FIRST CORE DESALINATION GROUP MEETING IN ATHENS, 11-12 June 2012

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GUIDING STATEMENTS

1. Desalination should be considered only after less expensive technical efficiency (demand management interventions) & allocative efficiency (efficiency with which society allocates its water resources among sectors for sustainable socio-economic development) are exhausted. Options such as water conservation, reallocation among sectors, water transportation, changing crop patterns, innovative irrigation techniques, reduction of NRW, etc. should be considered first.
2. Opportunity cost analysis, including the socio-economic & environmental externalities, should be used as a analytical tool to select among alternatives.
3. In case desalination is decided, it has to be subject to EIA study according to the national policies & guided by the internationally recognized criteria & procedures.

Discussions of Session II

Technical Aspects of Desalination BAT Using RES

DESALINATION BATs INCLUDING ADVANTAGES & DISADVANTAGES OF EACH

1. Multi-Stage Flash (MSF)
2. Multi-Effect Distillation (MED)
3. Mechanical Vapour Compression (MVC)
4. Reverse Osmosis (RO) with all its new developments.
5. Electro-dialysis (ED)
6. Membrane distillation (MD)
7. Thermo-Ionic™ Desalination
8. Forward Osmosis (FO)
9. Solar Stills
10. Humidification/Dehumidification (HDH)

TABLE 1 ON PAGE 33 OF THE REPORT

Renewable energy technologies for desalination BATs

- **SOLAR:** The relative sophistication of CSP plants make them less suitable for autonomous desalination units in remote and rural areas. Remote might be different than rural.
- **WIND:**
- **Geothermal:** It is believed by some investigators that geothermal energy is one the most promising options for renewable energy desalination. Geothermal reservoirs provide a continuous supply of thermal energy at fixed conditions throughout the day and year. Promising developments
- **Waste heat:** An example of such a set-up is the 5000 l/d MD plant in the island of Pantelleria, Italy, which derives 80% of its required power from the waste heat of a diesel power plant, and the remaining 20% from solar collectors.

COMBINATIONS OF RES & DESALINATION

A wide variety of combinations is possible.

1. Solar thermal-MED
2. Solar thermal-HDH in the range of 2-5 €/m^3
3. PV-RO in the range of 3.5 –7 €/m^3 for brackish and 9 –12 €/m^3 for seawater RO units
4. PV-ED
5. Wind-RO in the range of 1000-2500 m^3/day, the estimated cost is in the range of 1.50–3 €/m^3
6. Wind-MVC
7. Geothermal MED cost was reported to be 1.6€/m^3
8. Geothermal HDH and other thermal processes.

QUESTIONS TO BE ANSWERED

1. Are the listed desalination BAT and compatible RES comprehensive? Are you aware of more technological developments that can be added to the report? There are many other BAT but not mature enough.
2. Knowing the region specificities and the listed BATs with their relative advantages and disadvantages, what in your opinion the BAT that should be given special focus? Case specific
3. How can we further elaborate and use the table of comparison as a very brief guide or flier for decision makers? It can be very useful
4. Is there a need to further elaborate on the compatibility of desalination BAT and appropriate RESs to give options and alternatives to decision makers? Site specific
5. What sort of capacity development is needed to orient water engineers and administrators on the available mature desalination BAT and their compatible RESs? There is a need under the capacity building WP of SWIM.

SESSION III

ASSESSING COMMUNITY NEEDS FOR DESALINATION

OBJECTIVES OF THE SESSION

Factors to be considered for determining the feasibility & assess the real needs of a remote community to desalination

I- Geographical & physical considerations

1. Physical geography of the location which influences the type of soil & terrain, surface topography, geothermal reservoir activity and other geologic factors.
2. Local hydrology of the site. This includes the movement, distribution & quality of water at the location, water resources available & other aspects of the total hydrological profile.
3. Water crop of the region, with its three main components: precipitation, runoff, and evapo-transpiration.
4. The possible cultural, historical and archaeological heritage of a site to avoid damage caused by construction and other civil works.
5. Aesthetical damage that can be caused by unsightly plant installations. Wind turbines and wind farms to be objectionable especially so for historical sites.
6. Locations of wildlife habitat (e.g. NATURAL RESERVE) to protect them & potential impacts on bio-diversity.

II- Demographic & socio-cultural considerations

1. **The Socio-technical-institutional interdependence:** Interaction between 3 elements: people, technologies & organizations must be fully understood & accounted for.
2. **Involvement of beneficiaries:** The people affected by the project must be included at all stages & their input must be taken into account.
3. **Learning:** Opportunities for learning, raising awareness & training need to be provided from the earliest stages of a project to maximize benefits.
4. **Independence & autonomy:** Technological solutions, however cleaver & innovative they might be in the eyes of the decision-makers, must not be imposed on a community that finds them objectionable.
5. **Flexibility & Process orientation:** The general conditions for water supply in rural areas can change relatively quickly, and are generally very site-specific.
6. **Sustainability:** Average income per family, poverty levels, affordability, willingness to pay for desalinated water & government subsidies, play a major role in sustainability.
7. **Realism:** Project objectives & expectations must be realistic & feasible to avoid failure.

III- Cultural, religious & gender related issues

- Often a new technology introduced into a community for the first time is perceived as an alien intrusion that is incompatible with long-standing traditions, social structures and responsibilities of the community.
- Despite the important role women play, men take charge of decision-making & women are often left out.

IV- Raw water resource quality & availability

- Detailed water chemical analyses of raw water are required for the design of desalination systems to avoid scaling and/or fouling.
- In case of using well water as raw water source for desalination, detailed hydrological study/tests shall be conducted to ensure the draw down in the well, sustainability of the well for the current capacity plant throughout the period of operation of desalination plant.

V- Pricing structures & financing schemes (Affordability)

- A successful desalination project in area should manage to recover its running costs & depreciation. This necessitates that the water pricing reflects the real costs of water supply. On the other hand, access to safe drinking should be available & affordable for all.
- The main challenges facing desalination in rural communities are:
  1. The low income of the rural population.
  2. Limited financial resources within rural communities.
  3. High investment costs required for such projects.
- In response to these difficulties, a number of support mechanisms that do not distort the market function are possible, such as:
  1. Direct financing of the infrastructure.
  2. Providing financial incentives for the operators.
  3. Encouraging private sector involvement.
  4. Adopting the "life-line rate", where a variable pricing structure is applied based on the volume of water used. Progressive pricing.

V- Pricing structures & financing schemes (Affordability)

- Given the prevailing poverty in rural & remote areas, subsidizing the capital & operational costs of desalination by central government is unavoidable.
- Touristic resorts cannot be defined as remote or rural and shouldn't be entitled for governments subsidies by any means.
- In addition to subsidy, a variable service cost recovery using a progressive scale need to be established to ensure the financial sustainability of desalination and to rationalize water consumption in remote and rural areas.

VI- Institutional and regulatory factors

Three levels Institutions:

1. **National decision making level:** This typically includes ministries & other high-level government entities that are involved in setting water policy and planning.
2. **Executive level:** This is usually the role of government organizations that operate under the top-level decision making bodies.
3. **Stakeholders level:** This can be local communities that undertake the actual operation & maintenance of water supply facilities, also being the beneficiaries. The relation between the stakeholders and the national decision making organizations (responsible for the projects funding) is very crucial.

Licensing procedures should be oriented to environmental aspects and to technical issues; the latter is expected to address the following:

1. Borehole drilling and/or seawater withdrawal.
2. Brine disposal (often in the form of liquid waste disposal regulations).
3. Coastal zone construction.
4. Drinking water quality.
5. Renewable energy installations or electric power supply approval.

Regulations:

Licensing procedures should be oriented to environmental aspects regulated by the formal EIA policy and to technical issues; the latter is expected to address the following:

1. Borehole drilling and/or seawater withdrawal.
2. Desalinated water quality.
3. Renewable energy installations or electric power supply approval.

Questions to Answer

1. In your opinion, what other factors can be included in assessing community needs and capacity to invest in desalination using RES? Nothing more
2. What sort of capacity development is needed to gear remote communities towards desalination technologies using RES?
   - Capacity development of community in managing, operating and conducting regular maintenance. This capacity development should be on the job with familiarization on the design and concepts of the desalination technology and associated RES.
   - Central capacity to be available for major repair serving a cluster of desalination units. This can be a part of the installation contract .

3. In general terms, do you believe that desalination using RES is affordable by rural communities? Financing might be a serious obstacle. It isn't affordable & government subsidies are necessary for construction and operation.
4. Knowing the specificity of rural communities in the region in terms of poverty, unemployment and illiteracy, would desalination become a valid option without integrating it into a local sustainable development plan or package? Desalination cannot be addressed as a separate issue from the national & local water plans within IWRM context. Furthermore, desalination in remote & rural areas should be considered as one of the main drivers for sustainable development of the community. A holistic approach has to be adopted to inter-link desalination with an the ultimate objective of developing the community.

3. Do you think there is a need for SWIM-SM to start undertaking technical support activities related to the development of regulatory aspects including licensing for desalination in rural areas? Regulatory aspects of small scale desalination using RES are almost non-existent in most of the SWIM region. It has been deemed necessary to propose guidelines and criteria for PCs to license small scale desalination in remote areas.

SESSION IV

FACTORS TO BE CONSIDERED IN SELECTING THE BAT

OBJECTIVE OF THE SESSION

To review & discuss the factors that should be considered in the selection of a desalination BAT for a rural area using RE

Factor 1: Maturity & level of deployment of the processes

- A process can be considered matured if in commercial operation for ≥ 3 years
- Novel processes may possess attractive features, open up new possibilities & occasionally introduce remarkable improvements in performance; but difficult to recommend for rural applications.
- In order to forward novel processes, the investment should be contracted as BOT or BOOT, so that the risk is carried by the investor.
- To reduce the risk of innovative technologies in rural areas, a mature & tested technology can be considered side-by-side to the new technology. The provider of the new technology will grant the needed guarantees of proper operation & compensation in case of failure.

Factor 2: Volume, Quality and Variations of Feed Water

- The volume of feed water is one of the prime factors for selecting the proper DES process (e.g. MSF is suitable for large volume plants while HDH is suitable only for small capacities)
- The quality of feed water influences the pretreatment requirements and the efficiency of the desalination processes for stable operation & long plant life.

  For example membrane processes are generally more sensitive than thermal processes, and especially RO processes tend to be the most sensitive to feed quality requiring thorough pre-treatment systems, typically consisting of chemical dosing & filtration.

Factor 3: Operational skill level required

- A somewhat related issue to technology maturity & pre-treatment requirements that is important factor in selecting & recommending a technology is the relative ease of plant operation compared to the level of skill available in rural communities.
- However, appropriate training of the local people can be given (from the commissioning of the plant and at regular periods after the plant start-up) to operate properly the facilities in an efficient manner
- Also support from the provider and/or designer should be assured especially for non regular conditions (e.g. break down of high pressure piping) or pumps, etc.

<u>Factor 3</u>: Operational skill level required

- Another option is that support in non regular conditions could be given by a central government organization/agency.
- The minimum suggested staff in such projects should include
  - Special Technical Advisor, for the whole project in order to assist in the non regular conditions of the plant
  - Plant Operator, with the minimum training for the day-to-day operation of the plant
  - Maintenance experts (small team of 1-2 persons at central level to operate on call for a number of DES plants)
  - Specialized experts including, High Pressure Pumps Expert, IT expert for automations, Chemist and Material Science Expert.

Factor 4: ~~Energy~~ Water storage options

- Desalination plants are almost invariably designed to operate at fixed or slowly (seasonally) changing operating points, drawing fixed energy input at fixed rates.
- This contrasts sharply with the nature of many RESs, such as solar & wind, which are marked by instantaneous, diurnal, & seasonal variation. This introduces the need for energy storage & buffering.
- Energy storage is not practical while water storage during the RES occurrence can be more cost effective.
- Alternatively, hybrid design to utilize RES during their intense occurrence (e.g. solar power during the day) and fuel power during the low RES occurrence can be more cost effective (large capacity plants).

Factor 5: Brine disposal

In rural and remote inland desalination plants brine disposal is not a critical decision factor as in urban areas.

Brine can be disposed by any one following techniques:

1. Zero Liquid discharge techniques by Thermal Method. Very high cost
2. VSEP Treatment. Huge investment and need special skills
3. Brine injection: Might destroy aquifers
4. **Evaporation pond. Favored option in rural and remote areas**
5. **Using brine to agriculture & aquaculture (as part of the holistic approach to sustainable development of the area)**
6. Evaporation pond using enhanced Evaporation Mechanisms. Spray evaporation, air flow, turbulent flow, etc.

<u>Factor 6</u>- Other practical site characteristics

- Land topography & access, the availability & quality of roads & transportation considerations, and other infrastructure are all factors that need to be considered.

Factor 7- Total unit cost of the total proposed solution

- After all other factors are duly considered & appropriately weighed-in, the ultimate deciding factor for selecting the best solution out of a number of equally acceptable technical solutions is the total unit cost.

FACTORS TO BE CONSIDERED IN SELECTING THE BAT

1. What other factors you might consider as important in selecting the appropriate desalination technology for rural areas? None
2. How can we support water officials assess the maturity of the processes & evaluate the technical capacities available in rural areas that are adequate for technically operate & maintain selected desalination & RES options? Providing ideas on reducing the risks through combination of options & involving the investor in carrying the risks by providing the adequate guarantees.
3. Should we consider developing capacities on hydro-geological investigation for brine injection? Not necessary since evaporation ponds are least expensive and most feasible option.

1. Should SWIM consider capacity development activities for water practitioners on desalination technologies for rural areas including pretreatment of various desalination technologies? Yes, SWIM should consider capacity development on desalination BAT using RES at small scale with emphasis on the ever increasing potential and feasibility of various RES.
2. ~~Is there a need for further development for energy storage for desalination?~~
3. How can we ensure regular monitoring, inspection, compliance & enforcement of desalinated water quality criteria and brine water disposal regulations? SWIM might devise management systems for regular monitoring, inspecting, and auditing both desalinated water and brine discharge.

SESSION IV

Guidelines to Screen and Assess Desalination BAT Using RES

Step 1- Evaluation of available water resources & demand characteristics

- A comprehensive evaluation of the available water resources, as well as an evaluation of the water demand characteristics at the proposed site is the first step, with a purpose to ensure that all options are exhausted prior to deciding on desalination

1. Desalination projects should be integrated in a holistic approach for sustainable development of the area served rather than a separate water resources project.
2. Need for detailed opportunity cost analysis before deciding on desalination.
3. Among factors to be considered in the opportunity cost analysis (alternative waters, reuse of wastewater, production cost of desalination at the point of use, environmental externalities, savings from reduction of non revenue water, reallocation of water from irrigation with its socio-economic impacts, etc.)
4. SWIM shall include a chapter in the suggested guiding manual on opportunity cost analysis for desalination
5. A capacity building program to train water officials on the principles of opportunity cost analysis for desalination shall be considered with capacity building WP of SWIM program.

Step 2 - Evaluation of available renewable energy sources & grid connectivity

- The next major step in the process is to carry out an extensive study of the available energy resources, particularly focusing on renewable energy sources, if electric power supply is not available.
- A thorough understanding of the available RESs, their qualitative & quantitative characteristics is required.

- Do we need a capacity development program to train water officials on various RES for desalination, their current state of development, economics, technical aspects, advantages, limitations, etc.? Yes to orient water policy makers in SWIM countries of the new developments of RES compatible with small scale desalination.

Step 3: Short listing of candidate desalination processes based on available RES

- The previous steps of identifying, characterizing and selecting the RES should allow the elimination of all desalination processes that are not suited to the type of energy source chosen.

Step 4: Environmental Impact Assessment of DES-RES projects

- Once a desalination plant has been decided based on exhaustive elimination of alternatives using opportunity cost analysis tools, an EIA has to be under taken to identify, avoid and/or mitigate any potential environmental impacts according to national EIA policies.
- SWIM shall incorporate EIA as a fundamental step in the structure and context of the proposed DES-RES guidelines.
- The plan for the development of the proposed guidelines (tool box) including structure, scope & content will be developed & discussed with the CDG, electronically shared with PCs, developed, electronically shared & then discussed in an enlarged regional consultative meeting with the involvement of national water & environment experts from PCs.

Activity	June	July	Aug	Sept.	Oct.	Nov	Dec.	Jan	Feb	Mar	April	May
Preparation of the "Assessment of BAT for Desalination in Rural Areas												
Draft plan with structure, content and scope of the Tool box												
Hold a meeting for CDG to discuss & approve plan												
Engage an International consultant to develop the Tool box												
Electronically share draft Tool box with national FPs for comments & feedback												
Convene a Joint Regional Consultants meeting in collaboration with UNEP/MAP to reflect & approve Tool box												

مع خالص شكري وامتناني

Thank you for your attention

Merci pour votre attention

For additional information please contact:
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