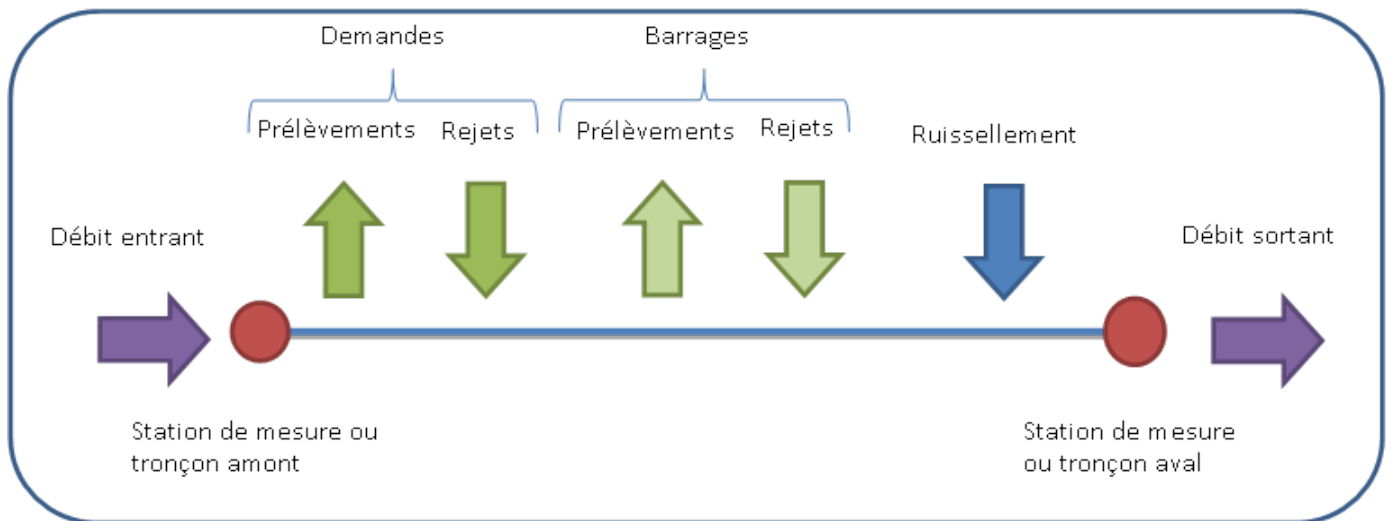
Offer quantitative evaluation

Rivers natural refilling

Rivers are naturally recharged by runoff water and by phreatic water tables exchange. In this model, we shall only consider rivers' refilling by runoff water.

Natural monthly recharging will be then calculated from runoff of part of the rainfall occurring on a territory by distinguishing, as previously defined, irrigated agricultural zones, urbanized zones and other zones.

Strategic analysis and foresight tool for the balance demand/availability of water resources

Runoff volume is then uniformly subdivided in proportion to the number of sections situated in the commune.

Anthropogenic refilling of rivers

- Water demand rejections

  Here it is about industrial and electrical stations' rejections directly flowing to the river, as well as after treatment wastewater plants' rejections.

  As for runoff, rejected runoff is uniformly subdivided in proportion to the number of sections situated in the commune.

- Dams' rejections create a temporal shifting

  Dams' water rejected volume depends on the season, dam's volume as well as on the dam's type (hydroelectrical dam, or low water supporting dam). Dams with hydroelectric vocations mainly leach in winter and a little in summer, as for the others, they mainly leach in summer in low water. Note that we integrate the evaporation of part of dams' water caused by wind and temperature.

  The drawing here under synthesizes the utilized methodology for volumes' calculation recharging the rivers:

Strategic analysis and foresight tool for the balance demand/availability of water resources
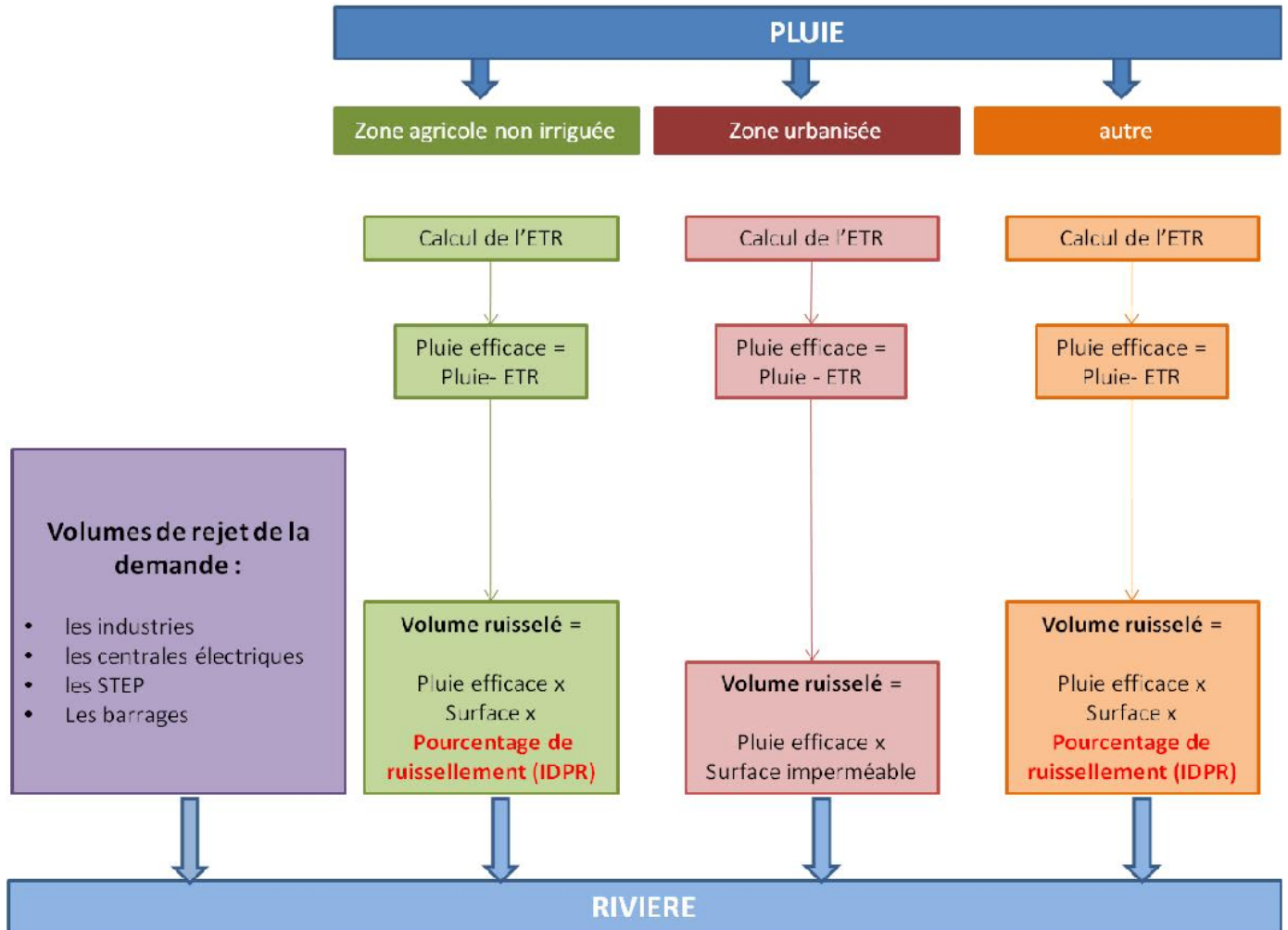
Figure 9 : Runoff into rivers

Offer temporalization

We consider that the needed time for a runoff is less than one month; it is then the efficient precipitation for month n that refills sections of month n.

Same for industrial, electrical stations and wastewater treatment plants' rejections, we consider that rejections for month n refill sections of month n.

But in the case of dams, rivers' rejections are done in a form which is special for the considered dam (hydro-electric or low water dam).

Strategic analysis and foresight tool for the balance demand/availability of water resources

Allocation with the demand

A certain part of water demand calculated in the territory is taken from surface water. This total demand is uniformly distributed between different hydrographic sections present in the territory.

Non conventional water resources

Sea water desalination

The model allows integrating a fresh water offer issued from sea water desalination. If we dispose information on the desalination plant production on the territory, this one is integrated as a supplementary resource.

Wastewater reuse

The model allows accessing the water volumes passing by purification stations. It is then possible to allocate a certain water percentage for uses not requiring fresh water (agriculture, gardens' watering), and to evaluate the impact of wastewater reuse increase on the balance offer/demand.
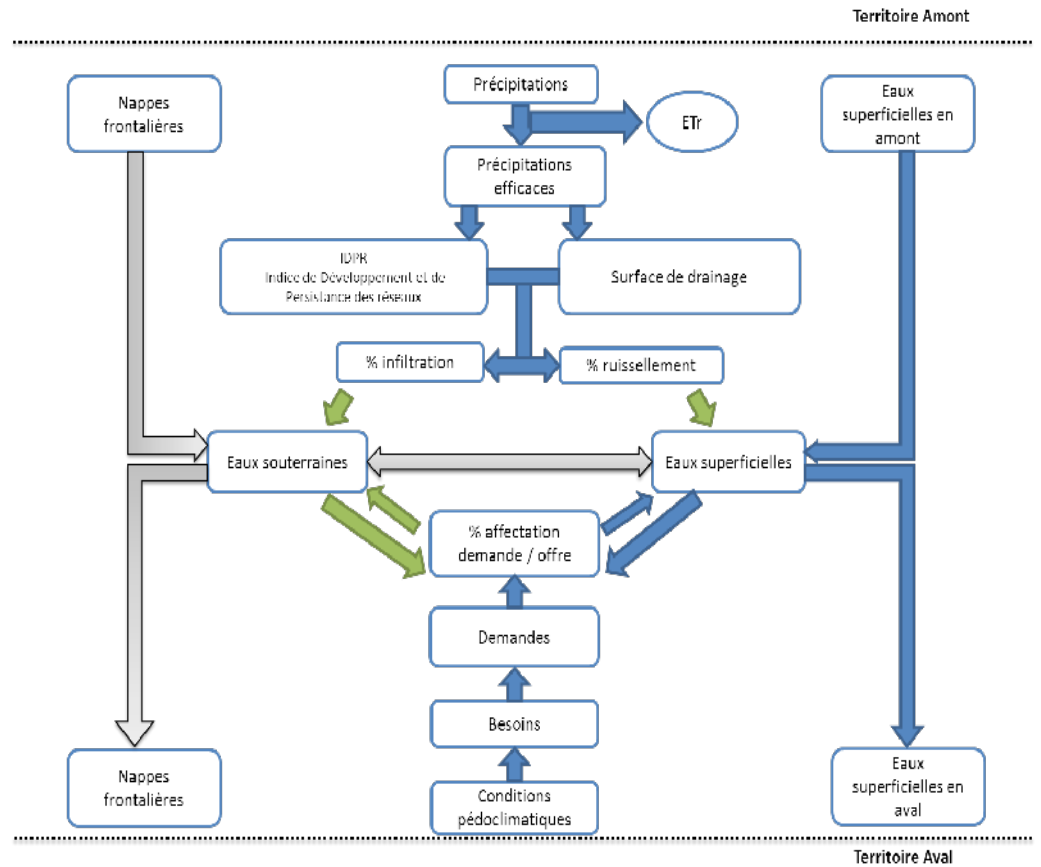
Annexes

Demand's Fragmentation

Sector

Agriculture

Industry

Energy

Tertiary

Residential

Environment

Branches

Agricultural Culture

Livestock

Coal and Lignite Mining

Hydrocarbons Extraction

Metal Ores Extraction

Other Extraction Industries

Extraction Industries Support Services

Food Industries

Beverages Industry

Tobacco Products Industry

Textiles Industry

Clothing Industry

Leather and Shoe Industry

Wood Manufacture as well as wood and cork products, except furniture,

And manufacture of articles of straw and plaiting materials

Paper and Paperboard manufacturing

Printing and Recordings Reproduction

Manufacture and Refining of Coke

Chemical Industry

Pharmaceutics Industry

Manufacture of Rubber and Plastic Products

Manufacture of Other Non-Metallic Mineral Products

Metallurgy

Strategic analysis and foresight tool for the balance demand/availability of water resources

Metal Products Manufacture, except Machinery and Equipment

Manufacture of Computer, Electronic and Optical Products

Electrical Equipment Manufacturing

Machinery and Equipment Manufacture (NCA)

Automotive Industry

Other Transport Material Manufacturing

Furniture Manufacturing

Other Manufacturing Industries

Repair and Installation of Machinery and Equipment

Building Construction

Civil Engineering

Specialized Construction

Production and Distribution of electricity, gas, steam and Air Conditioning

Trade

Offices

Transport (local only)

Cafes - Hotels – Restaurant

Community Habitat

Culture

Administration

Education

Health

Special Services such as Blue Elephant

Sports, Entertainment…

Rural zone

Urban Zone

Artificial Territories

Agricultural Territories

Forests and Semi-Natural Zones

Humid Zones

Water Surfaces

Sub-Branches

Coal Mining

Lignite Mining

Crude Oil Extraction

Natural Gas Extraction

Strategic analysis and foresight tool for the balance demand/availability of water resources

Iron Ore Mining

Uranium and Thorium Ore Mining

Mining of other non-ferrous metal ores

Quarrying of ornamental and building stone, limestone, gypsum, chalk and slate

Sand and gravel operations, clays and kaolin Mining

Mining of chemical and fertilizer minerals

Peat extraction

Salt Production

Other Extraction Activities (NCA)

Supportive Activities for the Hydrocarbons Extraction

Supportive Activities for other extraction industries

Meat Processing and Preservation

Poultry Meat Processing and Preservation

Meat Products Preparation

Processing and Preservation of fish, crustaceans and mollusks

Potato Processing and Preservation

Preparation of fruit juices and vegetables

Other Processing of fruits and vegetables

Oils and Fat Manufacturing

Manufacture of margarine and similar edible fats

Operation of dairies and cheese making

Ice and Sorbets Manufacturing

Grain work

Starch Products Manufacturing

Bread and Fresh Bakery production

Manufacture of biscuits, crackers and pastries conservation

Pasta Production

Sugar Production

Production of cacao, chocolate and confectionery products

Tea and Coffee processing

Condiments and seasonings manufacturing

Prepared Meals Production

Homogenized and dietetic food Production

Other food Production (NCA)

Food production for farm animals

Food production for pets

Distilled alcoholic beverages production

Wine production (grapes production)

Strategic analysis and foresight tool for the balance demand/availability of water resources

Manufacture of cider and fruit wines

Production of other non-distilled fermented beverages

Beer Production

Malting

Industry of mineral waters and other bottled water and refreshing drinks

Tobacco products industry

Textile fibers fabric and spinning

Weaving

Textile finishing

Manufacture of Knitted & Crocheted fabrics

Manufacture of textile articles, except apparel

Carpets and rugs manufacturing

Manufacture of cordage, ropes and nets

Manufacture of non-woven, except apparel

Manufacture of other technical and industrial textiles

Other textiles manufacturing (NCA)

Leather clothes manufacturing

Work wears manufacturing

Outerwear manufacturing

Underwear manufacturing

Other clothes and accessories manufacturing

Fur wears manufacturing

Manufacture of Knitted & Crocheted footwear

Manufacture of other knitted fabrics

Leather tanning and dressing; fur dressing and dyeing

Manufacture of luggage, leather goods and saddler

Footwear manufacturing

Sawmilling and planning wood

Manufacture of veneer and wood panels

Manufacture of assembled parquet floors

Manufacture of carpentry and other millwork

Wooden packing's manufacturing

Manufacture of other wooden products, manufacture of cork, straw and plaiting fabrics

Paper pulp manufacturing

Paper and paperboard manufacturing

Manufacture of corrugated paper and paperboard and of packing's of paper and paperboard

Manufacture of paper household and sanitary goods

Manufacture of paper stationery

Strategic analysis and foresight tool for the balance demand/availability of water resources

Wallpapers

Manufacture of other paper or paperboard goods

Newspaper printing

Other printings (commercial)

Pre-press activities

Bindings and related activities

Recordings reproduction

Coke manufacturing

Oil refining

Manufacture of industrial gases

Manufacture of dyes and pigments

Manufacture of basic inorganic chemicals

Manufacture of basic organic chemicals

Manufacture of fertilizers and nitrogen compounds

Basic plastics manufacturing

Synthetic rubber manufacturing

Manufacture of pesticides and other agrochemicals

Manufacture of paints, varnishes, inks and sealants

Manufacture of soaps, detergents and cleaning products

Manufacture of perfumes and toiletry goods

Explosives manufacturing

Glue

Essential oils manufacturing

Other chemicals manufacturing (NCA)

Manufacture of artificial or synthetic fibers

Basic pharmaceutics manufacturing

Pharmaceutical preparations manufacturing

Manufacturing and retreading tires
Manufacture of other rubber products
Manufacture of plastic plates, sheets, tubes and plastic profiles
Manufacture of plastic packing
Manufacture of plastic products for construction
Manufacture of other plastic products
Manufacture of flat glass
Shaping and processing of flat glass
Manufacture of hollow glass
Manufacture of fiber glass

Manufacturing and shaping other glass including technical glassware

Manufacture of refractory products

Manufacture of ceramic tiles

Manufacture of bricks, tiles and construction products, in terra cotta

Strategic analysis and foresight tool for the balance demand/availability of water resources

Manufacture of ceramic household or ornamental

Manufacture of ceramic sanitary ware

Manufacture of insulators and insulating ceramic

Manufacture of other technical ceramic products

Manufacture of other ceramic products

Cement

Lime and gypsum

Manufacture of concrete products for construction

Manufacture of gypsum products for construction

Manufacture of ready concrete

Manufacture of mortars and dry concrete

Manufacture of fiber-cement

Manufacture of other concrete, cement or gypsum products

Cutting, shaping and finishing stones

Abrasive Product Manufacturing

Manufacture of other non-metallic mineral products (NCA)

Steel industry

Manufacture of tubes, pipes, hollows and correspondent steel accessories

Cold bar stretching

Cold Strip lamination

Cold rolling by forming or folding

Cold drawing

Precious metals production

Aluminum metallurgy

plumb, zinc and tin metallurgy

copper metallurgy

Metallurgy of other non-ferrous metals

Developing and processing nuclear components

Foundry

Steel foundry

Light metal casting

Casting of other non-ferrous metals

Manufacture of metallic structures and structural parts

Strategic analysis and foresight tool for the balance demand/availability of water resources

Manufacture of metal doors and windows

Manufacture of radiators and boilers for central heating

Manufacture of other metallic tanks, reservoirs and containers

Manufacture of steam generators, except central heating boilers

Manufacture of weapons and munitions

Forging, stamping, powder metallurgy

Treatment and coating of metals

Machining

Cutlery

Manufacture of locks and hinges

Tooling

Manufacture of steel drums and similar metallic packaging

Manufacture of light metal packaging

Manufacture of metal wire goods, chains and springs

Manufacture of screws and bolts

Other fabricated metal products (NCA)

Manufacture of electronic components

Manufacture of electronic boards

Manufacture of computers and peripheral equipment

Manufacture of communication equipment

Manufacture of consumer electronics

Manufacture of instruments and appliances for measuring, testing and navigation

Horology

Manufacture of irradiation, electro medical equipment and electro therapy

Manufacture of optical instruments and photographic

Manufacture of magnetic and optical supports

Manufacture of electrical motors, generators and transformers

Manufacture of material for electricity distribution and control apparatus

Manufacture of batteries and accumulators

Manufacture of optical fiber cables

Manufacturing other wires and electronic or electrical cables

Manufacture of electrical installation material

Manufacture of electrical lighting instruments

Manufacture of domestic appliances

Manufacture of non-electrical domestic appliances

Manufacture of other electrical equipments

Manufacture of engines and turbines, except aircraft engines and vehicles

Manufacture of hydraulic and pneumatic equipments

Strategic analysis and foresight tool for the balance demand/availability of water resources

Manufacture of other pumps and compressors

Manufacture of other taps and valves

Manufacture of gears and mechanical transmission

Manufacture of stoves and burners

Manufacture of lifting and handling equipment

Manufacture of machinery and office equipment (except computers and peripheral equipment)

Manufacture of incorporated motor portable tools

Manufacture of aeraulic and cooling equipments

Manufacture of various general-purpose machinery

Manufacture of agricultural and forestry machinery

Manufacture of metal forming machines

Manufacture of other tool-machines

Manufacture of metallurgy machines

Manufacture of machinery for mining and construction

Manufacture of machinery for agro-food industry

Manufacture of textile industry

Manufacture of paper and paperboard industry

Manufacture of rubber or plastics industry

Manufacture of other machines of specific purpose (NCA)

Manufacture of motor vehicles

Manufacture of bodies and trailer

Manufacture of electrical and electronic motors

Manufacture of motor equipments

Construction of ships and floating surfaces

yachts Construction

Construction of locomotives and rolling stock

Construction of aircrafts and spacecrafts

Construction of military vehicles

motorcycles manufacture

Manufacture of bicycles and vehicles for disabled

Manufacture of other transport equipment (NCA)

manufacture of Office and Store Furniture

manufacture of Kitchen Furniture

Mattress Manufacturing

Other furniture Manufacturing

Coinage

jewelry Manufacturing

Manufacture of fashion jewelry and similar items

Strategic analysis and foresight tool for the balance demand/availability of water resources

Manufacture of musical instruments

Manufacture of sports goods

Manufacture of games and toys

Manufacture of medical and dental supplies
Manufacture of brushes
Other manufacturing activities (NCA)
Repair metal fabrication
Repair machinery and mechanical equipment
Repair of electronic and optical material
Repairing electrical equipment
Naval Repair and Maintenance
Repair and maintenance of aircraft and spacecraft
Repair and maintenance of other transport equipment
Repair of other equipment
Installation of machinery and industrial equipment
Property development
Construction of residential and non-residential buildings

Construction of roads and highways
Construction of railways and undergrounds
Construction of bridges and tunnels
Construction of utility projects for fluids
Construction of power grids and telecommunications
Construction of maritime and river projects
Construction of other civil engineering projects (NCA)
Demolition
Work site preparation
Drilling and probing
Electrical Installation
Plumbing and heating and air conditioning
Other installations
gypsum work
Carpentry
Flooring and walls work
Painting and glazing
Other finishing work
Roofing
Other specialized construction activities (NCA)
Nuclear electricity
Coal Electricity
Gas Electricity
Fuel electricity
Hydroelectric Power Generation
Wind power
Photovoltaic Solar Electricity
Solar Thermal Electricity
Biomass central electricity
Geothermal power

Electricity Transmission
Electricity distribution
Electricity Trade
Manufacture of gas
Distribution of gaseous fuels through pipelines
Trade of gaseous fuels through pipelines
Production and distribution of steam and air conditioning
Cultivation of cereals

Strategic analysis and foresight tool for the balance demand/availability of water resources

Cultivation of cabbage, roots and tubercle
Oilseed crops
Cultivation of protein
Cultivation of fodder

Nonpermanent Prairie
Potato Cultivation
Fresh vegetables cultivation
Orchard
Citrus cultivation
Vine Cultivation
Other cultivations
Rice cultivation

Livestock breeding
Pig breeding
Goats Breeding
Poultry farming
Sheep breeding
Equine care

Car and light motor vehicles trade
Other motor vehicles trade
Motor vehicles maintenance and repair
Vehicles equipment wholesale
Vehicles equipment retail sale
Motorcycles trade and repair
Commercial agents of agricultural raw materials, live animals, textile raw materials and semi-finished
Commercial agents of fuels, metals, minerals and chemicals

Commercial agents of wood and building materials
Commercial agents of machinery, industrial equipment, ships and aircraft
Commercial agents of furniture, house wares and hardware
Commercial agents of textiles, clothing, furs, footwear and leather
Commercial agents of food, beverages and tobacco
Specialized agents in other specific products' trade
Commercial agents of other products

Wholesale trade of cereals, unmanufactured tobacco, seeds and food for livestock

Flowers and plants wholesale trade

Wholesale trade of living animals

Wholesale trade of leather

Wholesale trade of fruit and vegetables

Wholesale trade of meat and meat products

Wholesale trade of dairy products, eggs, oils and edible fatty materials

Wholesale trade of beverages

Wholesale trade of tobacco products

Wholesale trade of sugar and chocolate and candy

Wholesale trade of coffee, tea, cocoa and spices

Wholesale trade of other food including fish, crustaceans and shellfish

Non-specialized wholesale trade of commodities, beverages and tobacco

Wholesale trade of textiles

Wholesale trade of clothing and shoes

Strategic analysis and foresight tool for the balance demand/availability of water resources

Wholesale trade electrical household appliances

Wholesale trade of crockery, glassware and maintenance products

Wholesale trade of perfume and cosmetics

Wholesale trade of pharmaceuticals

Wholesale trade of furniture, carpets and lighting fixtures

Wholesale trade of watches and jewelry

Wholesale trade of other household goods

Wholesale trade of computers, computer peripheral equipment and software

Wholesale trade of electronic components and equipment and telecommunications

Wholesale trade of agricultural machinery

Wholesale trade of machine tools

Wholesale trade of machines for mining, construction and civil engineering

Wholesale trade of machines for textile and clothing

Wholesale trade of office furniture

Wholesale trade of other machines and office equipment

Wholesale trade of other machines and equipment

Wholesale trade of fuel and related products

Wholesale trade of ores and metals

Wholesale trade of wood, construction materials and sanitary equipment

Wholesale trade of hardware and supplies for plumbing and heating

Wholesale trade of chemical products

Wholesale trade of other intermediate products

Wholesale trade of waste and debris

Non-specialized wholesale trade

Retail trade in non-specialized stores with food prevalence

Other retail trade in non-specialized stores

Retail trade of fruit and vegetables in specialized stores

Retail trade of meat and meat products in specialized stores

Retail trade of fish, crustaceans and shellfish in specialized stores

Retail trade of bread, pastry and confectionery in specialized stores

Retail trade of beverages in specialized stores

Retail trade of tobacco products in specialized stores

Other retail trade of food in specialized stores

Retail trade of fuel in specialized stores

Retail trade of computers, peripheral units and software in specialized stores

Retail trade of telecommunications materials in specialized stores

Retail trade of audio and video materials in specialized stores

Retail trade of textiles in specialized stores

Strategic analysis and foresight tool for the balance demand/availability of water resources

Retail trade of hardware, paints and glass in specialized stores

Retail trade of carpets, rugs and wall and floor coverings in specialized stores

Retail trade of electrical household appliances in specialized stores

Retail trade of furniture, lighting fixtures and other household items in specialized stores

Retail trade of books in specialized stores

Retail trade of newspapers and stationery in specialized stores

Retail trade of music and video recordings in specialized stores

Retail trade of sports items in specialized stores

Retail trade of games and toys in specialized stores

Retail trade of clothing in specialized stores

Retail trade of shoes and leather items in specialized stores

Retail trade of pharmaceutical products in specialized stores

Retail trade of medical and orthopedic items in specialized stores

Retail trade of perfumery and cosmetics in specialized stores

Retail trade of flowers, plants, seeds, and fertilizers, pets and food for these
 animals in specialized stores

Retail trade of watches and jewelry in specialized stores

Other retail trade of new goods in specialized stores

Retail trade of used goods in stores

Retail trade of food through stalls and markets

Retail trade of textiles, clothing and shoes through stalls and markets

Other retail trade through stalls and markets

Remote sales

Other retail trade outside stores, stalls or markets

Intercity rail transport for travelers

Freight rail transport

Urban and suburban transport for travelers

Passenger transport by taxi

Other land transport for travelers n.c.a.

Freight transport by road

Moving Services

Transport through channels

Sea and coastal transport for passengers

Sea and coastal freight transport

River transport for passengers

River freight transport

Air transport for passengers

Freight air Transport

Strategic analysis and foresight tool for the balance demand/availability of water resources

Space Transport

Warehousing and storage

Land Transport auxiliary services

Water transport auxiliary services

Air Transport auxiliary Services

Handling

Other auxiliary services of transport

Postal activities under universal service obligation

Other postal and mail activities

Hotels and similar residences

Tourist residency and other short-term residences

Camping sites and RV parks, or recreational vehicles

Other hosting

Restaurants and mobile food services

Catering services

Other food services

Pubs

Publishing of books

Publishing of directories and addresses files

Publishing of newspaper

Publishing of journals and periodicals

Other publishing activities

Edition of electronic games

Edition of other software

Production of cinematographic films, videos and television programs

Post-production of cinematographic films, videos and television programs

Distribution of cinematographic films, videos and television programs

Projection of cinematographic films,

Sound recording and music publishing

Publishing and broadcasting radio programs

Television programming and telecasting

Wire line Telecommunications

Wireless Telecommunications

Satellite Telecommunications

Other telecommunications activities

Computer Programming

IT consultancy

Computer facilities management

Strategic analysis and foresight tool for the balance demand/availability of water resources

Other computer activities

Data processing, hosting and related activities

Internet Portals

Activities of news agencies

Other information services n.c.a.

Central banking activities

Other monetary intermediations

Activities of holding companies

Investment funds and similar financial entities

Credit leasing

Other credit distribution

Other financial service activities, except insurance and pension n.c.a.

Life Insurance

Other insurance

Reinsurance

Pension

Administration of financial markets

Brokerage of transferable securities and goods

Other auxiliary activities of financial services, except insurance and pension

Risk and damage assessment

Activities of insurance agents and brokers

Other activities auxiliary to insurance and pension

Fund Management

Buying and selling of real estate

Renting and operating of owned or leased property

Real estate agencies

Management of real estate

Legal activities

Accounting activities

Activities of head offices

Public relations and communication council

Business and other management council

Architectural activities

Engineering Activities

Monitoring and technical analysis activities

Research and development in biotechnology

Research and development in natural sciences

Research and development in humanitarian and social sciences

Strategic analysis and foresight tool for the balance demand/availability of water resources

Advertising agencies activities

Media advertising

Market and surveys studies

Specialized design activities

Photographic activities

Translation and Interpretation

Other specialized scientific and technical activities n.c.a.

Veterinary activities

Rental and leasing of cars and light motor vehicles

Rental and leasing of trucks

Rental and leasing of recreational items and sports

Rental of videotapes and video discs

Rental and leasing of other personal and household goods

Rental and leasing of agricultural machines and equipment

Rental and leasing of construction machines and equipment

Rental and leasing of office machines and computer equipment

Rental and leasing of water transport equipment

Rental and leasing of air transport equipment

Rental and leasing of other machines, equipment and tangible goods n.c.a.

Leasing of intellectual property and similar products, except copyrighted works

Activities of Employment Agencies

Activities of temporary work agencies

Availability of any other human resources

Activities of travel agencies

Tour activities

Other reservation services and related activities

Private security activities

Activities related to security systems

Investigation activities

Combined support activities related to buildings

Frequent cleaning of buildings

Other cleaning activities of buildings and industrial cleaning

Other cleaning activities

Landscaping services

Combined administrative office services

Photocopying, document preparation and other specialized office support activities

Activities of call centers

Organization of trade fairs and congresses

Strategic analysis and foresight tool for the balance demand/availability of water resources

Activities of agencies that collect bills and financial information of companies about customers

Packaging activities

Other business support activities n.c.a.

General public administration

Public administration (tutorship) of health, education, culture and social services, other than social security

Public administration (tutorship) of economic activities

Foreign affairs

Defense

Justice

Activities of public order and security

Fire and emergency services

Mandatory social security

Pre-primary education

Primary education

General secondary education

Technical and vocational secondary education

Non-higher post-secondary education

Higher education

Teaching sports and leisure activities

Cultural education

Driving instruction

Various lessons

Support activities for teaching

Hospital activities

General practitioners activities

Doctors' activities

Dental practice

Other human health activities

Home nursing

Social residency for mental retardation, mentally sick and addicts

Social residency for elderly or physically disabled

Other activities of social residency

Social work without residency for the elderly and disabled

Social work without residency for young children

Other social work without residency n.c.a.

Performing arts

Support activities of performing arts

Artistic creation

Strategic analysis and foresight tool for the balance demand/availability of water resources

Management of venues

Managing of libraries and archives

Museum management

Management of sites and historical monuments and similar touristic attractions

Management of botanical and zoological gardens and natural reserves

Organization of gambling and money

Management of sports facilities

Activities of sports clubs

Activities of fitness centers

Other sports activities

Activities of amusement parks and theme parks

Other recreational and leisure activities

Activities of employers and consular organizations

Activities of professional organizations

Activities of employees unions

Activities of religious organizations

Activities of political organizations

Activities of membership organizations n.c.a.

Repair of computers and peripheral equipment

Repair of communication equipment

Repair of consumer electronic products

Repair of electric appliances and equipment for home and garden

Repair of shoes and leather items

Repair of furniture and household equipment

Repair of watches and jewelry

Repair of other personal and household goods

Laundry-dyeing

Hairdressing and beauty care

Funeral services

Body Care

Other personal services n.c.a.

Activities of households as domestic employers

Activities of households as producers of goods for proper use

Activities of households as producers of services for proper use

Activities of extraterritorial organizations and organisms

Home

Apartment

HLM

Strategic analysis and foresight tool for the balance demand/availability of water resources

Artificial green spaces, non-agricultural

Heterogeneous agricultural areas

Forests

Medium with vegetation of bushes / or herbaceous

Open spaces with little or no vegetation

Inland Wetlands

Marine Wetlands

Continental waters

Household usages

Boiler

Cooling

Consumption

Security

Extraction

Solvent

Industrial process

Transport

Water supply

Hygiene

Food

Spray

Filling

Heating

Cleaning

Usages

Circuit

Employees

Machine

Surface

Fire circuit

Water for injection

Dilution

Raw material

Manufacturing agent

Soaking

Organs

Ovens

Transport raw material

Strategic analysis and foresight tool for the balance demand/availability of water resources

Extraction of sugar

Rinsing

Washing

Downsizing

Whitening

Mercerization

Dyeing

Désencimage

Dairy

Crude desalting

Maintaining of air humidity

Water transportation

Jetting

Home hygiene

Food preparation

Drink

Tea, Coffee

Washer

Dishwasher

Garden

Car

Pool

Fountain

Aquarium

Heating Parts

Sprinkler irrigation

Runoff irrigation

Micro- irrigation

Flood irrigation

Cleaning the machines

Cleaning the surfaces

Heating of agricultural buildings

Natural consumption

Local cleaning

Tableware

Employees' hygiene

Local

Restaurant

Strategic analysis and foresight tool for the balance demand/availability of water resources

Car Cleaning

Flowerpots

Feeding the animals

Cooling product

Patient hygiene

Fabrication of ice

Fabrication of perfume

Sprinkler irrigation

Gravity Irrigation

Micro Irrigation

Food

Researcher

Rinsing

Cleaning

Hygiene of students

Hygiene - Sports

Creating snow

Cleaning the floor

Filling the tank

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True translation of the original French text hereto attached. 09.06.2010cp2

Strategic analysis and foresight tool for the balance demand/availability of water resources