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Conception of a territorial Observation and Prospective Tool for energy. The case of Fuelwood

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Abstract:

Decentralized energy planning has been emerged in France since the last three decades especially due to the development of renewable energies. One corollary is the increase of local actors' role in energy and land planning. In order to help them carrying out efficient policies, decision support systems (DSS) have been developed. In this paper, the authors deal with a DSS applied to fuelwood sector.

Keywords:

Decision support system (DSS), decentralized energy planning, territorial observation tools, actors, fuelwood, sustainable development.

Today's energy crisis (depletion of fossil fuels, prices increase, greenhouse gas' emissions augmentation) lead us to reconsider our consumption behaviours and ways of production. As a consequence, renewable energies (biomass, solar, wind, geothermy…) have been developed for the last three decades (Arnold *et al.*, 2003).

Location and availability of theses energy resources depends on local characteristics (climate, altitude, land-surveying…) (Arnold *et al.*, 2006). Thus, decentralized energy planning are emerging, within local actors' role is increasing. As regards of all these arguments, considering the energy problem at infra-regional scale with a territorial approach seems to be the best way to structure energy systems based on renewable resources. In this way, we would consider both actors of the energy system and local features (constraints and assets)[1]. According to (Fléty, 2007) relocation of energy problem to local scale tends towards "an increased entailment of local and regional actors, looking for information, tools and methods of management and planning"[*]. Whereas planners and decision-makers require more decision and support planning tools which would give them a global vision of the energy problem on their territory, professionals look for more specific information (number of lodging equipped of solar panels or information on woody resources for example). Actually, it

1. The concept of territory refers to geographic space and actors.
∗ Quotes asterisked have been translated by the authors.

transpires to give users some resources to understand the territory for an energetic point of view (structure and functioning).

In ThéMA's laboratory (geography and planning), a team is working on "energy and territory" in the frame of research program OPTEER (**O**bservation et **P**rospective **T**erritoriale **E**nergétique à l'**E**chelle **R**égionale)[2], and develops an observation and prospective tool on energy sector. The aim of the tool is to make data available for actors, whether they are institutional, associative or industrial, producer, distributor or consumer; in order to help them to understand energy issues on their territory, and then to decide and act. In this paper, we chose to focus on fuelwood sector and its modalities of integration in our tool.

This communication will be presented in three parts. First, we will explain the concept of decentralized energy planning, and the place of the tool in this context. We will clarify the philosophy of the project (territorial approach of energy) and expectation of actors towards the tool. Secondly, we will focus on the fuelwood sector, on its functioning and its links with territory. Thirdly, we will wonder on the best way to master the complexity inhere in the fuelwood system in a decision support system.

I. Decentralized Energy Planning and Decision Support System

Awareness of the environmental issues, and its corollary, emergence of decentralized and local energy planning, had lead to increase local actors involvement into land planning and energy sector. This observation has been underlined in the report of *Grenelle Environnement* (France), which have brought together "actors of sustainable development" during the year 2007: "Whether energy policy has been until now essentially formed at a national level, we need to involve local governments in struggling against global warming, by giving them technical, juridical and financial tools. A climatic and energetic revolution cannot be the only implement of State. Local characteristics (climate, resources, housing, planning), lead us to think that same purposes cannot be accomplished by the same ways everywhere on territory. Thus, local governments' competences have to be clarified or even consolidated"* (Grenelle de l'Environnement, 2007). This is clearly visible in France, in which State has traditionally an important role in definition of energy policies, and has to give up some competences to local governments. Indeed, in the synthesis report *Perspectives énergétiques de la France à l'horizon 2020-2050*[3] (Centre d'Analyse stratégique, 2007) analyses the importance of local governments, pretending that they are "some major actors of energy policy" and that "many measures […] henceforth lie within competences of local governments"*. In this regard, Figure 1 is particularly eloquent and presents the international energy context and its consequences on local policies.

Local actors' role is to carry out regional energy planning, in order to match potential (supply) and demand on a territory (Ramanchandra, 2008). According to the definition given by (International Energy Agency, 1994) quoted in (Troche, 1996), "local energy planning consists in formalizing and defining modalities for carrying out some favourable solutions to environment and energy saving at the level of energy distribution, linked with demand on a specific territory administrated by a local government". (Lacassagne and Schilken, 2003) adds that the main purpose of local energy planning is to "suggest strategic energy plans on a specific territory, promoting an optimal use of local re-sources"*. Moreover, each territory being specific, it justifies that "decentralized energy planning [have to] recognize the variation of energy situations in the different sub-national areas. Planning has to be area-based to recognise these variations and the local specificities of the energy situation. Decentralized energy planning is a synonymous with area-based planning, local energy planning, and rural energy planning" (Food and Agriculture Organization, 1995). In this context, local actors need decision support systems[4] to help them to understand structure and dynamics linked to energy field on their territories in order to carry out effective energy policies, trying to conciliate both economic development and preservation of natural environment.

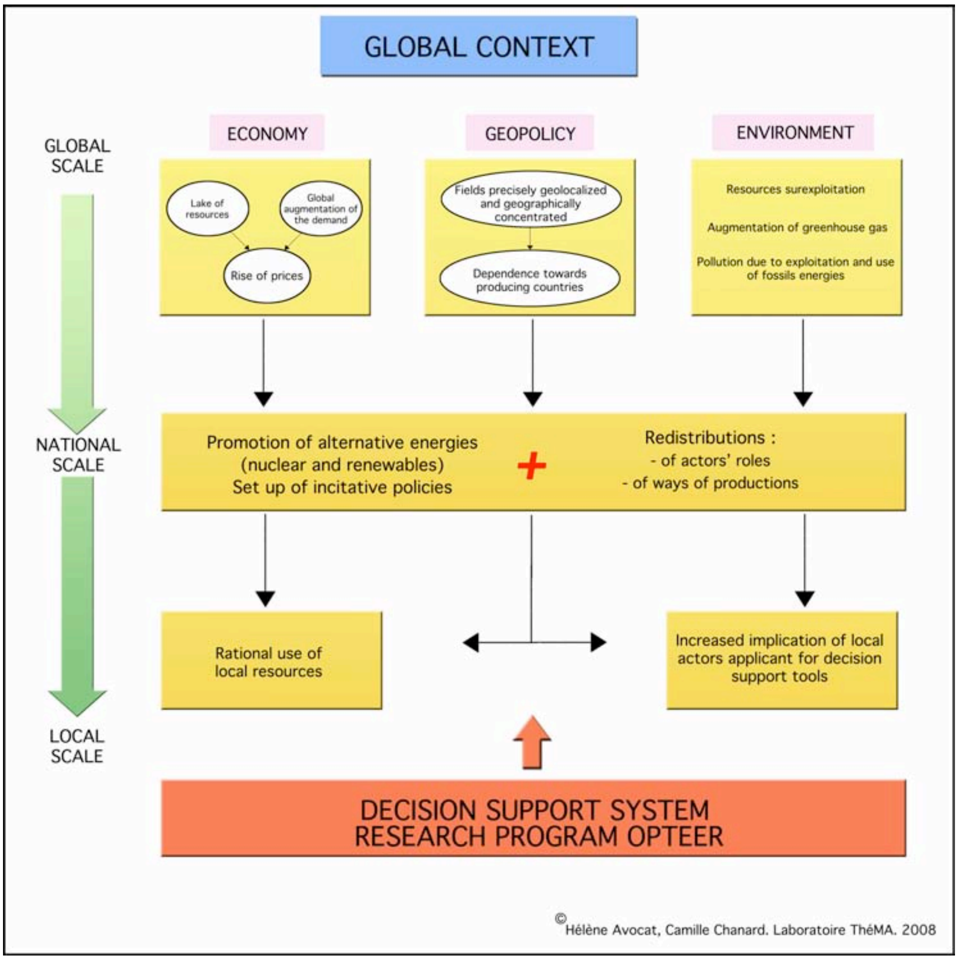
A decision support system (DSS) is "a coherent system of computer-based technology (hard-ware, software and supporting documentation)" (Ramanchandra *et al.*, 2004) used by "energy planner, policy maker or other decision maker to make more balanced choices" (Beck *et al.*, 2008), (Clarke and Grant, 1996). A DSS has to be enable to take into account specificities of a territory and different

2. Territorial Energy Observation and Prospective at Regional Scale.
3. *Energy perspectives in France until 2020-2050.*
4. We prefer the term of "*decision support system*" (DSS) proposed by (RAM, 2008), to the term "*decision support tool*" that can be found in the scientist literature, because it better express the complexity inhere in energy sector.

parameters such as economic, technologic, social, environmental (Finon, 2003). Indeed, carrying out an approach of local energy planning cannot be considered without thinking about two essential points (Troche, 1996):

- Purposes of energy planning must be integrated in the global planning on the territory,
- Tools and models have to be adapted to the local context in order to make simulations and then to test some possible scenarios.

Figure 1: Decision support system in a changing energy context



II. Fuelwood and Territory

According to the encyclopaedia on line techno-sciences[5], fuelwood (or dendroenergy) can be defined as "the type of bioenergy using the part of biomass constituted by wood" and also refers to "all the applications of wood as a fuel"*. The choice of fuelwood sector to test and develop our DSS tool can be explained by several reasons:

- On the one hand, several actors of the sector and financial partners show a real interest to involve themselves in the creation of the tool. Moreover, local authorities have to reconsider fuelwood sector as a strategic component from an alternative energy system in which renewable energies would have more importance. As soon as we cope with a subject of study, which needs knowledge and innovation, we can justify the relevance of such tool.
- On the other hand, in a perspective of sustainable development, national governments promote alternative energies to fossil fuels and particularly fuelwood. In France, the Department of Industry supported by ADEME[6] have carried out two fuelwood plans since 1994. Their goals is to

5. www.techno-science.net, consulted the 4th July 2008.
6. ADEME: *Agence de l'Environnement et de la Maîtrise de l'Energie*/Environment and Energy Saving Agency.

"structure the fuelwood sector considering sustainable criteria, at supplying level as well as boilers' building in residential, industrial or tertiary sectors"* (Agence de l'Environnement et de la maîtrise de l'Energie, 2006). Although the domestic sector is accounting for 78, 7% of global fuelwood consumption (DGEMP[7]), it is characterized by a multitude of small consumption units that make very difficult the comprehension of supplying processes. On the opposite, collective/tertiary and industrial sectors, characterized by bigger units of consumption, have respectively increased their consumption of 235 % and 20 % during the period 1985-2005 (Agence de l'Environnement et de la maîtrise de l'Energie, 2006). Since the mass of these big consumption units has suddenly increased, supply has to be structured. Resources and potentials must be inventoried in order to define "favourable sites for the installation of renewable energies' production units"* (Délégation de l'Aménagement du Territoire et à l'Action régionale, 2002), including fuelwood.

- Finally, fuelwood sector undergoes important mutations, but is still considered through a very sectorial and fragmented way. There is neither global approach nor really coordination between actors of the sector. "Fuelwood sector is characterised by a multitude of actors, public organisms, professionals and professional groups, cooperatives, forest owners [and managers]. All of them are involved into their speciality, without coordinated actions. So they don't have any global and shared vision of the problems and stakes of the sector"*[8]. Moreover territorial dimension is often scarcely considered.

The main argument of planners to promote these forms of energy is based on principles of local development: promotion of local resources, increased implication of local actors, economic and social development (Greffe, 2002). Although these arguments in favour of fuelwood seem to be praiseworthy, they are not always taken into account. For example, interviews with boiler's backers points out that economic criteria prevail over arguments in favour of local development. Thus, we have to ensure that the wood energy sector is getting structured locally, based on the territorial available potentials. DATAR[9] reminds that "fuelwood consumption development at a regional level strongly depends on availability of resources on the territory". Such an approach "involves disposing of an efficient quantity of wood in time and closed to consumption centres"* (Délégation de l'Aménagement du Territoire et à l'Action régionale, 2002).

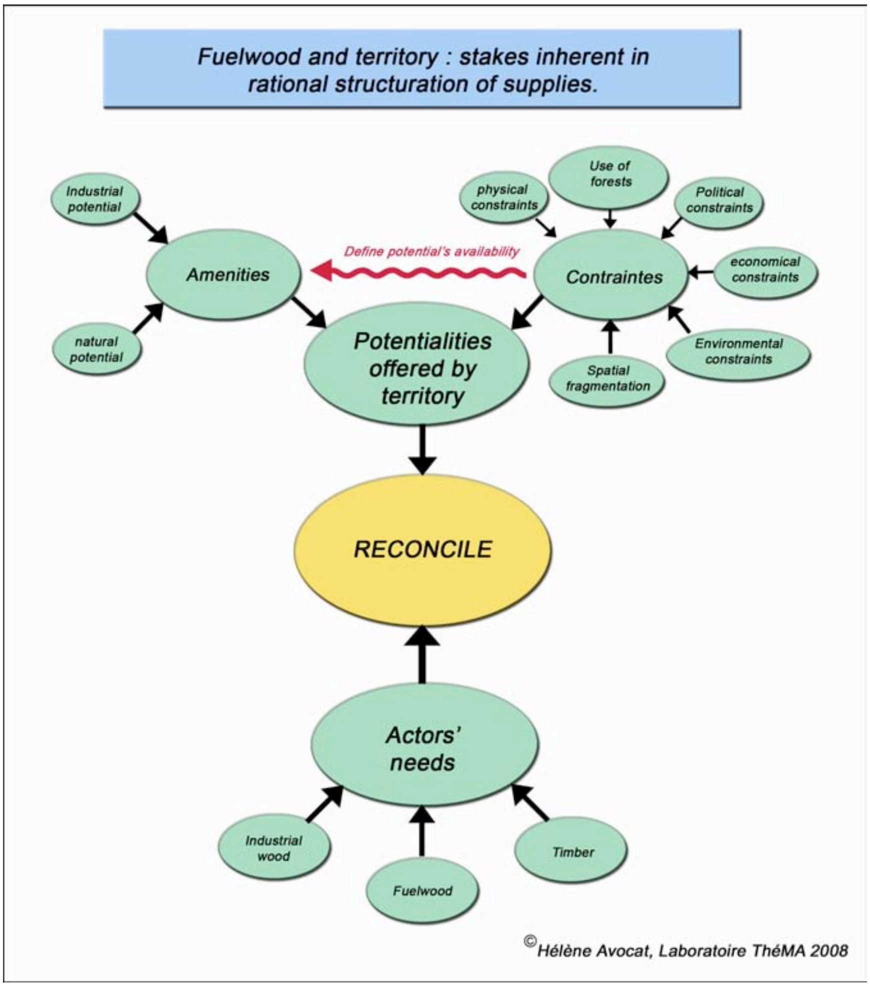
Nowadays, the fuelwood sector is getting structured considering an approach based on satisfaction of demand. In order to satisfy principles of local development, we propose an integrated structuring of the sector at a local scale, focusing on potentials offered by territory. These potentials can be divided into two categories: natural and industrial. Valuating natural potentials involves considering the complexity inherent in the resources system such as spatial fragmentation of forests, diversity of ways of production, multiplicity of forest owners and juridical statutes, heterogeneity of species, for example. Industrial potentials are even more difficult to valuate since we have to consider use conflicts. Indeed, they are constituted by wastes of wood industry (barks and sawdust) that can both be used for energy or other applications such as paper, timber and lumber industries.

Although "potential studies" are made to confirm projects, territory is usually not considered as a specific frame for supply structuring. De facto, it implies to define and characterize precisely wood potentials available for an energy use in order to match it with consumption units on a specific territory. This "territorial approach" differs from the classical "project's approach" generally used. Whereas "project's approach" is based on the exploitation of wood resources according to the boilers' powers (beforehand defined), "territorial approach" estimates potentials and then structures supplies considering territory's constraints and amenities. Figure 2 sums-up the links between fuelwood sector and territory, considering constraints, amenities and actor's needs; and thus clarify stakes inherent in a territorial structuring of fuelwood supplies.

Considering the problem of resources management and particularly fuelwood supply, a territorial approach seems more appropriated. In the current context of decentralized energy planning, local actors needs for DSS which would give them opportunities to understand energy issues on their territories: which is one of major OPTEER's goals.

7. DGEMP: *Direction Générale des Matières Premières et de l'Energie*. http://www.industrie.gouv.fr/energie/sommaire.html.
8. www.netbois.com, consulted the 4th July 2008.
9. DATAR:*Délégation à l'Aménagement du Territoire et à l'Action Régionale*/French land planning delegation.

Figure 2: Stakes linked to fuelwood supplies

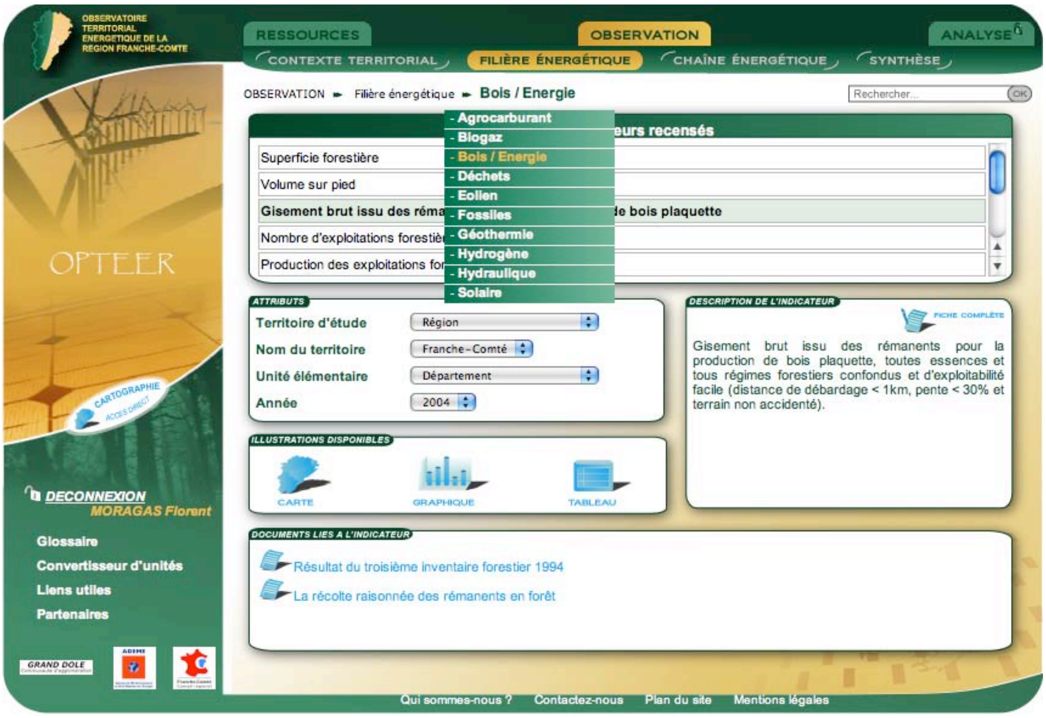


III. Reflection on the integration of fuelwood complexity in a DSS

One of the biggest difficulty in the conception of a DSS is to organize and integrate the complexity inhere in the fuelwood sector, due to the organization of supply in one hand, and to the multiplicity of actors and uses of wood resource on the other hand. The solution arrested is to propose three complementary and transversal incoming: a first access by "territorial context", a second one by "sector" and third one by "energy chain". These information are available on administrative territory (region, department, county, commune) or on a territory built by the user (also called "work territory"). Whereas the "territorial" incoming presents general information on the territory, the other ones give specific indicators in energy field:

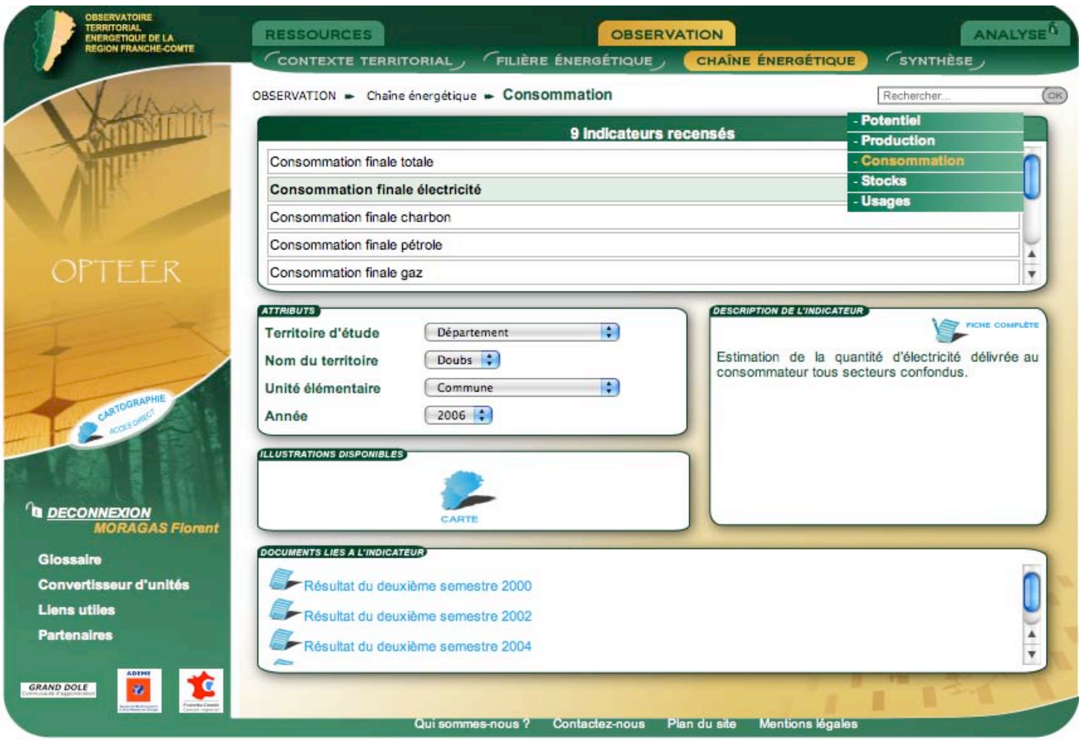
- We demonstrated previously that fuelwood sector is strongly linked with territory. Indeed potential evaluation, supply structuring and consumptions depend on territorial characteristics. Moreover, using fuelwood engages local actors and contributes to forest management and exploitation, which is one of the major aims of land planning. Thus, "territorial context" constitutes one of the three entrances of the tool. We can find on this part, information relative to themes more and less linked with energy field (population, activities, transport, environment). Such data enables us to understand energy structure and functioning on the territory. For example, data on land cover can give us a first estimation of the natural fuelwood potential (global quantity and location).
- The second incoming leads users to study a specific energy sector (fossil fuels, hydraulic, geothermal biofuel, biogas, fuelwood, wastes, solar, wind, hydrogen) on the territory. The aim of this incoming is to have a global view on the sector from potential to consumption, through production and distribution.

Figure 3:



- The incoming by "energy chain" can lead to the same results than the "sector" access, but presents data and indicator by stocks and process. Users can find information about potential, production, consumption and uses for the entirety of the sectors.

Figure 4:



Conclusion

In a context of decentralized energy planning, local actors have more and more responsibilities and prerogatives. In order to carry out energy policies and planning, they must understand how the energy sector is organized. In case of fuelwood, actors have to know where are potentials localised, what is the power of consumption units, how much wood collective and industrial boilers use, what kind of substructures and where are they localised etc. These questions underline the complexity inherent in the fuelwood sector, and its dependence on local specificities.

The team of the research program OPTEER, who is working on territorial approaches of energy problem, develops a DSS enables to take into account local specificities. The aim of the tool is to purpose to actors an access to data depending on their interests. Thus, two incomings can be used: by "sector" or by "energy chain". Moreover, this tool will be available on line and will permit actors to integrate their data themselves in order to realise analysis and share it with their partners.

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Bibliography

AGENCE DE L'ENVIRONNEMENT ET DE LA MAITRISE DE L'ENERGIE, 2006. *Programme national bois-énergie- Rapports d'activités 2000-2006*.Collection Connaître pour agir. 118 p.

ARNOLD M., KÖHLIN G. PERSSON R., SHEPHERD G., 2003. *Fuelwood revisited, what has changed in the last decade?* CIFOR, Occasional paper n°39. 47 p.

ARNOLD M., KÖHLIN G. PERSSON R., 2003.*Woodfuels, livelihoods, and policy interventions: changing perspectives*. World Development 34 (2006). pp. 596–611.

BECK J., KEMPENER R., COHEN B., PETRIE J., 2008. *A complex systems approach to planning, optimization and decision making for energy networks.* Energy policy 36 (2008). pp. 2795-2805

CENTRE D'ANALYSE STRATEGIQUE, 2007. *Perspectives énergétiques de la France à l'horizon 2020-2050.* Rapport de synthèse, réalisé par SYROTA J., commandité par le gouvernement. Paris : Imprimerie Nationale. 162 p. Available on the web: www.strategie.gouv.fr, Consulted the 9/01/2008.

CLARKE J.A., GRANT A.D., 1996. *Planning support tools for the integration of renewable energies at the regional level.* World Renewable Energy Congress 1996. pp. 1090-1093.

DELEGATION A L'AMENAGEMENT DU TERRITOIRE ET A L'ACTION REGIONALE, 2002. *Schéma de services collectifs de l'énergie*. Paris : les journaux officiels. 233 p.

INTERNATIONAL ENERGY AGENCY, 1994. *Annex 22 – Energy efficient communities – Final report.* July 1994. 132 p.

FOOD AND AGRICULTURE ORGANIZATION, 1995. *Wood Energy Planning, Wood Energy News*. Vol 10-n°4. 20p. Available on the web: www.rwedp.org/acrobat/wen10-4.pdf Consulted the 29/02/2007

FINON D., 2003. *Prospective énergétique et modélisation. Identification de pistes de progression méthodologique.* Note au Conseil Scientifique de l'Institut Français de l'Energie. 38 p.

FLETY Y., 2007. *Éléments d'analyse des modèles énergétiques*. Document de travail. Laboratoire ThéMA. 32 p.

GREFFE X. 2002. *Le développement local*. Ed. De l'Aube. 199p.

GRENELLE DE L'ENVIRONNEMENT, 2007. *Lutter contre les changements climatiques et maîtriser la demande d'énergie.* Rapport du groupe 1. 108 p.

LACASSAGNE S., SCHILKEN P., 2003. *Les outils de planification énergétique territoriale. Bonnes pratiques de villes européennes*. Energie-Cités, ADEME. 54 p.

RAMANCHANDRA TV., KUMAR U., VAISHNAV B., PRASAD SN., 2004. *Geographic resources decisions support system: an open source GIS.* Geospatial today. 3(3) : 52-9.

RAMANCHANDRA TV., 2008. *RIEP: Regional integrated energy plan.* Renewable and sustainable energy reviews. (article in press). 33 p.

TROCHE J-P., 1996. *Planification énergétique locale. Quelles applications dans le contexte français ? Outils, méthodes, et applications possibles des acquis de l'annexe 22 de l'Agence Internationale de l'Energie*. ADEME. 81 p.