EXPERT GROUP MEETING ON CUMULATIVE ENVIRONMENTAL IMPACTS OF DESALINATION ON THE MEDITERRANEAN. Brussels 23 June 2014.

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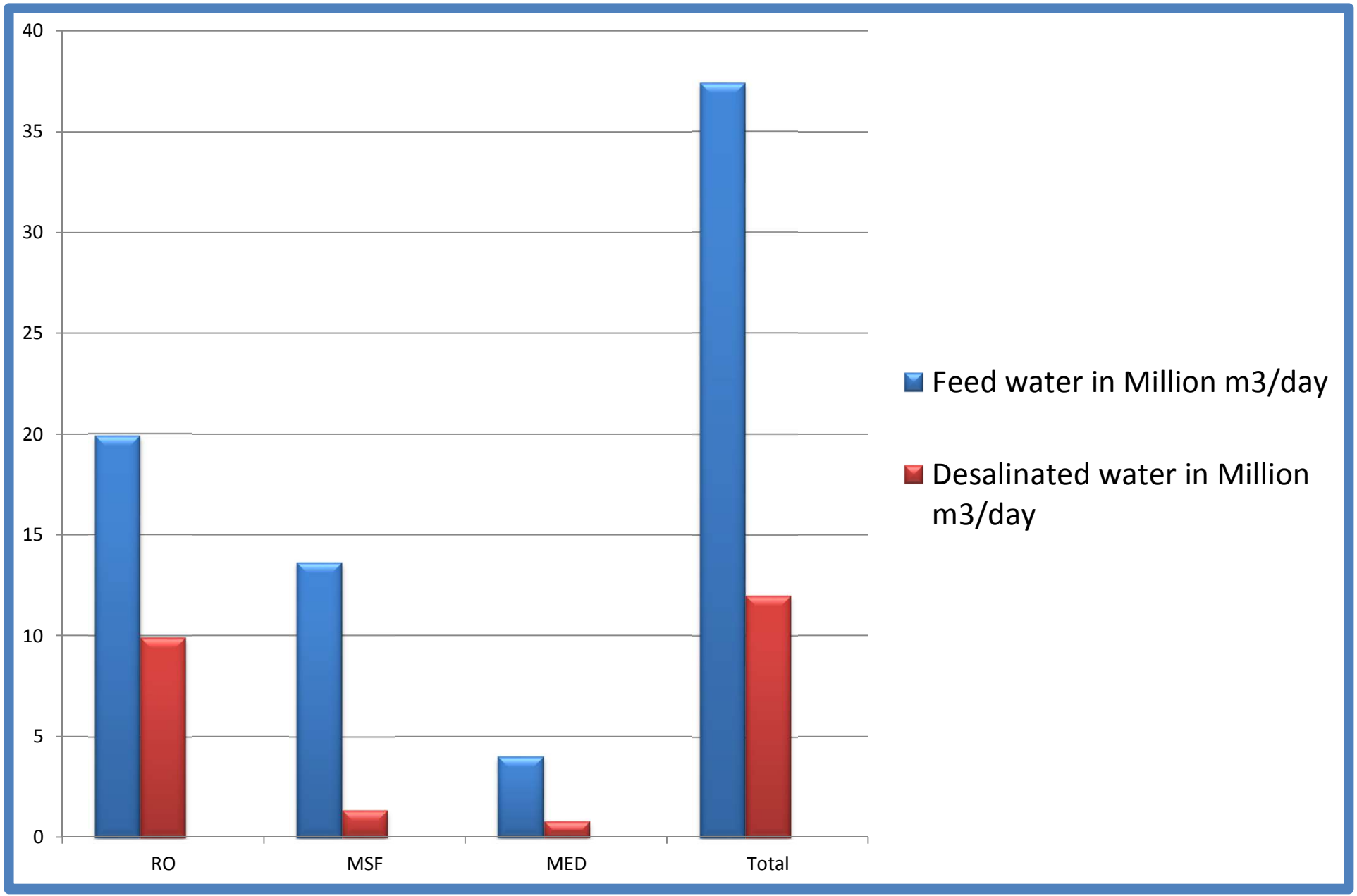
ENVIRONMENTAL PRESSURE OF SEAWATER DESALINATION IN THE MEDITERRANEAN SEA

I- CONCEPTS

- Seawater desalination produces two types of discharge. (1) during the regular operation called *effluent* and (2) *effusion*, generated during the maintenance cycles for cleaning, backwashing and purging the system.
- All seawater desalination plants require a large volumes source of feed-water, to be processed to produce fresh water as a final product.
- Based on the daily cumulative volume of desalinated seawater in the Med Sea region using the three used technologies (RO, MSF and MED), the estimated total volume of water **withdrawn** from the near-shore of the Med Sea for desalination is **37.4 Million m^3/day**.



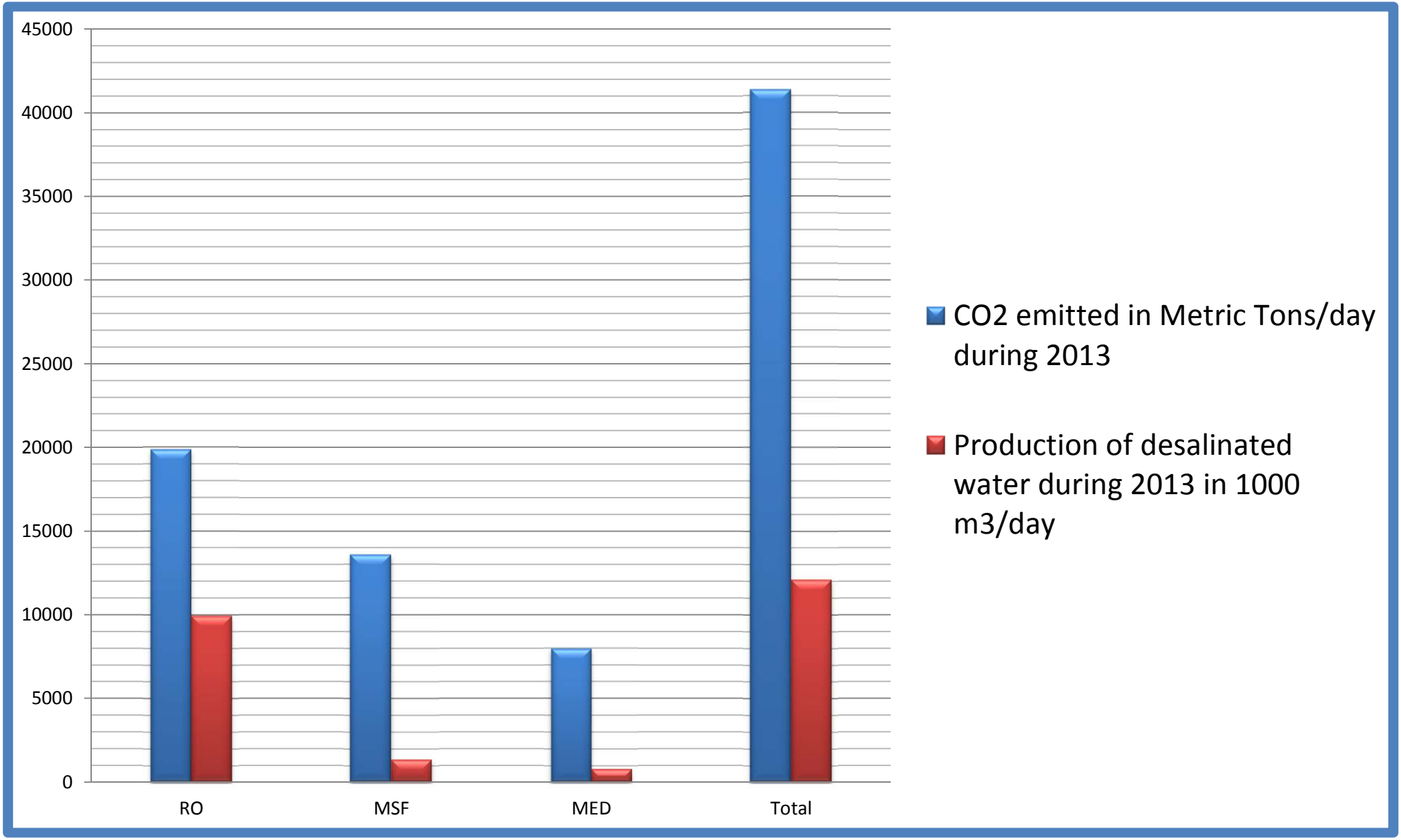
Daily volume of feed water withdrawn from the Med compared to production of desalinated water using different desalination technologies in Million m^3/day during the year 2013.

According to the predicted production of 30-40 Million m^3/day of desalinated water by the year 2030 in the Mediterranean, the estimated annual total volume of feed-water needed to desalinate such a volume of water will range from 34 to 45 Billion m^3/year.

For comparison, the annual flow of the River Nile to Egypt is 55.5 Billion m^3/year

- Water desalination is generally an energy intensive process. Depending on the desalination technology and energy sources, the industry has the potential to add significantly to the greenhouse gas emissions held largely responsible for CC. In many instance, desalination plants emit pollutants such as NOx, SOx, particulates, etc.
- The estimated amount of **CO_2** emitted for the production of one m^3 of desalinated seawater, using **RO** "low energy technology" **is 2.00 kg CO_2/m^3**.
- When using thermal desalination technology such as **MSF** the CO_2 is some **10 kg CO_2/m^3**.

- Estimated Total CO_2 emitted from all online desalination plants in Med Region for the year 2013 is equivalent to **15 Million Ton of CO_2/ year.**
- Assuming the best scenario that all future desalination will be using only RO technology, the estimated total CO_2 emissions during the year 2030 will range from **22.75 to 29.0 Million metric tons/year**.



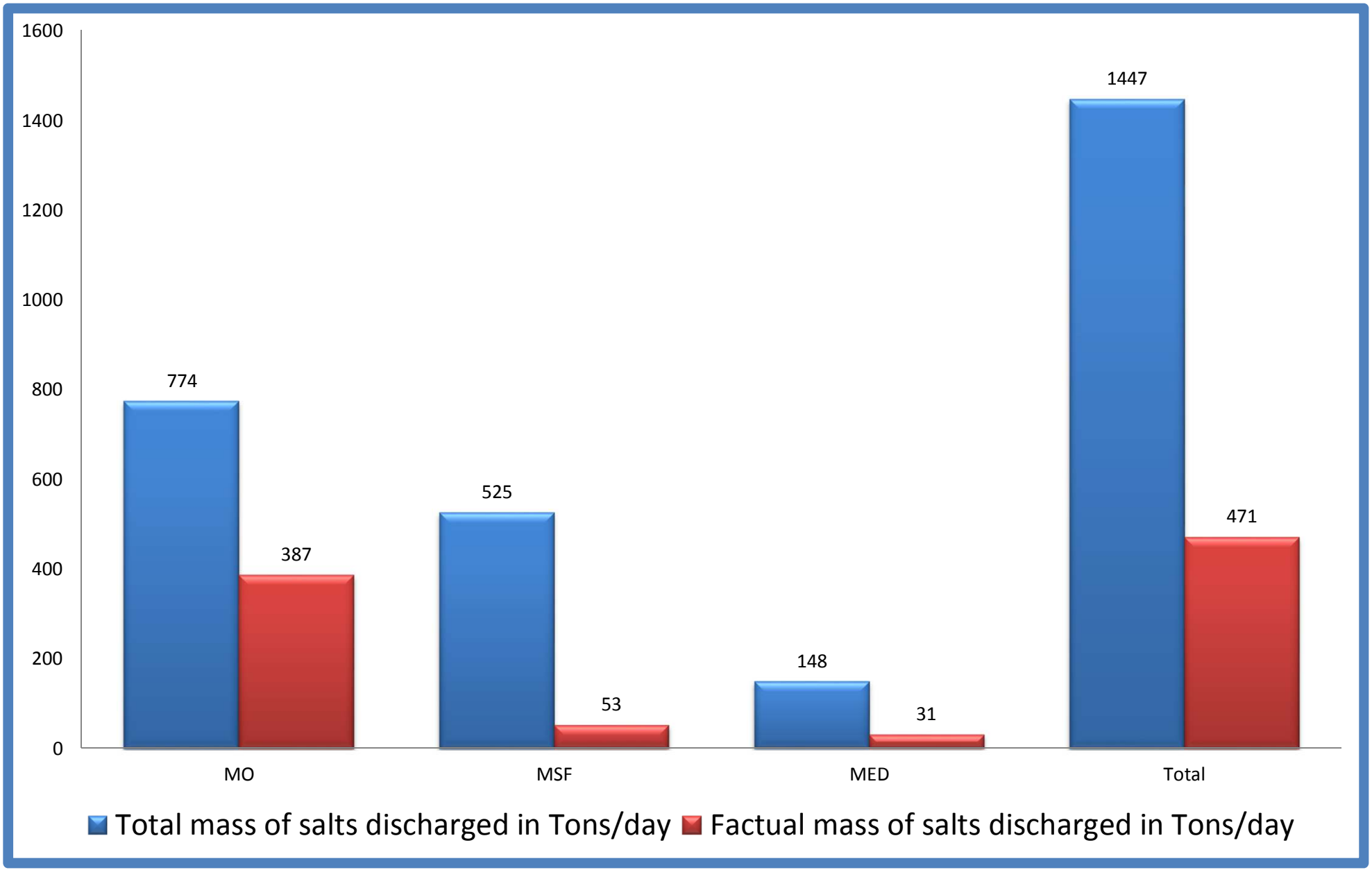
CO_2 emitted on a daily basis from seawater desalination in the Med Region during the year 2013 as compared to the daily volume of produced desalinated water.

- The total CO_2 emitted from desalination of Med seawater during 2013 is equivalent to putting **3.3 Million new cars** on the roads or burning a volume of petrol slightly over **24 Million liters/day**.

- The desalination process separates saline water into two streams: 1- A low dissolved solid stream (desalinated water), and 2- another stream containing the remaining dissolved solids (brine reject).

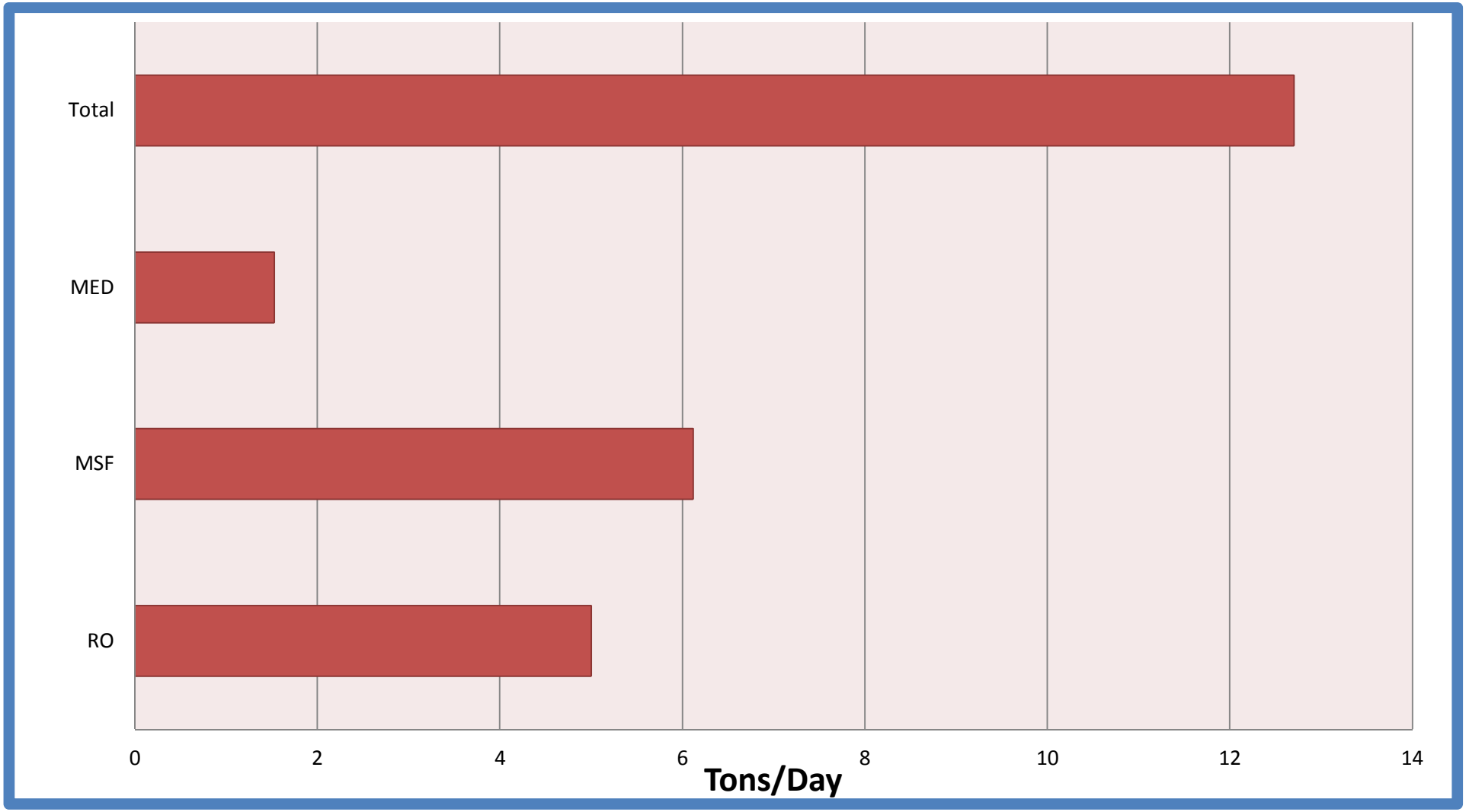
In the Mediterranean the calculated volume of brine is:

- Brine discharged from RO is = 9,926,161 m^3/day
- Brine discharged from MSF is = 12.24 Million m^3/day
- Brine discharged from MED is = 3.16 Million m^3/day.
- Total brine discharged to the Med Sea during 2013 is = **25.3 Million m^3/day**



Total and factual masses of salts discharged on a daily basis to the near shores marine environment of the Mediterranean Sea in Metric Tons during the year 2013.

Environmental Aspects of Anti-Scalants in Brine Reject in Med Region



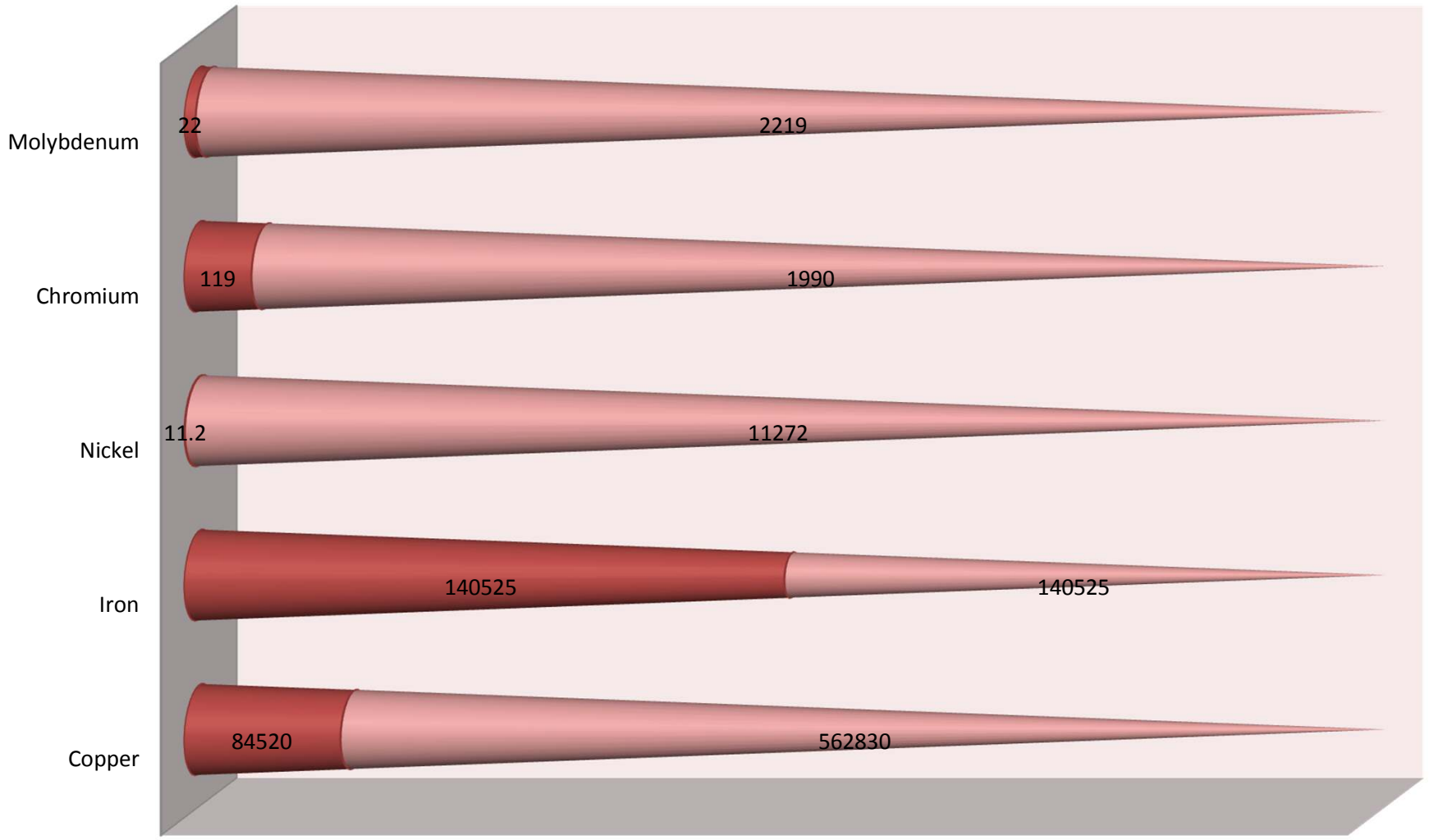
Mass of discharged polymeric anti-scalant from seawater desalination plants around the Med sea in tons/day during the year 2013.

ENVIRONMENTAL ASPECTS OF TRACE METALS IN BRINE REJECT

- In **thermal** desalination plants, it is plausible to find corrosion and elution products in brine waters resulting from the effect of water flow, dissolved gases and treatment chemicals (acids) on the alloys utilized in the construction of desalination pipes and equipment's. The corrosion products may include harmful heavy metals such as
    1. Nickel (Ni),
    2. Copper (Cu) and
    3. Molybdenum (Mo) and
    4. less toxic metals such as Iron (Fe) and Zinc (Zn).

Metal	reported Range in ppb	Minimum possible discharged load in Kg/day	Minimum possible discharged load in Kg/year	Maximum possible discharged load in Kg/day	Maximum possible discharged load in Kg/year
Copper	15-100 Oldfield and Todd (1996)	183	67,000	1,222	446,030
Iron	25 Mannaa (1994)	305	111,325	--	--
Nickel	0.002-2.0 Lattemann & Hopner, (2003)	0.024	8.80	24.4	8,906
Chromium	0.035-0.35 Fable & Rigitz (1995)	0.430	157	4.30	1,570
Molybdenum	0.004-0.4 Fable & Rigitz (1995)	0.048	17.5	4.80	1,752

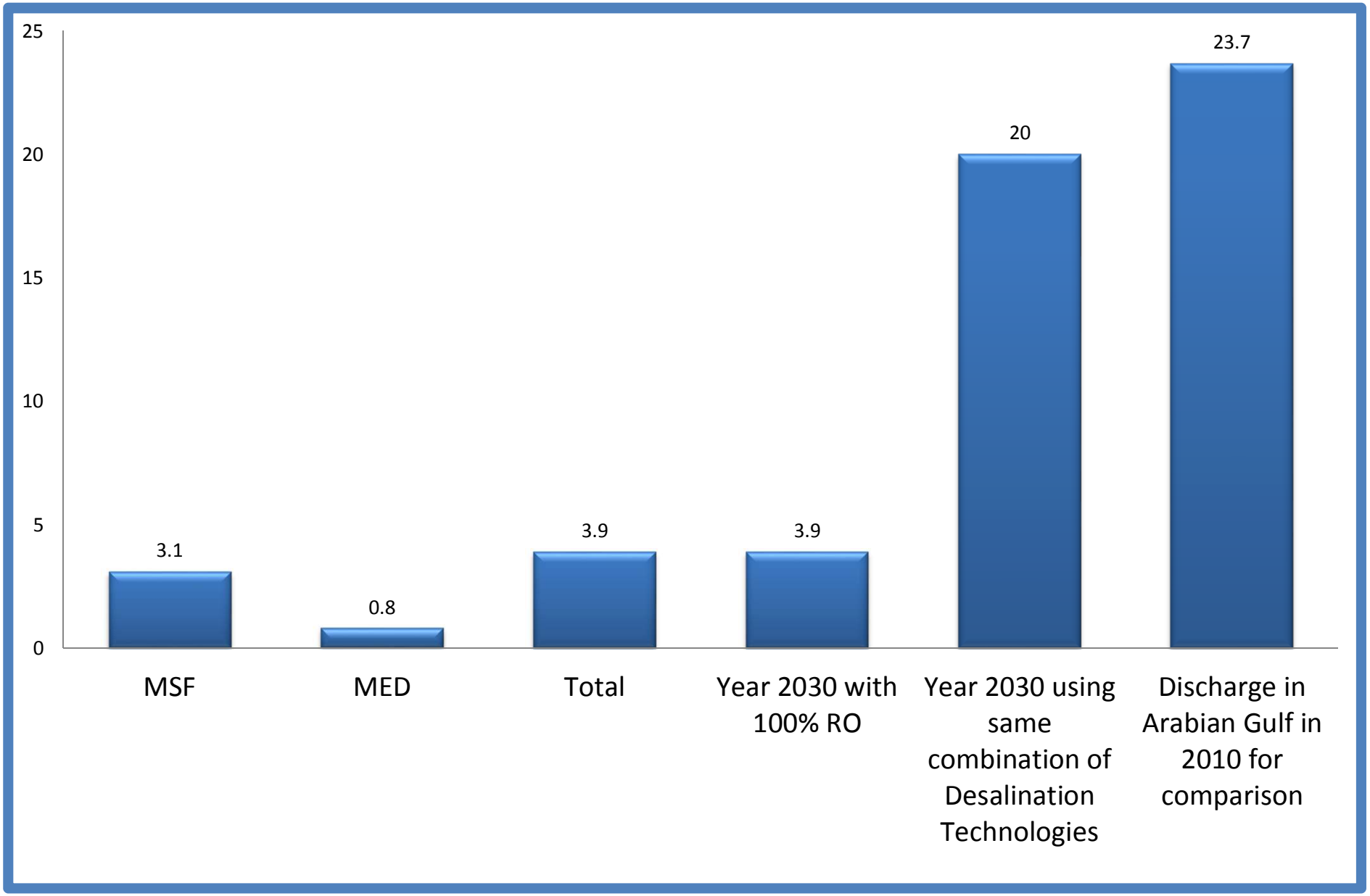
Load of metals discharged into the near-shore marine environment from MSF desalination plants on the Mediterranean Sea during 2013.



Estimated lowest and highest possible discharges of trace metals in the near-shore Mediterranean Sea from MSF & MED during the year 2013 in Kg/Year.

Environmental Aspects of Antifouling Agents (Chlorine) in Brine

- For well over half a century, chlorine has proven to be of immense benefit in controlling biofouling in power and desalination plants, but its adverse toxic effects at trace levels have become evident. Desalination plants including RO use chlorine injection to protect the processes from biofouling. A typical dosage ranges from 1 to 2 mg/l depending on the chemical and biological composition of the feed-water. Furthermore, shock chlorine doses are commonly applied intermittently at 10-15 mg/l for shorter durations to eliminate any potential biofouling.



Residual chlorine discharge to the near-shore of the Mediterranean Sea from MSF & MED desalination plants in Tons/day during 2013 with projections for the year 2030.

Environmental Aspects of Trihalomethanes (THMs) in Brine Reject

- 4 THMs were consistently detected in brine waters. Brominated species were dominating the formation distribution, with Bromoform ($CHBr_3$) accounting for more than 90% of the total THMs followed by dibromochloromethane ($CHBr_2Cl$). The detected levels of total THMs in Kuwait ranged from 90 ppb in the immediate vicinity of the point of discharge to less than 1 ppb within few kilometers seaward.

Environmental Aspects of Chlorinated Volatile Liquid Hydrocarbons (VLHs)

- Volatile Liquid Hydrocarbons (VLHs) are defined empirically as compounds with low boiling points. They include toxic light aromatics such as benzene and toluene.
- The reaction of discharged residual chlorine with VLHs contaminants would lead to the formation of more complex chlorinated VLHs such as chloro-benzene, chloro-phenols, etc.
- The detected levels of chlorinated VLHs at the nano-gram/liter (ppt) should not give reasons for concern.

مع خالص شكري وامتناني

Thank you for your attention

Merci pour votre attention

For additional information please contact:
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