Workshop on Integrated Coastal Urban Water Planning in Coastal Areas of the Mediterranean (Barcelona, December 9-11, 2009)

REPORT

Priority Actions Programme
Regional Activity Centre
Split, December 2009

Workshop on Integrated Coastal Urban Water Planning in Coastal Areas of the Mediterranean (Barcelona, December 9-11, 2009)

Background

1. Water management is a key factor for sustainable urban development in coastal areas. By the same token, the sustainable urban development of coastal regions is necessary for the sustainable management of scarce Mediterranean water resources. Coastal cities in the Mediterranean are facing significant problems relating to the management of their water resources. Pollution, scarcity, droughts and floods are becoming more frequent and are triggering tensions and conflicts, both within cities and between cities and rural areas. The existing infrastructure is ageing while its replacement is costly. Continuous urbanisation, especially in peri-urban areas, poses costly demands for new infrastructure. Urban water management in coastal Mediterranean settlements is currently approached as a series of separated tasks and many of the current problems are the result of a fragmented approach. There is a need to move to a more integrated management approach whereby the three tasks are managed together and furthermore, in close co-ordination with urban development and management, coastal zone management and water resource management at the river basin level. As a response to these issues, PAP/RAC commissioned the preparation of the Guidelines on Integrated Coastal Urban Water Planning in Coastal Areas of the Mediterranean. In order to promote the Guidelines and to assist the interested authorities in implementing them, PAP/RAC organised a workshop held in Barcelona, Spain, on December 9-11, 2009. The venue of the Workshop was the Catalan Water Agency (Agencia Catalana de Agua/Agència Catalana de l'Aigua - ACA) who kindly offered their conference room.

Participation

2. The workshop was attended by representatives of 10 Mediterranean countries (Algeria, Bosnia and Herzegovina, Croatia, Cyprus, France, Israel, Malta, Montenegro, Spain, Turkey) and PAP/RAC. A complete list of participants is attached as Annex I.

Opening of the Workshop

3. Mr. A. Munné i Torras, Head of the Monitoring and Ecosystem Improvement Department of ACA, welcomed the participants to Barcelona and the ACA. He expressed their satisfaction that the Workshop was organised in their premises and the possibility for their staff to participate as they found the topic very interesting and potentially beneficial for their water management plan that was in preparation. He briefly introduced his Agency and its activities and then wished the participants a successful work.

4. Mr. M. Prem, PAP/RAC Director a.i., greeted the participants on behalf of MAP and PAP. Since most of the participants were in a PAP meeting for the first time, he briefly introduced PAP/RAC and its activities. He stressed the fact that the meeting was organised in Barcelona where the Barcelona Convention had been signed, which is the fundamental document for MAP. Mr. Prem briefly introduced the Guidelines and the activities that lead to their preparation, and linked that with the ICZM Protocol which recognises the water resources as a crucial element of ICZM. He also referred to the Declaration of Marrakech adopted by the Contracting Parties in their November 2009 Meeting, focused on adaptation to climate change. The expected climate change will affect seriously the water resources supply, which is particularly crucial in urban areas. He raised hopes that the Workshop would contribute to better knowledge of rational use of water, and could as such represent an important contribution to adaptation to climate change. Finally, Mr. Prem thanked the Catalan Water Agency for hosting the Workshop.

5. Mr. G. Kallis of the Autonomous University of Barcelona, principal author of the Guidelines and moderator of the Workshop, introduced himself and his work. Then he briefly introduced the Guidelines and how the work during the meeting was envisaged.

6. Mr. G. Kallis presented the Agenda which was adopted as contained in the Annex II.

7. The participants were invited to introduce themselves so they briefly explained where they came from and their professional background.

Working Sessions

8. Mr. J. Margeta, PAP/RAC consultant and one of the authors of the Guidelines, made a presentation on the importance of an integrated approach for urban water management in the Mediterranean. He started by explaining the main factors which characterise the existing trend of changes and pressure on the development and operation of urban water systems in the Mediterranean area: (i) More people on the way and growing demand in the southern and eastern areas, especially in the coastal zone; (ii) Rising pressure on the water resources resulting in a lack of water, especially in the coastal zone; (iii) Insufficient development of urban water infrastructure which fails to keep up with the rising urban needs; (iv) Degradation of resources and ecosystems as a result of overexploitation and pollution. Having elaborated the problems, Mr. Margeta presented solutions and activities needed to overcome unfavourable trends: increased regional and global co-operation through organisations such as the Mediterranean Action Plan, EU – Med co-operation, application of integrated management, increased efforts on combating pollution, increased exploitation potential in a sustainable way, stronger emphasis on demand management and especially on losses reduction, sustainable funding and better application of economic instruments. In his presentation he particularly stressed that the main prerequisite for achieving sustainability of urban water system management was Integrated Urban Water System Management. The main characteristics of the integrated approach methodology were presented (functional links among the various parts of the urban water cycle, and between urban water cycle and environmental and global processes in urban areas, as well as river basin and coastal areas). Mr. Margeta concluded his presentation by stressing that the above methodology and approach were fully addressed in the Guidelines.

9. Mr. Dr Kallis, as the main author of the Guidelines, offered a brief overview of the motivation, rationale and key messages of the document. Data was offered about the fast pace of urbanisation in the Mediterranean coast and the limitations of the conventional “big pipes-in, big pipes-out” model of water management. The conceptual framework of integrated coastal-urban water management was explained, based on the principles of system science. The main components of important systems, such as the urban water cycle and the urban catchment, were explained with the use of illustrations, and the different levels of degrees of integration between different administrative competencies recognised. The presentation concluded with a summary of the steps of an integrated planning process and an explanation of tasks essential for its success - such as data management, public participation, financial planning, legal and organisational reform. The slides that accompanied his presentation are contained in Annex III.

10. Mr. L. Galbiati, Head of the Unit for Co-ordination of Investments and WFD Implementation of ACA, presented his Agency and its activities into greater detail. He particularly stressed their work on the River Basin Management Plan of Catalonia.

11. A vivid discussion followed Mr. Galbiati's presentation. The participants were very interested in the ACA operation and had numerous questions regarding, among others, the cost of various elements, involvement of stakeholders in plan preparation and integration of various planning departments. Reference was also made to the climate change and how it should be envisaged, areas that should be left free of construction in order to prevent floods, etc.

12. Mr. D. Sauri of the Autonomous University of Barcelona introduced water issues in the Metropolitan Region of Barcelona. Water scarcity often linked to severe droughts has been a constant issue in the supply of this vital resource to Barcelona. The last episode of 2008 left as a popular media image ship tankers carrying water to the city. Both physical and human factors play a role in explaining scarcity. First, recurrent periods of insufficient precipitation have been common in the last decades and are likely to become worse as climate change intensifies. In human terms, population increase, and the increase of welfare and the suburbanisation of Barcelona (showing urban sprawl patterns) lead towards an increase in water consumption because of the proliferation of outdoor uses such as gardens and swimming pools. Water planning and management must face these challenges combining changes in the supply approach (using desalinated water as well as treated wastewater and rainwater), and in demand management (increase in the efficiency of water appliances at home, pricing, awareness campaigns, etc.). One important point open to discussion is whether alternative water resources (treated wastewater, rainwater) should be managed taking advantage of centralised systems (large water reuse schemes; big storage tanks for rainwater) or, rather, decentralised systems (involving technologies at the scale of the household and/or the building) should be preferred. The slides that accompanied his presentation are contained in Annex IV.

13. The discussion that followed tackled various technical details of the water supply system options.

14. Mr. Kallis introduced the work in groups. The participants were put in the role of a team of policy-makers, scientists and stakeholders entrusted by the Generalitat de Catalunya to prepare a Master Plan for the Sustainable Management of Water in the Metropolitan Region of Barcelona (for the year 2020). They were divided into three working teams, each charged with one of the following essential tasks: 1. Organisation of the planning process and co-ordination with other planning processes. 2. Public Participation. 3. Data management. Using the Guidelines as an aid and with the help of experts from Barcelona, each team prepared a small presentation of the main actions they proposed in each task, and presented it to the whole group. This was followed by discussion, as well as exchange of experience from real-life situations in the participants' countries. This hands-on work of the participants on a real case helped them familiarise directly with the contents of the guidelines, and get to see its usefulness in their everyday tasks as water managers, planners or policy-makers.

15. On the morning of the second day, a visit was organised for the participants of the desalination plant of the city of Barcelona. It is run by the ATLL (Aigües Ter Llobregat), a state-owned company of the Ministry of the Environment and Housing of the Generalitat of Catalonia. Mr. J. Compte i Costa, Manager of the ATLL, kindly received the participants and informed them of his organisation and presented in great detail the functioning of the desalination plant. The Ter and Llobregat rivers provide, after appropriate treatment, drinking water for over 100 municipalities with over 4 million inhabitants. However, the flows of those two rivers are insufficient to permanently guarantee adequate supply, especially during summer months when greater demand coincides with less resource availability. Therefore, the decision had been taken to build a seawater desalination plant, deeming it the best option which simultaneously increases the quantity and quality of the distributed water. After the presentation, the participants visited the plant and were further explained all the phases of the process.

16. The afternoon session of the second day began with Mr. Kallis who offered a quick overview of the main management options for an integrated coastal-urban plan, including conventional and new water technologies, alternative water sources, water conservation, wastewater management and stormwater control together with urban design and land-use planning. The presentation followed an interactive format where, after presenting each option, the presenter facilitated a discussion with participants, where they were asked to bring to the group the experience with these options from their own countries. This grounded the discussion of advantages, disadvantages, opportunities and obstacles for each option in real-world cases. It was demonstrated that there was no easy solution to water problems, nor a universal panacea that can be applied everywhere. Different solutions might fit better different contexts and it is

generally a combination of different options, adaptable to the local context, that offers the most promise. The slides that accompanied his presentation are contained in Annex V.

17. Mr. Kallis then introduced the new round of group work. Participants were back in their role-play as Barcelona's water stakeholders. The planning process had advanced and they had now a clear problem statement and planning goal, which was "to satisfy the water needs of the population of Barcelona in a cost-effective and safe way, while minimising contribution to local, regional and global environmental problems". This included objectives, such as "to reduce the risk of impacts from water shortages or floods to socially acceptable levels", " to secure that drinking-quality water remains affordable to all", "to maintain that the coastal and other recipient water bodies of Barcelona comply with the ecological standards of the Water Framework Directive, "to reduce the ecological footprint of Barcelona's water supply", "to ensure that water management contributes to the goals of a sustainable land-use development of the coastal zone of MRB". Within this context of agreed objectives, participants were divided into four action committees whose mission was to come up with specific proposals for the Action (Master) Plan. These four committees were: water supply and alternative sources; water conservation; pollution control; stormwater and urban design. Each committee was expected to propose the three most important actions for Barcelona. Experts from the city who brought with them the necessary data and support material, supported the participants in their deliberations, giving them information where relevant about the local context. At the end of the group work, each committee presented three actions and the group as a whole came in agreement over a set of criteria upon which the desirability of the different actions should be evaluated. Once again, this learning-through-action group work offered the participants an opportunity for a hands-on familiarisation with the contents of the guidelines. In order to propose actions, participants had to search, read and discuss the relevant sections of the Guidelines where different options were being discussed, and interact, question and discuss with the authors of the Guidelines in an informal and learning-inductive environment.

18. The above group work paved the way for the activities of the next day, when Mr. G. Gamboa of the Autonomous University of Barcelona showed to the participants how to use NAIADE, a software tool for the evaluation of planning alternatives according to multiple evaluation criteria. He first introduced the social multicriteria evaluation and the need for it, and then the NAIADE software itself. A detailed summary of his presentation is given in the Annex VI. The method was then used to evaluate the proposals made by the groups the day before.

Closure of the Workshop

19. Mr. Kallis thanked the participants for their dedicated work, raising hopes that they would benefit from it and be able to use the Guidelines in their future work. He thanked the lecturers for their interesting presentations and PAP/RAC for organising the workshop. He declared the workshop closed on December 11 at 12:00.

ANNEX I

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ANNEX II

Agenda

Wednesday, December 9

09:00 - 09:30	Registration
09:30 - 10:00	Welcome addresses by PAP-RAC, ACA and local organisers
10:00 - 10:30	The importance of an integrated approach for urban water management in the Mediterranean (Jure Margeta)
10:30 - 11:00	Overview of the guidelines (Giorgos Kallis)
11:30 - 12:30	Presentation of the Agencia Catalana de Agua
12:30 - 13:30	Water issues in the Metropolitan Region of Barcelona (David Sauri)
15:00 - 15:30	Introduction to group work (Giorgos Kallis)
15:30 - 16:30	Group work in Planning Committees (assisted by Giorgos Kallis, Jure Margeta, David Sauri)
16:45 - 18:00	Group work in Planning Committees (assisted by Giorgos Kallis, Jure Margeta, Laia Domenech)

Thursday, December 10

9:00 - 13:00	Guided visit at the desalination plant of the city of Barcelona
14:30 - 15:30	Tools for coastal urban water management (Giorgos Kallis, assisted by David Sauri)
15:30 - 16:30	Group work in Action Committees (assisted by Giorgos Kallis, Jure Margeta, David Sauri)
16:45 - 18:00	Group work in Action Committees (assisted by Giorgos Kallis, Jure Margeta, Laia Domenech)

Friday, December 11

09:00 -10:00	Presentation of the NAIADE software for social multi-criteria evaluation (Gonzalo Gamboa)
10:15 - 11:450	Simulation of NAIADE on the selection of measures for coastal urban water system management in Barcelona (Gonzalo Gamboa)
11:45 - 12:00	Concluding remarks and closure of the Workshop (Giorgos Kallis)

ANNEX III

Overview of the Guidelines

by
Giorgos Kallis

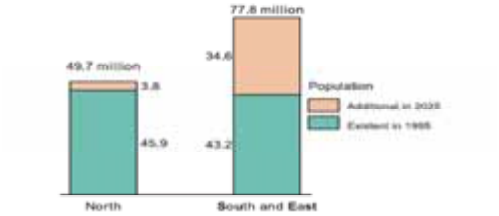
Overview of the Guidelines

Giorgos Kallis,
ICREA Fellow, ICTA-UAB (www.eco2bcn.es)

Workshop on Integrated Coastal Urban Water Planning in Coastal Areas of the Mediterranean

Barcelona, December 9, 2009

An urbanizing Mediterranean

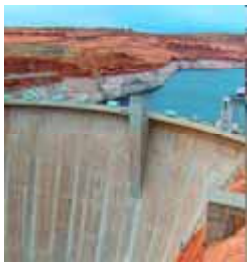


Population living in cities with more than 10,000 people

Coastal Mediterranean cities face particular conditions.

- Seasonal climate and seasonal demands.
- Climate change exposure.
- Aquifer-sea interface.
- Vulnerable coastal aquatic ecosystems.

The "big pipes in – big pipes out" approach is dead



We need an approach that is:

- Integrated.
- Forward-looking.
- Innovative.
- Context-sensitive.
- Socially consensual.

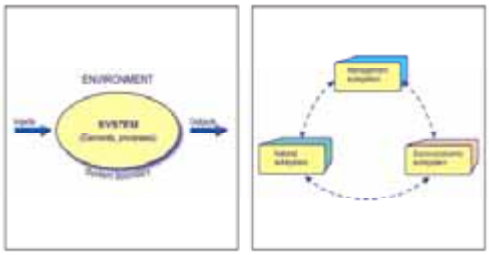
Integrated Coastal Urban Water System Planning

- How to?
  - Organization.
  - Process.
  - Novel alternatives.

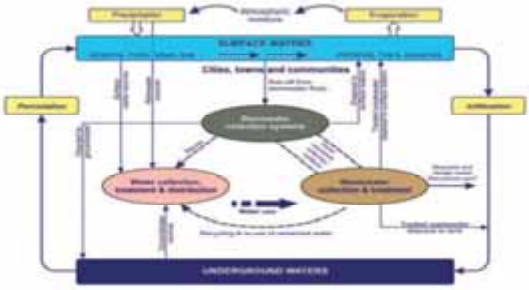
This presentation

- The coastal urban water system
- The meaning of integration
- The planning process
- Support/preparatory tasks

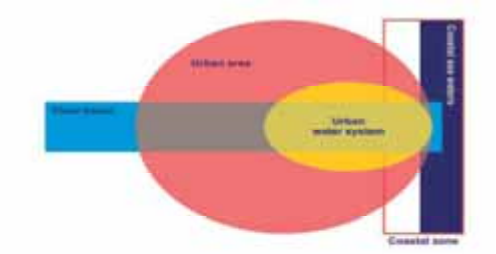
A systems view



Our system: the urban water cycle



Our unit of planning: the coastal urban catchment



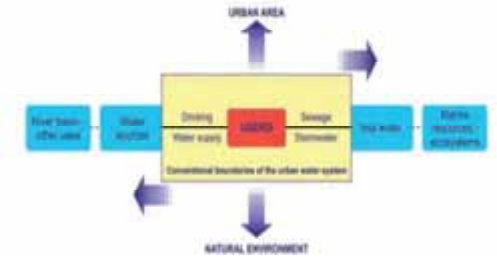
Elements of the coastal urban water system

- Drinking water sources
- Drinking water production infrastructure
- Distribution and storage infrastructure
- Urban water uses
- Stormwater drainage infrastructure
- Stormwater overflow, disposal and treatment infrastructure
- Sewage system
- Wastewater treatment units and outfalls
- Reuse infrastructure
- Receiving waters and coastal sea
- Urban surface and groundwaters
- Channels, weir, intake and/or pumping stations, etc.
- Estuaries, deltas, wetlands and coastal marine resources, etc.

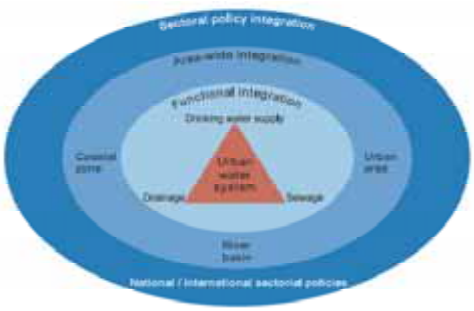
This presentation

- The coastal urban water system
- The meaning of integration
- The planning process
- Support/preparatory tasks

Extend beyond the traditional management competencies of a water agency/company



The three levels of integration



Why integrate with river basin planning?

- WFD is a policy priority.
- Allocation of water, pollution and flood control better decided at river basin scale.
- Source protection the most effective way to guarantee drinking water quality.
- Ecological standards (including for coastal water)

Why integrate with urban planning?

- Water infrastructure is central in causing/controlling urban sprawl.
- Compact urban forms have multiple water resource advantages.
- Urban design affects stormwater management.
- Synergies from joint urban – water infrastructure management.

Why integrate with Coastal Zone Management?

- ICZM a policy priority in the Mediterranean.
- Water effluents main pressure factors for coastal ecosystems.
- Coastal land-use design can play a role in stormwater and wastewater management.
- Coastal infrastructure can impact water quality.
- Flood protection needs to take into account tidal and wave patterns.

This presentation

- The coastal urban water system
- The meaning of integration
- The planning process
- Support/preparatory tasks

Why plan?

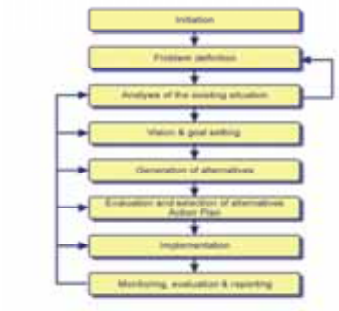
- Prepare for the future.
- Bring actors together.
- Make public debate transparent.
- Explore synergies, identify unknowns, reduce tensions.
- Adapt planning to local realities.

It is the process that matters.

Who should plan?

- Not the water company alone.
- National – regional mandate.
- Set up a committee, agency or partnership.
- Formal vs. self-organizing approach.

Steps of the planning process



Complementary water planning processes

- Master Plan for water sector.
- Integrated Water Resource (and Demand Management) Plan.
- Environmental Management (or Conservation) Plan.
- Risk Management Plan.

Other important planning processes

- Urban strategic plan.
- Land-use plans (zoning).
- Coastal Zone Management Plan.
- River Basin Plan.

How to integrate different plans?

- Joint representation in planning committees / councils.
- "Model plans" – Best Practices.
- Data sharing.
- Joint projects.

This presentation

- The coastal urban water system
- The meaning of integration
- The planning process
- Support/preparatory tasks

Organization

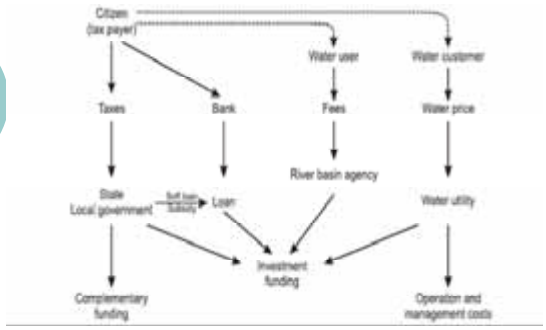
- Who is to be involved?
- What structure?
- Should the water sector be reformed and how?

Human Resources

- Staffing new agency/partnership, creating good working conditions.
- Cross-training and education on new (interdisciplinary) knowledge.
- Training on collaboration capacities.

Funding

- Budgeting (procedure and implementation).
- Source of financing.
- Cost sharing.



Public participation

- Different levels (information, consultation, engagement)
- Who participates and for what?
- Tools and process.

Data management

- Data to characterise and monitor the system (indicators).
- Data gaps – research programs.
- Sharing data procedures.
- Procedures for transparency and quality assurance.

Legislation

- Is the legal framework covering all areas relevant? (service, pricing, quality standards, ecosystem protection, etc)
- Enforcement responsibilities and capabilities.
- Is the implementation of the Plan going to be voluntary or formalized through a legal-binding agreement?

GROUP-WORK

Mission

- You are a team of policy-makers, scientists and stakeholders entrusted by the Generalitat de Catalunya to prepare:

A Master Plan for the Sustainable Management of Water in the Metropolitan Region of Barcelona 2020

Prepare

- Organization of the planning process and coordination with other planning processes.
- Public Participation.
- Data management.

ANNEX IV

Strategies for sustainable water management in the face of scarcity and drought: the case of Barcelona

by
David Sauri

Strategies for sustainable water management in the face of scarcity and drought: the case of Barcelona

David Sauri
Departament de Geografia
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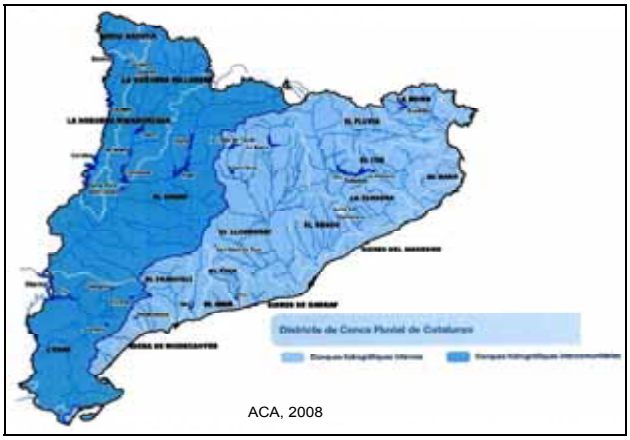
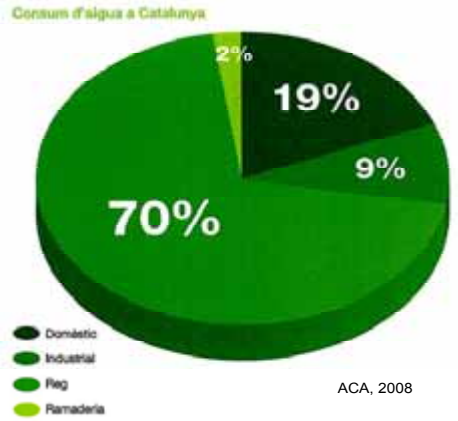
OUTLINE

- Introduction
- Challenges
- Opportunities
- Outcomes
- Conflicts
- Which way ahead?



ACA, 2008



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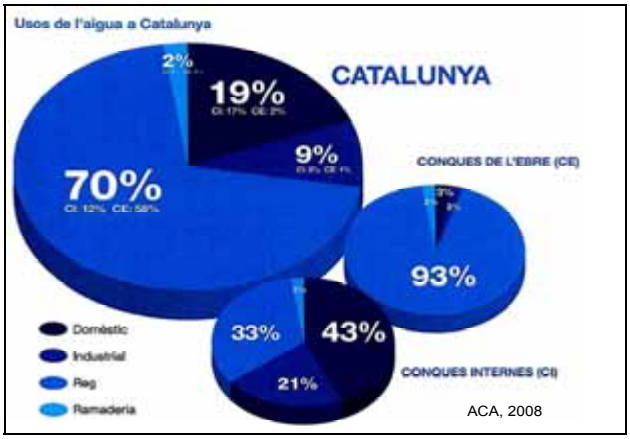
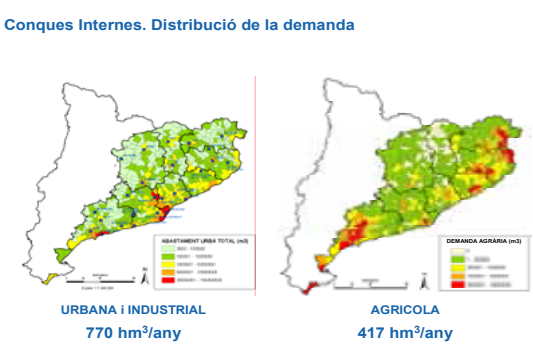


ACA, 2008

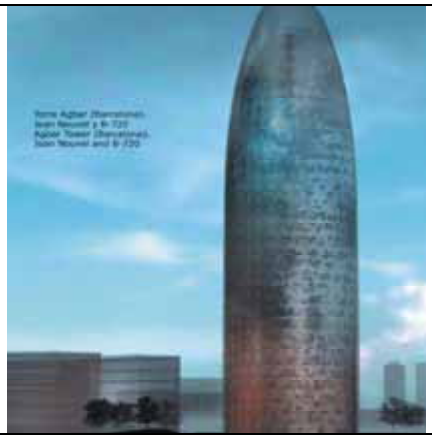


ACA, 2004

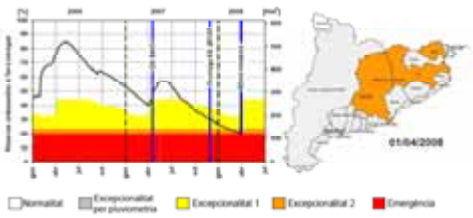
The water supply system in Barcelona

- **ATLL ("Aigües Ter Llobregat"):** public company belonging to the regional Department of the Environment. Distributes bulk water to companies supplying the cities of the Metropolitan Region of Barcelona.
- **AGBAR:** private company (70% of capital belongs Suez Environnement since October 2009). Distributes water to domestic customers in Barcelona and Metropolitan Area.
- AGBAR is the largest water company of Spain supplying to 13 million people in 1200 municipalities. It also supplies 10 million customers in Algeria, Chile, China, Colombia, Cuba, Mexico and the United Kingdom.

ATLL Distribution network



Water stored in Barcelona reservoirs.
January 2006 to April 2008



ACA, 2008

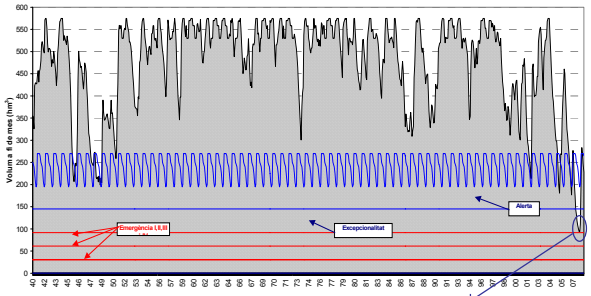
Aigua a preu d'or

- CHALLENGES

Average annual precipitation of Catalonia inner basins. HIstogram (blue) indicates variation in precipitation with respect to the average value 1940-2007. The line (red) indicates variation in accumulated annual precipitation with respect to the average accumula ted annual precipitation

ACA 2008

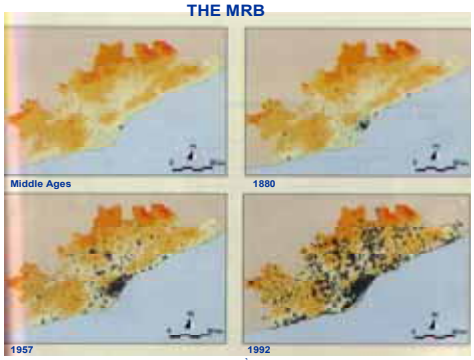
Simulated evolution of water stored in the reservoirs of the Ter –Llobregat system



The worst situation in 67 years!!

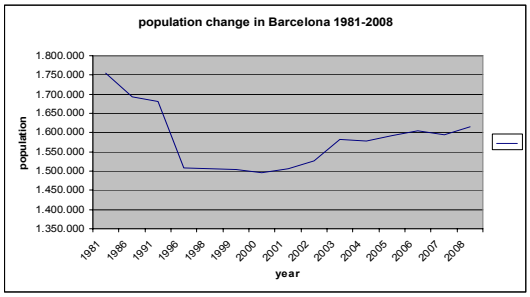
ACA, 2008

HISTORICAL EVOLUTION OF URBAN LAND USE IN THE MRB

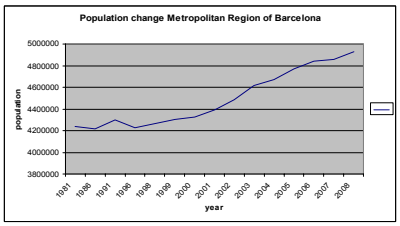


From J. Acebillo i R. Folch: Atles Ambiental de l'Àrea de Barcelona, Barcelona, Ed. Ariel, 2000.

Population change in the city of Barcelona. 1981-2008



Population change in the Metropolitan Region of Barcelona 1981-2008



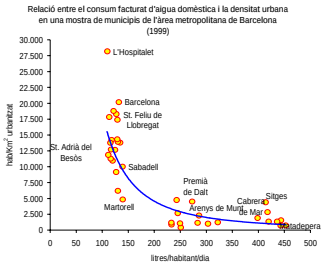
Urban sprawl in the Mediterranean coast and water consumption

Suburbanization and the proliferation of low dense residential fabrics is not only a problem of Barcelona but also strongly affect the Spanish Mediterranean coast and other parts of Europe

In Spain, and concretely in the Mediterranean, this is a very important issue regarding water resources conservation

Water consumption in the dense city: around 130 lpd (liters/person/day)
Water consumption in suburban areas: > 200 lpd, with cases >500 lpd

Urban Density and domestic water consumption



Rivera, Capellades, Saurí, 2001

- OPPORTUNITIES

Very dense urban pattern

Population density of Barcelona: near 17.000 persons/sq kilometre
London: 4.500 persons/sq kilometre
Los Angeles: 2.990 persons/sq kilometre

High Efficiencies of water distribution networks

- 98 % of domestic water is metered

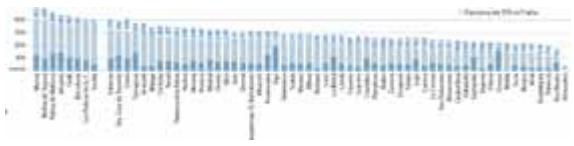
Physical efficiencies of delivery networks:

- "Aigües Ter-Llobregat" (ATLL): 97%
- "Aigües de Barcelona" (AGBAR): 93 % (*)

(*) Does not include losses by faulty meters or frauds (about 10% of all water delivered on the average for Barcelona)

Water price in Catalonia. Comparisons with other areas (euros/cubic meter)

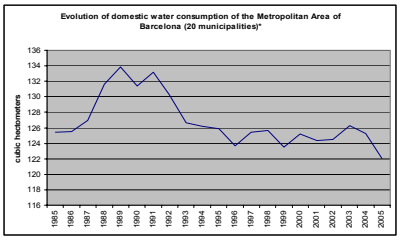
Water prices in Spanish cities 2009 (*)



(*) Cost for a bill of 175 m3/year

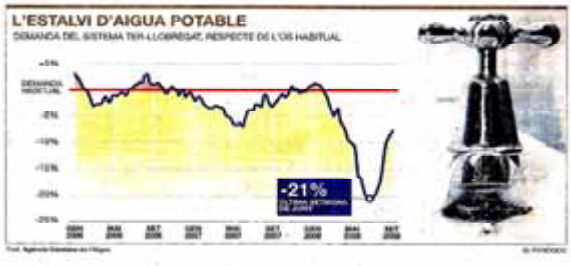
Water consumption for selected European Cities (2006)

Domestic water consumption in the Metropolitan Area of Barcelona.



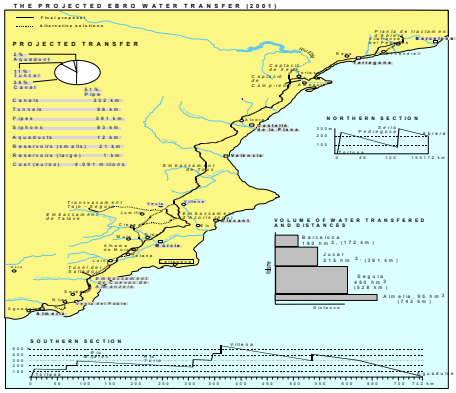
ACA, 2006

Water savings by Barcelona citizens during the drought of 2008



El Periódico, 22 september 2008

- (CONVENTIONAL) SOLUTIONS

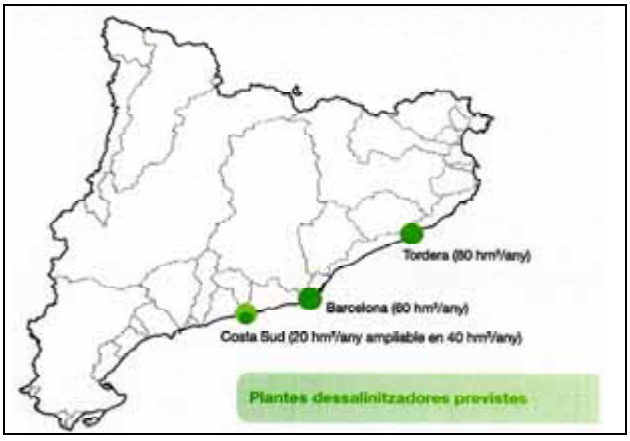


The New Cornucopia?

Desalination plants along the Mediterranean coast

Desalination plants as the compromise solution to the tension between increasing demands of water (increase of the supply) along the Mediterranean coast and "New Water Culture" of the donor basins

In 2009 desalination plants are expected to supply around 1,250 cubic hm3.



- CONFLICTS

The "Barcelona water war" (1992-1999)

- Between 1987 and 1993, average prices for domestic uses in BMA rose from 0.59 to 1.23 euros/cubic meter (an increase of 108%).
- In 1991 the Catalan government raised substantially the water bill adding new taxes to pay for wastewater treatment plants required by the European Wastewater Directive
- Neighborhood community groups in the Metropolitan Area of Barcelona stopped paying the tax part of the water bill in protest for the raise.

The "Barcelona water war" (1992-1999)

- Main reasons for the revolt: In Barcelona, taxes for domestic water where higher than in other cities of Spain, and they were four times comparatively higher than those charged in the industrial sector
- Moreover, it was reported that golf courses remained exempt of the hydraulic tax during the period 1991-1996
- The area potentially affected by the tax revolt covered a total of 23 municipalities and a total population of 2.6 million people.
- A At the end of the 1990s more than 80,000 families objected to the payment of taxes.
- The disproportionate fraction of cost of environmental modernization by the lower income segments of the metropolitan population

The Geography of the Barcelona Water War

The struggle against the Ebro water transfer (2001)

- National Water Plan of 2001: Ebro water transfer to Catalonia, and to Valencia, Murcia and Almeria
- Opposition of “donor” regions (Aragon+southern Catalonia)
- Arguments
  - Deepening uneven development between inland Spain and the coastal areas
  - Impacts on the Ebro delta
  - Need of a “new water culture” not based on big projects

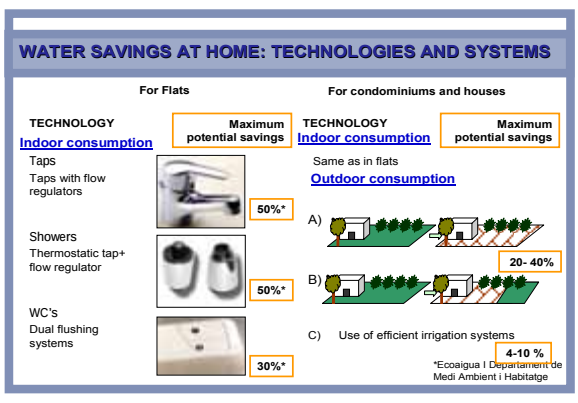
- (ALTERNATIVE) SOLUTIONS

Key factors in future water consumption trends I

- Urban and territorial planning
  - Concentrate urban growth in medium size cities and stimulate compact forms.
  - Avoid urban sprawl as much as possible

Key factors in future water consumption trends II

- Increase savings and efficiency in household water use
- Increase efficiencies of the supply networks (system losses around 20% in the Barcelona area but only 7-8% of these are leaks)



Key factors in future water consumption trends III

- Use of alternative resources: Rain water and treated wastewater
- But what approach?

	Rainwater	Recycled/Regenerated/ Greywater
Centralized	Detention water tanks (underground or open-air)	Wastewater treament plant→ tertiary treatment, (reverse osmosis), (double distribution network) Use: 1)TT+RO+Treatm: drinking water (ex: Namibia, Singapore, etc) 2) TT+double piping: secondary uses
Decentralized	Rooftop rainwater from public buildings, households Stormwater: from parking areas, etc Use: water gardening, toilet flushing, washing	Greywater: Shower, bath, hand basin→ toilet flushing, garden watering Recycled water: small-scale wastewater treatment equipment toilet flushing, garden watering

Wastewater plant of El Prat de Llobregat

- Year of construction: 2002 (2006)
- Type of treatment: Biological with N and P removal
- Capacity: 420.000 m3 daily (population equivalent of 2.275.000)

- Wastewater treated: 700 Hm3/year
- Treated wastewater reused: 30% (2015)

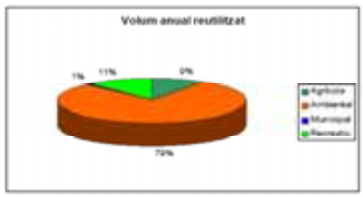
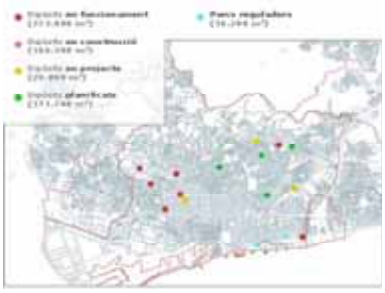


Figura 1: Percentatges de reutilització actual per usos l'any 2006

Flood retention areas in Barcelona



Water Savings Ordinance of Sant Cugat del Vallès

In operation since 15 november 2002

For residential uses especially

For new buildings and large renovations

Mandatory installation of

Tot edifici:
- **Pressure regulators in taps**
- **Air flows in showers**
- **Dual flushing systems in toilets**

Condicionat:
- **Timers (public buildings)**
- **Rain water deposits (gardens > 1.000 m²)**
- **Pool water re-use (gardens>40m²)**
- **Grey water use systems (> 8 housing units)**

Example: GREYWATER REUSE

- Greywater is low polluted water which includes all the wastewater produced in a household with the exception of the wastewater from toilet flushing
- After treatment, **greywater may be reused on site**
- Uses given to greywater: **toilet flushing, garden watering and laundry**



RAINWATER HARVESTING

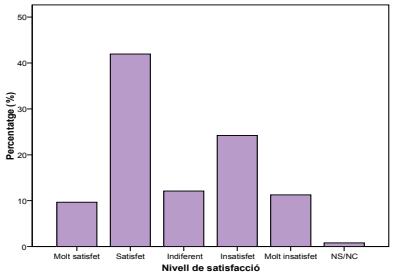
- Collection of rainwater runoff generated from an impermeable surface and its storage for later use
- Components of the system: catchments area, gutters, storage tank

Rural rainwater harvesting systems



Urban rainwater harvesting systems

Degree of satisfaction with grey water reuse systems in (sample of apartment blocks in Sant Cugat del Vallès, july 2008, N=14; n=278)



Domènech, 2008

- CONCLUSIONS

Which way ahead?

- Drought and scarcity conditions have become a “normal” state of affairs for Barcelona during the last decade.
- Despite favorable conditions (high density urbanism, metering, high prices and sound conservation attitudes) water demand will continue to grow in the future
- Last episode (2007-2008) ended with desalinization as the main alternative together with water conservation and water re-use as important management options as well
- Interesting debate with important implications for sustainability: large scale centralized systems for wastewater and rainwater or small scale decentralized systems at the scale of the household coupled with domestic technologies for saving water? (as in the energy field)?
- Important to debate economic, social and environmental costs and benefits of both options, including also costs to households in terms of time, more management responsibilities, etc.

ANNEX V

Alternatives and Criteria

by
Giorgos Kallis

Management alternatives

Giorgos Kallis,
ICREA Fellow, ICTA-UAB (www.eco2bcn.es)

Workshop on Integrated Coastal Urban Water Planning in Coastal Areas of the Mediterranean

Barcelona, December 10, 2009

This presentation

- Water supply.
- Alternative water sources.
- Water conservation.
- Wastewater control.
- Stormwater management and urban design.

Dams and/or Transfers of rivers/lakes

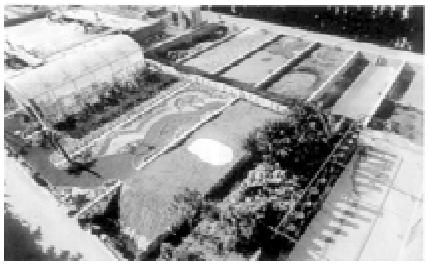
Groundwater (Boreholes)

This presentation

- Water supply.
- Alternative water sources.
- Water conservation.
- Wastewater control.
- Stormwater management and urban design

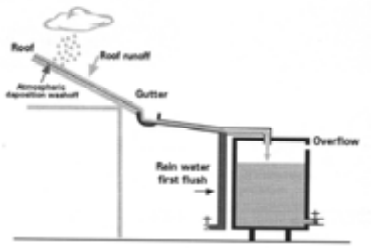
Desalination

Wastewater recycling



Dual piping

Rainwater harvesting

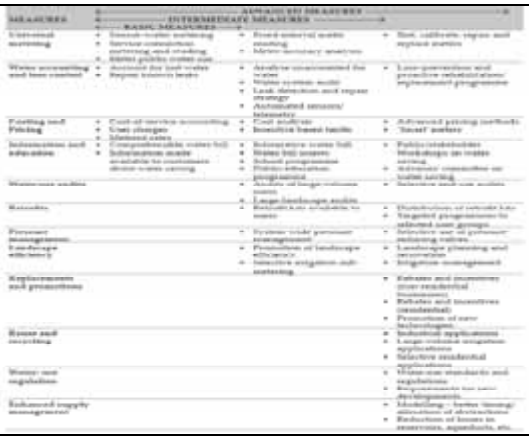


Rainwater harvesting

Aquifer recharge

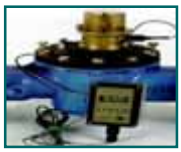
This presentation

- Water supply.
- Alternative water sources.
- Water conservation.
- Wastewater control.
- Stormwater management.
- Urban-coastal interventions.



Efficient appliances

Leakage detection and control

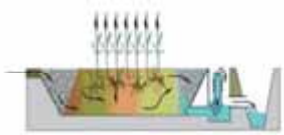


This presentation

- Water supply.
- Alternative water sources.
- Water conservation.
- Wastewater control.
- Stormwater management and urban design.

Tertiary and advanced treatment

Constructed wetlands

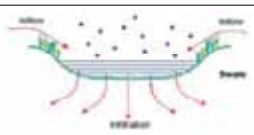


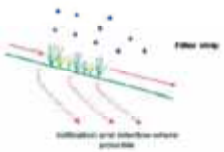
Separation at source and differential treatment

This presentation

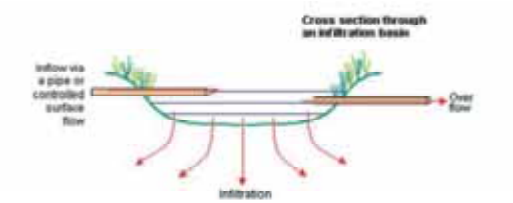
- Water supply.
- Alternative water sources.
- Water conservation.
- Wastewater control.
- Stormwater management and urban design.

Constructed grass surfaces





Infiltration basins



Permeable surfaces

Ponds and constructed wetlands

Urban design

- Public open space networks.
- Housing layout.
- Road layout.
- Streetscape.
- Parking area storage.
- On-site detention for large sites.

GROUP-WORK

Problem definition

- Barcelona is facing increasingly severe **droughts and floods**, while low-density urban housing is expanding in the **suburbs**, increasing **demands** for water and **pollution** loads.

Goal for 2020

- To satisfy the water needs of the population of Barcelona in a cost-effective and safe way, while minimizing contribution to local, regional and global environmental problems.

Objectives

- Reduce the risk of impacts from water shortages or floods to socially acceptable levels.
- Secure that drinking-quality water remains affordable to all.
- Maintain that the coastal and other recipient water bodies of Barcelona comply with the ecological standards of the Water Framework Directive.
- Reduce the ecological footprint of Barcelona's water supply.
- Ensure that water management contributes to the goals of a sustainable land-use development of the coastal zone of MRB.

Mission

- You are the Council of the Master Plan, entitled to propose a set of actions that can achieve the goal and objectives of the plan.
- You divide your work in four action committees: water supply and alternative sources; water conservation; pollution control; stormwater and urban design.
- Each committee is expected to propose the three most important actions.
- After this, you are expected,
  - 1. to group some of the actions proposed into coherent packages of measures.
  - 2. to codify the objectives of the plan into a set of evaluation criteria that will be used to rank (tomorrow) the twelve alternatives.

ANNEX VI

Social Multi-criteria Evaluation

by
Gonzalo Gamboa

Social Multicriteria Evaluation in practice

Introduction

Nowadays, there is a wide recognition of the need to consider altogether the social, ecological and economic dimensions in decision-making processes within the framework of public policy and environmental management. Past decades have witnessed a high priority given to the economic dimension, which has brought several socio-environmental imbalances at different spatial and temporal scales.

On the other side, when we have to make a decision concerning socio-environmental issues, there are conflicting values, interests and requirements from different social groups, and there is no solution that simultaneously maximizes all objectives

The combination of multicriteria evaluation and public participation, under the framework of Social Multi-criteria Evaluation (Munda, 2004), is aimed at considering a wide range of perspectives in a public decision making process. In order to cope with the complex[1] nature of socio-environmental relationships, SMCE considers multi/inter-disciplinary work and public participation.

A multi-criteria structure consists in a set of alternatives conforming a decision space, which are evaluated under several criteria. Table 1 shows a problem structured in a a a A multi-criteria fashion: with n possible actions aj (j = 1, 2, ..., n) and m relevant evaluation criteria gi (i = 1, 2,..., m).

Criteria are at least partially contradictory, that means that one alternative can be the best under one criterion, but not necessarily under the rest of the criteria.

Table 1: Multi-criteria impact matrix

Criteria	*Alternatives*			
	A₁	***A₂***	**-**	***Aₙ***
g_1	$g_1(A_1)$	$g_1(A_2)$	-	$g_1(A_n)$
g_2	$g_2(A_1)$	-	-	-
-	-	-	-	-
-	-	-	-	-
g_m	$g_m(A_1)$	$g_m(A_2)$	-	$g_m(A_n)$

1 A system is complex when its relevant aspects cannot be captured using a single perspective (Funtowicz et al.,1999; O'Connor et al., 1996).

In SMCE, alternatives are based upon the plans and desires of the different social actors and can be created through several participatory approaches (e.g. participatory mapping, problems tree. See also www.sas2.net). On the other side, criteria are the technical translation of social actors' objectives, which are also identified by means of participatory approaches.

There are several multi-criteria models, each one with its advantages and disadvantages: the lexicographic model, for instance, consists in applying criteria one-by-one to the set of alternatives, eliminating those options that don't fulfil the limit established by the applied criterion. The procedures continue until all selected criteria have been considered and/or until one alternative is selected.

Other methods are based on linear aggregation of criterion scores, which is done after a transformation of the performances by means of utility or value functions (See for instance, Keeney and Raifa, 1976). These methods are completely compensatory.

There are also the outranking methods (Roy, 1990), which are based on the concept of partial comparability. That is, the preferences between two alternatives can be modelled by means of binary relationships: indifference, strict preference, weak preference and incomparability. These models do pair-wise comparisons of alternatives in order establish whether one alternative is *at least as good as* the other, according to most of the criteria.

The desirable features of a multi-criteria model in the public policy domain are discussed in Janssen and Munda (1999), Munda (2004) and Munda (2005). In short, the model has to be as simple as possible to guarantee transparency. Non-compensation is desired to avoid that very good performances in some dimensions— for instance the economic one— overcome bad results in other dimensions— for instance ecological or social ones—, which could be important for some social groups.

Case Study

This part of the presentation shows the process and main results of a case study about the implementation of two windfarm projects in western Catalonia (See Gamboa and Munda, 2007). First, it describes the projects and the conflict around them. Then, it presents the (qualitative) participatory approaches applied in order to present the research project and to identify social actors objectives.

It follows the creation of options. In this case, we create seven alternatives by means of combining different size and locations of the windmills. In this way, we consider social actors preferences (visual impact) and the technical viability of the projects (wind availability)

Alternatives are then compared across 8 criteria: Owner's income, Municipalities' income, number of jobs created, forest lost due to deforestation, avoided CO_2 emissions, noise and installed capacity

Then, we present the social impact matrix: how social actors evaluate each alternative. Based on this information, we can obtain (by means of applying NAIADE model) possible coalitions between the different groups and the ranking of preferred alternatives by each coalition.

In conclusion, SMCE involves the following steps:

1. *Isolation of relevant social actors,* by means of institutional analysis, individual interviews with key agents or with a random sample, focus groups, etc.
2. *Definition of social actors' values, desires and preferences*, mainly through in-depth interviews and focus groups.
3. *Generation of policy options and evaluation criteria.* This process must be a collective

creation resulting from a dialogue between the scientists and the social actors. Criteria are indicators that assess to which extent the different social actors' objectives are achieved by each alternative.

4. *Construction of the multi- criteria impact matrix*. It synthesizes in a matrix form, the scores of all criteria for all alternatives. Each criterion score represents the performance of each alternative according to each criterion.
5. *Construction of the equity impact matrix.* This allows representing the distance between the positions of the social actors, by using a linguistic evaluation of the alternatives that expresses the point of view of each group. By means of a dendrogram, it shows the degree of conflict and the possible coalitions among the groups of social actors on each possible alternative.
6. *Application of a mathematical aggregation procedure.* In order to obtain a final ranking of the available alternatives, the criterion scores must be aggregated by means of a mathematical algorithm. Many Multi-criteria models have been formulated since the Sixties, each one with advantages and disadvantages. In each case the most appropriate must be chosen, weighting the pros and cons of each model.
7. *Sensitivity and robustness analysis.* Some assumption are changed or some parameters are given a different value in order to test whether the final ranking changes. This step is very important due to unavoidable degree of uncertainty that characterizes most real-world decision-making processes.

One has to note that policy evaluation is not a one-shot activity. On the contrary, it takes place as a learning process which is usually highly dynamic, so that judgements regarding the political relevance of items, alternatives or impacts may present sudden changes, hence requiring a policy analysis to be flexible and adaptive in nature. This is the reason why evaluation processes have a cyclic nature. By this is meant the possible adaptation of elements of the evaluation process due to continuous feedback loops among the various steps and consultations among the actors involved. Of course, these steps are not rigid. On the contrary flexibility and adaptability to real-world situations is one of the main advantages of social multi-criteria evaluation.

References

Funtowicz, S.O., Martinez-Alier, J., Munda, G., Ravetz, J.R., 1999. Information tools under conditions of complexity. Environmental issues series No. 9. European Environment Agency.

Gamboa, G., Munda, G., 2007. The problem of wind-park location: a social multi-criteria evaluation framework, Energy Policy Volume 35, Issue 3 , March, Pages 1564-1583.

Janssen, R., Munda, G., 1999. Multi-criteria evaluation for quantitative, qualitative and fuzzy evaluation problems. in: J.C.J.B van der Bergh (ed.): Handbook of environmental and resource econommics. Cheltenham/Northhampton, MA, Edward Elgar, 837-852

Keeney R., Raiffa H. (1976) - Decision with multiple objectives: preferences and value trade-offs, Wiley, New York. Munda G., 1995. Multicriteria evaluation in a fuzzy environment, Physica-Verlag, Contributions to Economics Series, Heidelberg.

Munda G., 2004. “Social multi-criteria evaluation (SMCE)”: methodological foundations and operational consequences, European Journal of Operational Research, vol. 158/3, pp. 662-677

Munda G., 2005. Multi-Criteria Decision Analysis and Sustainable Development, in J. Figueira, S. Greco and M. Ehrgott (eds.) –Multiple-criteria decision analysis. State of the art surveys, Springer International Series in Operations Research and Management Science, New York, pp. 953-986.

O'Connor, M., Faucheux, S., Froger, G., Funtowicz, S.O., Munda, G., 1996. Emergent complexity and procedural rationality: postnormal science for sustainability. In: Constanza, R., Segura, O., Martínez-Alier, J. (Eds.), Getting Down to Earth: Practical Applications of Ecological Economics. Island Press/ISEE, Washington D.C., pp. 223–248.

Roy B., 1990. Decision aid and decision making, in Bana e Costa C.A. (ed.)- Readings in multiple criteria decision aid, Springer-Verlag, Berlin, pp. 17-35.

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Dealing with the problem of Windfarms location: A SMCE framework

Development and Application of a Multicriteria Decision Analysis softwareTool for Renewable Energy sources (MCDA-RES)
(http://www.exergia.net/mcda/MCDA_default.htm
)

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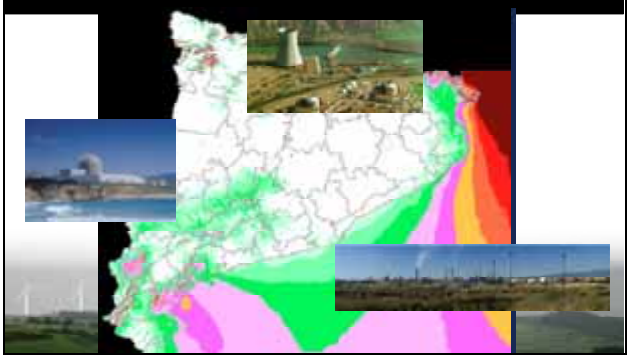
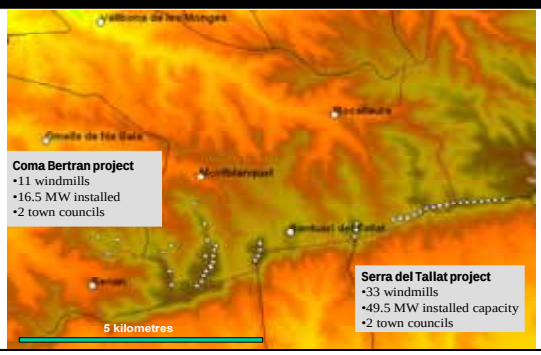
Windfarm projects



Windfarm projects



The conflict

- Migration trends
- Social needs
- Municipalities and some citizens supporting the windfarm projects
- Social movements against the construction of windfarms
  - Ecologists, second residences, neo-rural people…
  - Tourism projects (Ruta del Cister)

Meetings

Activity	Place and date	Participants
Preliminary meeting	Municipality Vallbona de les Monges 19/12/2003	2 majors
Open meeting	Municipality Vallbona de les Monges 09/01/2004	~30
Open meeting	Municipality Rocallaura10/01/2004	~40
Focus group	Municipality Vallbona de les Monges 16/01/2004	5
Preliminary meeting	Municipality Els Omells de Na Gaia 16/01/2004	Major and 2 representatives

Meetings

Activity	Place and date	Participants
Open meeting	Bar Els Omells de Na Gaia 17/01/2004	~30
Focus group	Municipality Els Omells de Na Gaia 24/01/2004	5
Open meeting	Municipality Senan 14/02/2004	~30
Open meeting	Montblanquet 27/03/2004	~40

Multi-criteria structure - Alternatives

- 12 alternatives
  - Based on:
    - Social actors preferences (visual impact)
    - Technical viability (wind availability)
  - GIS
    - Miramon
    - Viewshed, distances from town…

Multi-criteria structure - Alternatives

Multi-criteria structure - Alternatives

Impact matrix

Table 28. Multi-criteria Impact Matrix

Criteria	Units	Dir.	CB Pre	CB	ST	CBST	L	R	NP
Owners' income	[€/year]	▲	48.000	33.000	99.000	132.000	78.000	72.000	-
Municipalities' economic income	[€/year]	▲	-16.726	-19.022	-52.601	-71.646	-41.823	-38.090	-
Number of jobs		▲	2	1	4	5	3	3	-
Visual impact	Km²	▼	76.570	71.465	276.550	348.015	220.400	163.290	-
Forest lost	[ha]	▼	8,4	8,1	6,6	14,7	3,9	2,6	-
Avoided CO2 emissions	ton CO²/year	▲	4.480	4.010	19.740	25.750	14.740	13.760	-
Noise	dB(A)	▼	39,9	39,6	26,6	39,6	30,1	13,3	-
Installed capacity	[MW]	▲	13,6	16,5	49,5	66	39	36	-

Notes: In the case of noise annoyance it is shown the worse score between of the sound pressure level considering the five involved towns.

Evaluation

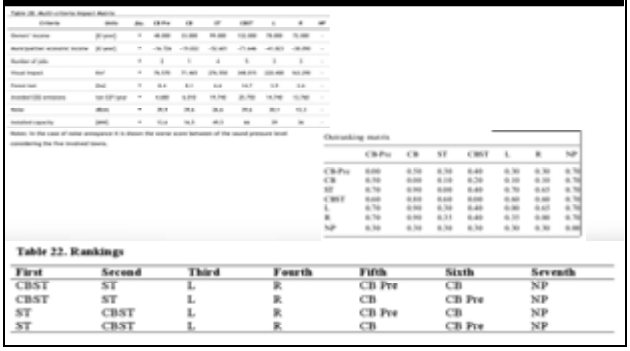
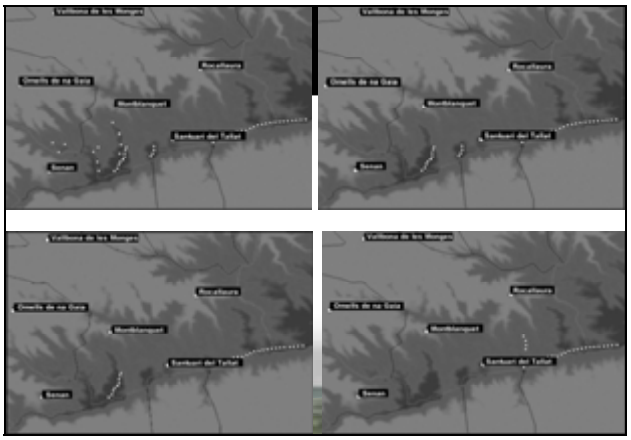


Table 22. Rankings

First	Second	Third	Fourth	Fifth	Sixth	Seventh
CBST	ST	L	R	CB Pre	CB	NP
CBST	ST	L	R	CB	CB Pre	NP
ST	CBST	L	R	CB Pre	CB	NP
ST	CBST	L	R	CB	CB Pre	NP



Social Evaluation

Conflict analysis – Social evaluation

Table 23. Social Impact Matrix

Social groups	*CB Pre*	*CB*	*IT*	*CB IT*	*L*	*R*	*ATP*
O1	Catalonia government	+ or - Good	+ or - Bad	Very good	Perfect	Good	Good	Extremely bad
O2	Municipality of Vallbona de les Monges	+ or - Good	+ or - Bad	Very good	Perfect	Good	Good	Extremely bad
O3	Municipality of ela Ouelle de se Oeus	Very bad	Good	Bad	Good	Bad	Bad	Bad
O4	Municipality of Rocalleura	+ or - Good	+ or - Bad	Very good	Perfect	Good	Good	Extremely bad
O5	Municipality of Senan	Very bad	Very bad	Very bad	Extremely bad	+ or - Bad	Moderate	Perfect
O6	Coordinating committee to defend the land	Very bad	Very bad	Extremely bad	Very bad	Very bad	Bad	Perfect
O7	Platform for Senan	Very bad	Very bad	Extremely bad	Extremely bad	+ or - Bad	Moderate	Perfect
O8	Association of friends and neighbors of Montblanquet	Extremely bad	Extremely bad	Very bad	Extremely bad	Very bad	+ or - Bad	Perfect
O9	EDF	Extremely bad	Extremely bad	Perfect	Perfect	+ or - Good	Moderate	Extremely bad
O10	Greens	Very Good	Perfect	Extremely bad	Perfect	Extremely bad	Extremely bad	Extremely bad

Conflict analysis - Coalitions

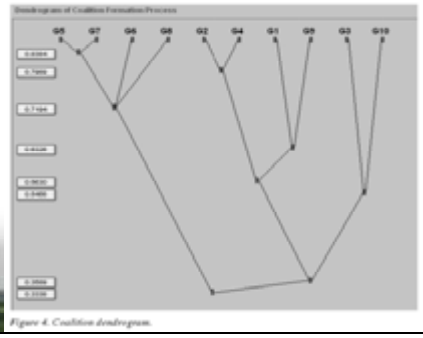
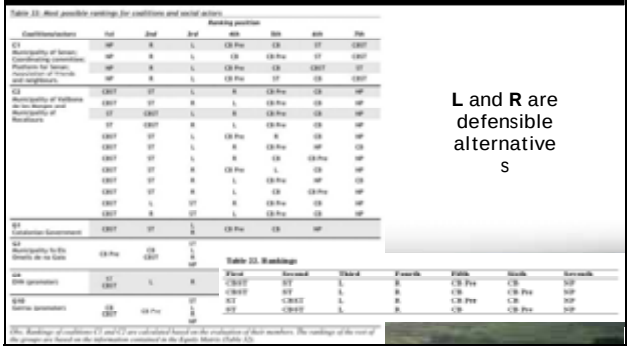


Figure 4. Coalition dendrogram.

Conflict analysis - rankings



L and **R** are defensible alternatives

Conclusions

- Social and technical inconmensurability
  - Participation and Multi-Criteria evaluation
- Process
  - Isolations of relevant social actors
  - Identification of values, objectives and preferences
  - Problem struturing
  - Technical and Social Evaluation
  - Sensitivity analysis
- Learning process

Conclusions

- Participatory processes
  - Right to participate (democracy)
  - Appraisal of complexity
  - Acceptance of policy implementation / Legitimacy
  - Social learning