



Local development plan for Small Hydroelectricity

Application to the « Mont du Pilat » Area

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ADEME

**(Agency for Energy and Environmental
Management)**

Plan

A **Context**

B **The Asconit method**

B-I **Principles**

B-II **Criteria**

C **Application by Climat Energie Environment**

C-I **Area Covered**

C-II **Objectives**

C-III **Application of Asconit criteria**

C-IV **Results**

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A - Context

■ Ecology and Energy : The New Deal

- ◆ *International* : *Kyoto Protocol (1997) - 5%*
- ◆ *Europe* : *12 % (6 %) electricity from RES 2010*
- ◆ *France* : *21 % (15 %) electricity from RES 2010*

■ France – Investment Program 7 mars 2003 : 2007 objectives

- ◆ *Wind Energy* : *2000 à 6000 MW*
- ◆ ***Hydroelectricity*** : ***200 à 1000 MW***
- ◆ *Photovoltaics* : *1 à 50 MW*
- ◆ *Biomass* : *300 à 600 MW*
- ◆ *Biogaz* : *50 à 100 MW*

A - Context

- **Directive 2000/60/EC:** European water framework directive
 - ◆ *Water protection, quality enhancement, quality restoration*
 - **Sustainable Water Management**
- **For France : Classified Rivers**
 - ◆ *No new hydropower plants on these rivers*
 - Without impact studies
 - Without DCE guarantees
 - Without energetic objectives interests
- **Need for a COMPROMISE / an objective method to detect places for new hydro facilities / upgrading existing facilities.**
 - **ASCONIT STUDY for ADEME**

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B – The ASCONIT method

B-I Principles

- **Goal** : to evaluate the hydropower development potential, taking into account the environmental constraints
- **Means** : A list of criterions / an evaluation scale
- **A GIS** to fuse the constraints and map the results

B-II Criterions

- **Energetic potential**
 - ◆ *For new facilities*
 - ◆ *For optimizing existing facilities*
- **Ecological conditions**

B – II Criteria

■ Energetic Potential

◆ *For implementing new facilities*

- Hydraulic potential: annual module and variability of the potential,
- Steadiness of the flow : minimum monthly flow / maximum monthly flow
- Mean slope of the site

◆ *For improving existing facilities*

- Improving production: ratio between existing production capacity vs. maximal (theoric) production capacity
- Using reserved flow (10 % of mean module) / if $P = g.h.Q > 50 \text{ kW}$
- Equipping existing sites (if $P > 50 \text{ kW}$)

B – II Criteria

New Facilities

<p><u>Steadiness of the flow (SD)</u> Two aspects : water quantity and steadiness of the flow</p> <p><u>Flow (m³/s)</u> Annual mean flow (Q en m³/s) ; extrapolation of existing dataset (hydro database, measurements) to places where the flow is supposed to stay steady (no contributions, and no losses)</p> <p><u>Maximum Monthly Flow variations (SD)</u> Ratio of monthly mean flow coefficient (CMD) $R = \text{CMD}_{\text{max}} / \text{CMD}_{\text{min}}$; CMD are calculated from monthly flow repartition. Values are extrapolated to places where the flow is supposed to stay constant (no contributions, and no losses)</p>	Q < 0,1	0,1 < Q < 1	1 < Q < 5	5 < Q < 10	Q > 10
<p><u>Seasonal Flow Variation (SD)</u> Ratio « S » between monthly mean flow at winter times vs. Annual mean flow</p>	Unsteady hydro-potential	R > 20	20 < R < 5	2 < R < 5	R < 2
<p><u>Slope (m/m)</u> The slope is an intrinsic data of the river. It is calculated for homogeneous places along the river.</p>	Unsteady hydro-potential at winter times	S < 1	1 < S < 2,5	2,5 < S < 5	S > 5
	Turbulences	$P < 10^{-3}$	$10^{-3} < P < 10^{-2}$	$10^{-3} < P < 10^{-2}$	$10^{-2} < P < 10^{-1}$

Optimizing existing facilities

<p><u>Optimizing microfacilities</u> Is it possible to increase the production ? We add the two following criterions :</p> <p><u>Efficiency (R)</u> performance vs. Max capacity</p> <p><u>Overequipment capacity</u> (optimizing the site) $R = \text{equipment flow} / \text{flow module}$</p>	Very good (R > 90%) R > 150%	Good (90 > R > 80) 150 > R > 125	Mean (80 > R > 65) 125 > R > 100	Bad (65 > R > 50) 100 > R > 50	Very bad (R < 50%) R < 50
<p><u>Reserved flow (kW)</u> Reserved flow (roughly) : $P = 9.81 * Q_{\text{reserve}} * H_b$ où H_b</p>	P < 50	50 < P < 100	100 < P < 200	200 < P < 400	P > 400
<p><u>Equipping existing barrages</u> Possible if usages, high and flow are suitable.</p>	P < 50	50 < P < 100	100 < P < 200	200 < P < 400	P > 400
<p><u>Potential power (kW)</u> $P = 9.81 * Q_{\text{reserve}} * H_b$</p>	0	1	3	5	10

B – II Criteria

■ Ecological Conditions

- ◆ *Physical (chemical) and Biological quality of water: from existing grids (System for Water Quality Evaluation “SEQ” - 1999) based on World Health Organization criterion*

SEQ : physical quality of water / biological quality of water / hydrological or morphological quality of the river

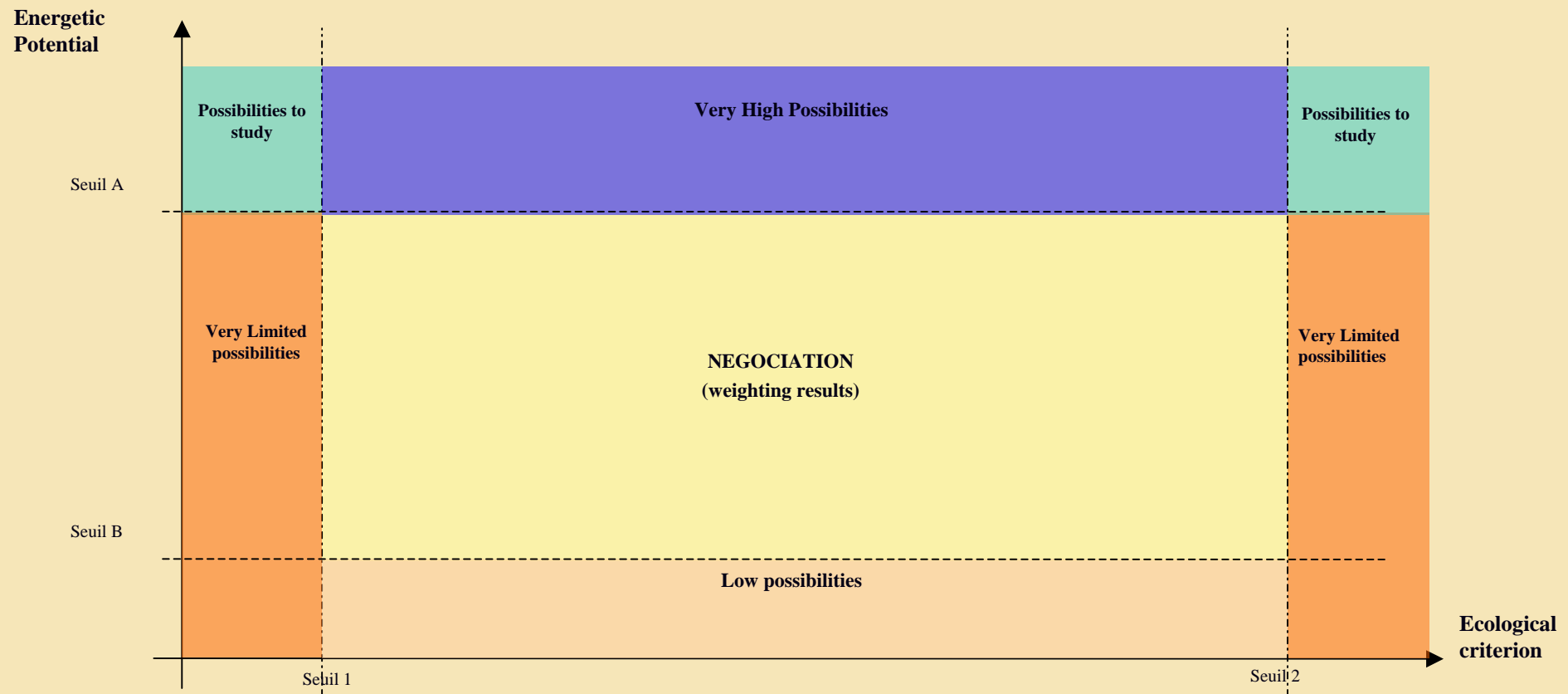
- ◆ *Hydro-Geo-Morphological quality of the water:*
 - Is the river border natural or artificial ?
 - Is solid transport perturbed ?
 - Is the fish circulation free ?
 - Is the regime flow natural, altered, or changed?
- ◆ *Patrimonial value:*
 - Are there rare species (European Directive for species protection) ?
 - Is the area of special ecological interest ?
 - Impact on migrating species ?

B – II Criteria

	0	1	3	5	10
PHYSICAL (CHEMICAL) AND BIOLOGICAL QUALITY					
Chemical quality Global water quality from « SEQ-eau »	Very Bad (Red)	Bad (Orange)	Mean (Yellow)	Good (Green)	Very Good (Bleue)
Biological quality Evaluated from various biological indices. Mainly l'IBGN.	Very Bad (Red)	Bad (Orange)	Mean (Yellow)	Good (Green)	Very Good (Bleue)
PHYSICAL (HYDRO-GEO-MORPHOLOGICAL)					
Is the border artificial Qualitative evaluation	Very important (changed)	Important (modified)	Mean (dam)	Low (rocs)	None
Solid transport perturbation Qualitative evaluation : erosion, mud banks ...	Very strong ($V > 1 \text{ Mm}^3$)	Strong ($1 \text{ Mm}^3 < V < 100\,000 \text{ m}^3$)	Mean ($10\,000 \text{ m}^3 < V < 100\,000 \text{ m}^3$)	Low ($V < 10\,000 \text{ m}^3$)	None
Fish free circulation Longitudinal and transversal evaluation		Partitionned area without affluent	Partitionned area with affluent	Free zone but hard circulation	Free circulation
Is the flow perturbed (add the above marks) <i>Is the flow regime modified ?</i> Qualitative evaluation <i>Prélèvements</i> Is the reserved flow substantial? Ration between reserved flow and yearly mean flow "natural". $R = Q_{\text{réservé}} / \text{module}$.	Highly modified (floods and dries modified or suppressed) $Q_R < 2,5\%$	Modified (yearly floods modified) $2,5\% < Q_R < 5\%$	Roughly modified $5\% < Q_R < 10\%$	No or small modification $Q_R > 10\%$	None (natural flow) None
PATRIMONIAL VALUE					
Protected or remarkable species	None	Improbable	Protected on national territory	Annexe II Directive Habitats	Annexe IV Directive Habitats
Ecological Interest Local protections or remarkable zones.	None		National Park, ZNIEFF Type 2	ZNIEFF Type 1, Réserve naturelle Volontaire	Arrêté de Biotope, Zone Natura 2000
Migrators Free circulation for fishes (article L. 432-6 du Code de l'Environnement).	None		Classified river (décret seul)	Classified river (with decreet on list of species)	Classified for large migrators
Presence of migrating species difference between migrators changing of biotope (sea to river) vs. Small migrators		Holobiotique (brochet)	Holobiotique (truite fario, ombre commun)		Amphibiotique (saumon, truite de mer, anguille, alose)

B – II Criteria

Analysis



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C-IV Results

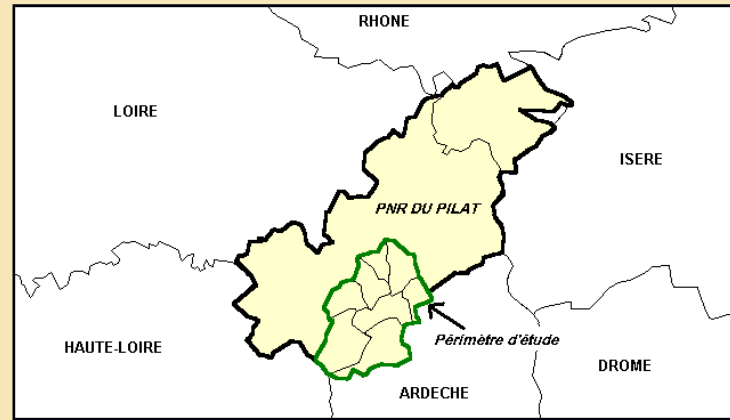
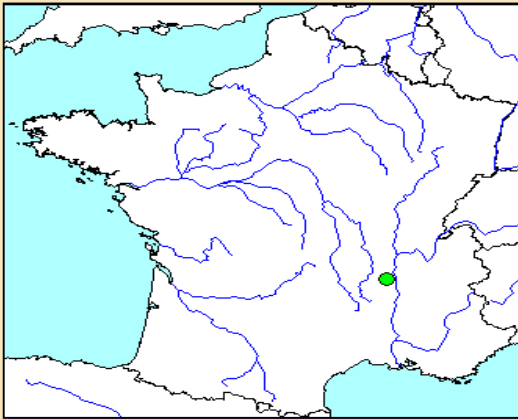
C – I Area covered

- « Mont du Pilat » regional Park

- ◆ *Rhone-Alpes area*
- ◆ *Includes 47 localities*

- **In concertation with local authorities: focus on 8 sub-areas**

- ◆ *Déôme Valley (6 500 inhabitants, 16 000 km²)*



C – II Objectives

■ Framework: European Project « LEADER + »

◆ *Economic rehabilitation of the area*

- Inventory of hydraulic resources : economic, social and cultural structuration of the area in the past

◆ *Goal :*

- Economic development (tourism ...)
- Promotion of renewable energies
- Social development (employment)
- Protecting environment (rehabilitation of existing hydro sites)

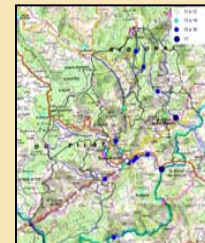
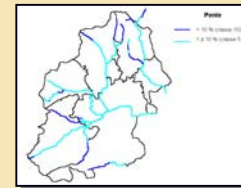
→ **Application of the Asconit method to 50 existing sites of the «Mont du Pilat» regional park for setting up the local « Territory Development Plan » for the next 10 years**

C - III Application of the Asconit criteria

Energetic Potential

Theme 1 : New facilities

- **Hydraulic disponibility :**
 - ◆ *many sites have a very low flux ($< 1 \text{ m}^3/\text{s}$)*
 - ◆ *Only 4 sites with $1 < Q < 5 \text{ m}^3/\text{s}$ (Deo 14 to 18)*
- **Steadiness of the flow : good for all sites ($20 < R < 5$)**
 - ◆ *Based on monthly mean flow coefficient $R = \text{CMD max} / \text{CMD min}$*
- **Seasonal flow variation : good for all sites ($S = 1, 4$)**
 - ◆ *$S = \text{monthly mean flow in winter} / \text{annual module}$*
- **Slope : very high for each 50 site** →
- **RESULT : THE ENERGY INDEX MAP** →



C - III Application of the Asconit criteria

Energetic Potential

Theme 2 : Optimizing existing facilities

- Equipping existing barages / Potential power evaluation



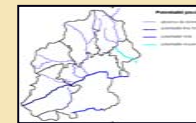
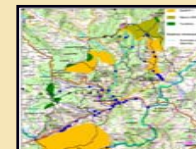
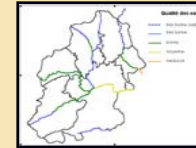
- RESULTS : 13 sites / 1100 kW / 242 kW already installed

Energetic Potential 700 kW

C - III Application of the Asconit criteria

Ecological Conditions

- Physical (chemical) quality of water
- Patrimonial value and ecological interest
- Fish migration
- RESULT : the environmental index



C - III Application of the Asconit criteria

Conclusion

Code	Available power (kW)	Environmental index	Global comment
Arg4	82	- 17	To encourage and optimize
Deo10	120	- 22	To encourage with emphasis on environmental constraints
Deo12	90	- 22	To encourage with emphasis on environmental constraints
Deo13	57	- 22	To discuss with the owner
Deo15	70	- 17	To encourage with emphasis on environmental constraints
Deo16	60	- 17	To encourage
Deo18	136	- 17	To strongly encourage – feasibility study to launch
Rio1	92	- 21	Strong environmental constraints
Rio2	140	- 21	To encourage – detailed environmental impact study to launch
Rio 3 et Rio 4	55	- 21	To encourage with emphasis on environmental constraints
Ter 6 à Ter 15	200	entre – 10 et - 26	10 sites to group in 1 (ter 6 to 15). Feasibility study to launch ?

For 1 site ADEME and local authorities began the process for a detailed site evaluation

Conclusion

- **An objective operational method has been designed to locate future hydro sites**
- **That method takes into account the hydro-potential, ecological impact, and is a basis for concertation**
- **The method has been applied on a limited area**
- **3 interesting sites have been identified, one (up to now) will be studied into details**
- **That method is operational. Difficulties are on:**
 - ◆ *data collection for each place of the area*
 - ◆ *reaching a consensus on marks on the ecological part*