Friends of the Earth Middle East

Promoting Green Jobs and Exports in a Green Water Economy in Israel

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Executive Summary

This report investigates the potential for creating "green" jobs and increasing water-related exports through policies that embrace water-saving measures as a permanent part of Israel's water economy.

The government's preferred policy response to Israel's perennial water shortages has been to build more desalination capacity. FoEME's view is that the environmental costs of desalination make it an inferior (though sometimes necessary) option for increasing water availability, compared to water saving. The 2009 water crisis in Israel prompted the introduction of water saving policies to reduce demand. These measures are to be applauded. However, it is far from clear whether they will become permanent features of Israel's water economy, or whether they will be relaxed when more desalination capacity comes on line.

This report continues the research of a 2010 FoEME report on the economic advantages of water saving measures. The earlier report found that the marginal cost of water made available through a number of demand saving wedges is lower than the cost of water from desalination plants. The present report attempts to evaluate the potential for creating "green jobs" – that is good quality employment opportunities in sectors that help foster environmentally sustainable economic growth. We also examined the potential for increasing water-related exports through such policies.

We employed a research methodology of conducting interviews with over 20 stake holders in the Israeli water industry. The principal findings regarding job creation were: expanding desalination as currently planned would make available an additional **430 MCM** of water/year and create approximately **1260 jobs per year** of which around 25% would be skilled, high quality positions, and 75% would be in construction. 2.84 jobs/ MCM. – 0.91 jobs MCM excluding short term construction jobs. Expanding water saving policies in these four areas would yield an additional **316 MCM** of water by 2020. It would create an additional estimated **5200 jobs per year** of which approximately 63% would be high skill, "green jobs" and 37% would be low-skill minimum wage jobs. The water saving sector averages 16.5 jobs/MCM. Desalination is a highly capital intensive method of producing water with much lower job creation potential than demand side approaches.

In addition, we attempted to estimate the potential impacts on exports Israeli water-related products of creating a significant domestic market in the water saving area. (The international success of Israeli drip irrigation companies like Netafim, and more recently, of desalination enterprises like IDE were substantially aided by creating large domestic market for their products.) Based on existing analyses of the Israeli and international water industries, we estimated that building a strong domestic market for water savings technologies could increase water-related exports by additional $2 billion per year by 2020, and created approximately an additional 10,000 good quality jobs in the high-tech water sector.

One obstacle to achieving these benefits is the chronic shortage of water engineers in Israel. We endorse recommendations that others have made for overcoming this problem. The more general challenge is to engender the political will and the cultural shift necessary to move water saving from being a short term crisis response to a central and permanent role in Israel's water policy. If Israel can overcome these obstacles, then it can reap the benefits in high quality jobs and high tech exports of being at the forefront of a major growth industry and also of helping to solve a critical 21st century global challenge.

1. Introduction

Israel has been consuming water at, or beyond, renewable rates since the 1970s. Growing demand, especially for household (and urban commercial) use, has put increasing pressure on the nation's water supplies. Israel has responded by reducing water use in the agricultural sector, and by augmenting supplies via reuse of treated sewage and construction of desalination plants. While planned desalination capacity as of 2013 is expected to close the gap between annual supply and demand[1], it will take an additional number of years until the depleted reserves are restored to their previous levels.

EcoPeace/Friends of the Earth Middle East (FoEME) has identified cost-effective opportunities to conserve freshwater within the Israeli economy ("wedges"). The savings of water, from a range of different policies, could potentially be transferred to the Lower Jordan River to restore the river's flow to a sustainable level. Nonetheless, should such conservation measures be implemented, the ultimate use of the water saved is, of course, a matter for policy-makers to decide. (G. Rosenthal and Dr. D. Katz, 2010.)

This study attempts to advance the work of FoEME's 2010 report in two directions.

1. **Firstly, it aims to describe and estimate the potential economic benefits to Israel of implementing these demand reduction wedges.** The global water market is estimated at $400-500 Billion, the third or fourth largest commodity market in the world.[2] Israel is widely perceived as a world leader in water technologies. Yet according to industry experts, Israel has the capacity to capture a far larger percentage of this market that the current $2 billion of exports earned from water technologies in 2010. Israel Newtech, an initiative aiming to make the water industry an area of national priority asserts that Israel could potentially achieve $10 billion in water-related exports within ten years. This FoEME study aims to show that demand reduction wedges could increase the domestic demand for Israeli water technologies and also help Israeli companies to scale up their activities and access global markets.
2. **Secondly it aims to estimate the numbers of possible jobs that would be created by a demand management focused water economy in Israel ("green jobs"),** as compared to the business as usual approach that relies primarily on an increase in desalination capacity. FoEME hypothesizes that a green or sustainable water economy would generate significant numbers, of decent, good quality jobs in the water services sector, in addition to maintaining and restoring the scarce natural water reserves in the Middle East region, and help us move towards sustainable water consumption.

Besides maintaining natural capital, a green water economy would reduce greenhouse gas emissions significantly, and hence contribute to climate change mitigation.[3]

This paper follows on from the publication of the Green Economy Report in February 2011

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1 See paragraph 2 and Table 2 in FoEME & Kivun Consulting, 2010.

2 McKinsey and Co. 2009

3 See for example UNEP (2011). Towards a green Economy: Pathways to Sustainable Development and Poverty Eradication – A synthesis for Policy Makers. http://www.unep.org/greeneconomy/Portals/88/documents/ger/GER_synthesis_en.pdf
Or: Interview with Juan Somavia, Director-General International Labour Organization and partner in the Green Economy Initiative: http://www.ilo.org/global/About_the_ILO/Media_and_public_information/Feature_stories/lang--en/WCMS_084092/index.htm

by the Green Economy Initiative (GEI), an initiative under the United Nations Environment Programme. The ground-breaking UNEP study uses economic analyses and modeling approaches to demonstrate that investment in greening the economy across a range of sectors can drive economic recovery and lead to future prosperity and job creation, while at the same time addressing social and environmental challenges.[4] FoEME will build on the opportunity to draw upon UNEP's Green Economy Report as a valuable resource for this study, and capitalize on the momentum created to draw the attention of decision-makers, businesses in the water sector and the public to the possibilities and benefits of a green water economy in Israel.

The complete study consists of five elements;

1. A review of methodologies of identifying green jobs in other countries and sectors; (Included as Appendix B)
2. An overview of current practices in the water sector in Israel compared with available demand focused policies;
3. An estimation of the number of green jobs created through the adoption and implementation of the "wedges", causing a transition towards a more sustainable water economy in Israel;
4. An evaluation of possible obstacles for implementation of the policy opportunities or "wedges" approach in Israel;
5. Conclusions and Recommendations.

The first part, the review of methodologies, can be found in the background paper to this report.[5] The current water practices, the economic analysis of green jobs, as well as the obstacles for implementation of the green water economy are described in this report. The final chapter gives a summary of the findings, and discussion of implications for policy makers.

2. Current practices in the water sector in Israel

2.1 Current trends

While recharge annual rainfall in Israel is showing a downward trend, population increase and economic growth are pushing the demand for freshwater up. The current trend shows that demand in every sector is expected to keep pace unless water savings measures are implemented. The Israel Water Authority has stated that increased desalination capacity will solve Israel's water problems by 2013. Beginning in 2007, Israel began major desalination projects. As of 2010, Israel was set to desalinate 225 mcm per year, or just under one-third of the household consumption. Desalination is expected to produce 692 mcm by 2020.[6]

However, desalination generates a number of negative effects on the environment, such as emissions of air pollutants and GHG from the energy consumption (primarily emissions of CO2, SO2, NOx, and particulate matter), expropriation and exploitation of coastal land, and damage to the marine environment from seawater intake and brine discharge.[7]

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4 Green Economy Report: http://www.unep.org/greeneconomy/GreenEconomyReport/tabid/1375/language/en-US/Default.aspx

5 Silver, E. (2011). *Background Paper to Promoting Green Jobs in a Green Water Economy in Israel, Review of Methodologies*. Friends of the Earth Middle East.

6 Rosenthal, G. & Dr. D. Katz (2010). *An Economic Analysis of Policy Options for Water Conservation in Israel.* Friends of the Earth Middle East & Kivun Consulting.

7 Ibid.

Given the high amount of energy and the chemical inputs necessary for the desalination process, jobs related to this sector are generally not "green", meaning they do not enhance the sustainable growth of the water sector and do not avoid water exploitation or environmental pollution.[8]

2.2 Water conservation

Friends of the Earth Middle East has shown in a recent study[9] that a range of policy options, or "wedges", exist to achieve a reduction in water demand (see table 1 below). Implementing the cost-effective measures for water conservation would reduce the need for extra desalination capacity.

UNEP (2011) recognizes that desalination plays a role in closing the gap between growing demand and supply. However, assessments often reveal that it is cheaper to invest in demand control. In addition, if investments in infrastructure and water-policy reforms that improve efficiency of water use are not increased, a water crisis may be expected to emerge.

	Policy Wedge	Water Conserved by 2020 (mcm/year)			Cost Effectiveness (US$/m3)	Feasibility 1-Low 5-High
		Low	Medium	High		
Supply	Reduced water losses from leakages	29	51	73	0.45	4-5
	Reduced water losses from reservoirs	65	81	101	0.007	4-5
	Rooftop rainwater collection	4	7	13	2.14	1-2
Demand	Awareness raising	76	101	126	0.10	4-5
	Change in plants used in gardens	23	46	68	0.61	4-5
	Price increases or reduced allocations in agricultural sector	70	138	200	0.30	3
	Grey water use (irrigation)	36	76	118	1.32	1-2
	Grey water use (toilets)	13	27	55	2.21	1
	Removal of trade restrictions	30	45	60	High	1
Unadjusted	Total - net cost less than desalination	293	462	628		
	Total - net cost more than desalination	53	110	186		
	Total	346	572	814		
Adjusted	Total - net cost less than desalination	249	393	534		
	Total - net cost more than desalination	45	94	158		
	Total	**294**	**486**	**692**		

Note: The figures for total water saved in the last three rows of the table have been reduced by 15% from the figures above to adjust for likely double-counting, as each option's water saving potential was evaluated in isolation, and for options whose environmental desirability or technical feasibility is questionable, such as covering freshwater reservoirs.

Table 1. Summary of policy wedges for water conservation (source: Rosenthal, G. & Dr. D. Katz, 2010)

In response to the most recent water crisis, Israel has begun (2009) to institute some of these water saving measures. Public awareness campaigns and the distribution of water savings devices have succeeded in reducing household water consumption in the short term by 15%. An ambitious program to reduce leakages and waste in municipal water systems has been started successfully by

[8] See the definition for "green water jobs" in: Silver, E. (2011); see 4.
[9] See 5.

the most forward looking local water corporations.[10] A new system of allocating water to municipal parks and gardens has triggered the implementation of more water efficient gardening methods. These initiatives are promising and commendable steps but are not yet widespread or permanent. They have yet to be implemented across the board in Israel. We hope that this report, by showing the broad benefits of such approaches will contribute, to their establishment and entrenchment in Israel's water economy.

3. Economic analysis of green jobs in the water sector in Israel

This chapter describes the economic analysis of the economic and employment potential in a green water economy in Israel.

3.1 Method and assumptions

In this research green jobs are defined as "green water jobs that reduce water consumption and overall enhance the sustainable growth of the water sector, avoiding water exploitation and pollution or any other kind of environmental pollution, and in addition offer adequate wages and job security (social benefits) to employees. This includes short-term as well as long-term jobs."[11]

For the estimation of the potential number of green water jobs that can be created once Israel moves towards a sustainable water economy, a scenario analysis has been carried out. The different scenarios were based on the policy wedges as shown in table 1, paragraph 2.2. In the current study we have not considered roof top rain water collection because of the relatively small potential yields, nor the possible savings from reducing evaporation from reservoirs, because of environmental problems with that approach. For the four wedges of education, substituting water efficient plants, reducing municipal leakages, and legalizing and regulating grey water systems, we have taken the medium level water savings projections. (In the field of reducing water leakages, we found reason to revise the expected savings upwards – see below.) These were compared to the business-as-usual (BAU) scenario, in which the current expected rate of water consumption in Israel continues and water supply will be augmented by increased desalination capacity, as described in paragraph 2.1.

In detail, the analysis includes two scenarios:

- BAU: water consumption keeps growing at current expected rate, desalination capacity will be expanded from 270 mcm to around 700 mcm by 2020.
- Green Scenario: investments are made to achieve water conservation of maximum 316[12] mcm per year by 2020. Desalination capacity remains at current level or will increase by only 120 MCM .

For these scenarios the total number of jobs has been estimated. Employment numbers were indicated in FTE (full-time equivalent) rather than persons or jobs, to incorporate the fact that one person may work only part-time and that some full-time jobs may be only partially "green". Also in this version of the paper we haven't yet calculated the indirect and induced jobs, hence, all growth and job creation estimations in this paper are only for 'direct jobs'.

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[10] Hezi Bilik (ed.) *The Reduction of Water Loss in Municipal Systems: Guidelines for Systematic Implementation in Israel.* (Hebrew) The Israel Water and Sewage Authority, 2010.

[11] Silver, E. (2011). *Background Paper to Promoting Green Jobs in a Green Water Economy in Israel, Review of Methodologies*. Friends of the Earth Middle East.

[12] Those 316 mcm includes only 4 wedges in the urban sector. It doesn't include the agriculture sector wedges as was calculated and summarized in the Rozental & Katz, 2010, and presented here in table 1.

In addition, the types of work and the social aspect of labor were considered; are these low or high skilled jobs in the water sector and do they offer adequate wages and job security.[13]

The economic analysis was based on over 20 interviews held with key Israeli stakeholders in the water sector, spanning academia, the business sector, NGO's, the Water Authority and government. The job creation estimates that emerged from this process are therefore somewhat subjective.

3.2 Analysis of five areas of Israel's water economy.

We have considered the economic and employment implications of increasing water availability through action in five areas. These are not mutually exclusive.

1. Expanding desalination capacity as planned, (Business as Usual.)
2. Expanding and entrenching education and awareness raising campaigns aimed at reducing domestic water use.
3. Continuing and expanding the policies to encourage the substitution of more water efficient plants for less efficient species.
4. Aggressively implementing measures to reduce water loss through wastage and leakage in Israel's municipal water systems.
5. Legalizing and encouraging grey water recycling.

1. Expanding Desalination Capacity as Planned:

As noted above, Israel was set to produce around 270 MCM of water in 2011 and plans to expand desalination capacity to the point where it can produce around 700 MCM by 2020, both by increasing expand at existing facilities and by building new plants. According to the Israel Water Authority, Israel aims to achieve 2 billion MCM in desalination capacity by 2040. Israel currently has three desalination plants in operation, and aims to have six working plants in 2020.

Desalination incurs a significant environmental impact through expropriation and exploitation of coastal land, and damage to the marine environment from seawater intake and brine discharge. It is also an energy intensive means of producing water. The Water Authority estimates that the proportion of the country's energy budget that will be consumed by the water industry will increase to around 10% before returning to the current level of around 6-7% through 2020.

Economic and Employment Benefits:

Employment: Desalination is a capital intensive way of producing water. The operation of desalination plants requires relatively few people. According to figures provided by the desalination division of IWA building a desalination plant requires around 1000 people for 3 years. Of these around 150 are engineers and technicians. The remainders are construction workers many of whom are foreign workers. After construction, running each plant requires 75 mostly skilled workers. The country aims to have 6 plants running by 2020, up from 3 today.

Based on these estimates we can infer that increasing Israel's desalination capacity by 430 MCM by 2020 through building three new plants will require 3x3x1000 person years of construction-related work, including 3x3x150 years of engineering and technical work, (taking the

[13] Ibid.

mean value of the WA's estimates.)

Averaged over ten years, this amounts to 1035 jobs per year - including 135 that are in the engineering or technical fields.

Adding the employment gains from the operation of three additional construction plants, implies a total of 450 workers running the plants by 2020, up from 225 today. In total this translates as 1260 full time job equivalents of which 900 will be in construction. This works out as 2.93 jobs/Million Cubic Meters of Water produced. However, if one does not consider the short term construction jobs that would mostly be taken by foreign workers, then this falls to 0.84 jobs/MCM.

Economic Benefits: Israel's Desalination plants have so far been built through partnerships between the Israel Desalination Enterprises company (IDE - a world leader in designing and building desalination plants) and a foreign company, with IDE holding approximately a 50% share. Assuming that future plants follow the same formula, and that water from the desalination plants continues to be sold at the current price of $ 0.57/CM. This implies that an additional 430 MCN of water from desalination by 2020 will yield an additional $122.5 Million in revenues per year for the Israeli company. We should note that high upfront capital cost of building large scale desalination plants – the Soreq plant has just agreed total project financing of $400 Million.

Summary: Expanding desalination on BAU predictions is expected to produce an additional 430 MCM of water by 2020, creating an additional estimated 1260 jobs per year (mostly unskilled and short term) and earning an additional $122.5 Million in revenue per year for an Israeli company.
2.91 jobs/million cubic meters of water – 0.84 jobs/MCM, excluding construction jobs.

2. **Education and Awareness Raising Campaigns.**

Over the course of the year 2009, in response to a very severe water crisis, Israel managed a reduction in domestic sector water reduction of around 15%.[14] This was achieved by a combination of press, radio, TV and billboard advertising, campaigns in schools public buildings and work places and more. Through taking simple steps to minimize water use in the areas of toilet flushing, dishwashing, laundry, tooth brushing and showering, the public significantly reduced its daily water use. Note that during the same period there was also a significant water price increase. It would require more data than is available, and a full econometric analysis to ascertain how much of the decline was due to the price increase.)

In addition, during 2011, the Water Authority carried out a project to distribute aerating water efficient taps to homes in Israel. It claims to have reached 55% of Israeli homes and to have further reduced household water consumption. It required 1000 workers to implement, almost all on short term 3-4 month contracts.

FoEME's 2010 report identifies significant potential for water savings in this area, ranging from a low level of 12.9% of to a high of 20.9%, implying a range of possible savings of 76.4 MCM per year through 125.5 MCM. They also found that this is a particularly cost effective way of increasing available water – costing $0.07-0.13 per cubic meter of water saved compared to a cost of around $0.57 for water produced by desalination.

The historical problem with these campaigns and their results has been one of short-termism.

[14] Hovel, 2010; http://www.calcalist.co.il/local/articles/0,7340,L-3388769,00.html

During Israeli water crises on the past, public awareness campaigns have reduced domestic water use by around 15% in the short term, only for consumption to bounce back to previous levels – or even higher - after people feel that the crisis has passed. The challenge is to institutionalize water saving programs in order to make the 15% consumption reduction permanent rather than temporary. According to the Water Authority, the key limiting factor here is budget.[15]

In this respect, Israel lags behind best practice internationally. For example, the city of Zaragossa in Spain succeeded in reducing water consumption in the long term from 113 litres per person in 1996 to 96 litres in 2007, a 15% decline.[16] The long term measures taken by Zaragossa to achieve this reduction are outlined in FoEME's paper on International Best Practice Demand Management. This example and others show that a sustained 15% reduction in domestic water use is possible if education and awareness campaigns are ongoing.

Economic and Employment Benefits.

The economic benefits of such water saving campaigns are striking. Even if we assume the maximum cost of water produced this way estimated by FoEME's 2010 report, (0.13c), saving 100 MCM of water per year through ongoing education and awareness campaigns will save Israelis $42 million per year compared to the cost of purchasing desalinated water. If we factor in all the transportation, storage and externality costs of desalination then the saving rises to $75 Million per year. [17]

It has been difficult to obtain data on the employment provided by such campaigns. The Water Authority was unable to provide data on the employment created by their recent campaign. [18] 100 people employed full time would be a very conservative estimate. A further source of information on this comes from organizations working to provide environmental awareness education in schools. SPNI Jerusalem branch estimates that currently 6-7 people (full time equivalent) are employed in the city in this field (including all the organizations working in the area.) They further estimate that around 10% of the city's schools are covered by such programs. They further estimate that a fully funded ongoing environmental education program covering all the city's schools would require 30 full time staff, an additional 24 people. Assuming that Jerusalem accounts for 10% of the country's population, extending such a program across the whole country would create 270 full time jobs. (We have assumed that Jerusalem, because of its symbolic importance to program funders is currently twice as well served in this area than other places in Israel.

Adding this number to our estimate of 100 people to run a permanent government-led campaign implies creation of 340 jobs to run public education and awareness campaigns that could maintain a permanent 15% reduction in domestic water use.

Conclusion. Achieving an additional 100 MCM of water from permanent water saving campaigns through 2020 would create an additional estimated 370 good quality jobs for environmental educators, **3.7 jobs/ million cubic meters.**

[15] Interview with Yaakov Lev, Head of the Water Saving Division at the Water Authority, March 2011.
[16] EU report on water scarcity in the European Union, 2007.
[17] FoEME 2010 estimates the total cost of desalinated water including storage, treatment, transport and externalities at $0.88 per cubic meter.
[18] E-mail from Water Authority Spokesman, June 2011.

3. **Changing Plant Types in Parks and Gardens.**

Irrigation of parks and gardens accounts for nearly 20% of all domestic and municipal water consumption. Based on discussions with landscape gardeners, and reports of the Ministry for Environmental Protection, FoEME's 2010 report estimates that replacing water intensive flora with more indigenous, water efficient species could result in a 50% decrease in water consumption for urban irrigation[19], saving 46 MCM per year by 2020.

During the 2009 water crisis, the Water Authority briefly considered bans on the watering of grass in parks. At the request of the Israel Gardeners Association (concerned that such a policy could cause 30% of Israel's 30,000 gardeners to lose their jobs) the Authority instead instituted a policy of making specific allocations to municipalities based on a detailed assessment of the water needs of their parks. These assessments were progressively reduced in line with the declining availability of water. The result is that the municipalities are challenged to redesign their parks substituting more water efficient plants and layouts, so as to remain within the new reduced water allocations water.

Simultaneously, sharp rises in the domestic price of water, particular for households using above average quantities of water, is beginning to trigger a similar process of substitution in private gardens.

Employment and Economic Benefits: The net result is a rise in employment in the gardening sector as both homes and municipalities progressively redesign and replant their parks and gardens with more water efficient species and designs. The Israeli Gardeners' Association estimates that if the current policies of high prices and tight water allocations for municipal gardens continue, there will be a progressive increase in employment in the gardening sector in Israel of 10% by 2020, implying an additional 3000 jobs. The Gardeners Association estimates that around 60% of these will be relatively unskilled, minimum wage jobs, around 25% will be for skilled workers and 15% for contractors with expertise in landscape planning.

There would also probably be some domestic economic benefit from the increased spending on plants, gardening equipment etc. in the conversion process. However, it has not been possible to come up with meaningful evidence of the value of this benefit. Although Israel is a world leader in developing water efficient plant species, turning this advantage into a significant export market is currently hampered by difficulties in transporting storing plant species.

Conclusion: Maintaining current policies of tight water allocations could save 46 MCM of water per year by 2020 and create in the process 3000 gardening jobs (around 60% at minimum wage and 40% skilled labor.) **65 full time equivalent jobs per MCM of water saved**. This water saving and creation of green jobs would also come about through transformation of private/domestic gardens. A higher tariff on overuse will further encourage people to adapt their gardens to more water efficient plants and irrigation.

4. Implementing measures to reduce water wastage and leakage in municipal water systems.

Leakage, wastage and "unmetered water use" in the municipal system account for a significant proportion of Israel's water usage. FoEME's 2010 report estimated that water loss

[19] Bea'r Ron, 2010, http://www.water.gov.il/Hebrew/about-reshut-hamaim/Authority-Board/20081/protocol_18_10408_nispach.pdf

through these channels amounted to 10-15% of Israel's domestic water consumption.[20] However, since that report, research has shown that local water corporations may well have been underestimating the extent of these losses and the true figures are probably higher.

A further adjustment of that report is required, in the light of the successful experience of those water corporations that have acted aggressively to reduce leakage and wastage. Some of these have managed to reduce wastage by as much as 65-80% and to bring wastage levels down to 5%. If we assume very conservatively that municipal wastage on the national level is 15%, then this experience shows that a general reduction in wastage by 66% is quite possible.

The FoEME 2010 report assumed that reducing losses by 35% (51 MCM/year) would count as medium, and 50% (73 MCM/year) should count as "high." In our view as of 2011 we may upgrade our expectations of the possible savings in the area of municipal wastage: savings of 50% (73 MCM) should be called "medium" and 66% (96 MCM) should be counted as "high." Assumingly (optimistically) that 10% of the possible savings have been realized. This implies a possible 66 MCM of potential additional savings under the "medium" scenario.

In December 2010, the Israel Water Authority published guidelines for reduction of municipal water loss.[21] These guidelines set out a program of action in the following areas.

i) Pressure Management. Sophisticated pressure measurement and management reduces water loss when leaks occur.
ii) Active Leakage Control.
iii) Improving speed and quality of repairs to pipes and infrastructure,
iv) Improving pipeline and asset management, through selection, installation, maintenance, renewal and replacement.

The Water Authority has allocated budgets to all local water corporations to cover the costs of this action program. However, to date, although most Water Authorities are in early stages of planning to implement the plan, a small proportion of Israel's water corporations have implemented it. The Water Authority itself estimates that less than 10% of the potential water savings have been realized[22]. Our estimates of the potential employment and economic benefits of implementing these policies are based on interviews with heads of the two water corporations that are widely believed to have done most in this area.

Kiryat Shemoneh, a city of about 30,000 people reduced its water loss from 30% in 2007 to 6% in 2011. Ariel, an Israeli city in the West Bank of 18,000 achieved a water loss reduction from 18% in 2004 to 5% in 2011. The impressive improvements were achieved through installing Automated Meter Reading (AMR) technologies and advanced pressure management techniques.

Economic and Employment Benefits.

The economic benefits of achieving water savings in this area are significant. Both local water corporations surveyed attested that they had exclusively used Israeli technologies to implement their program and **that Israeli companies are world leaders in this field.** Arad Technologies and Miya are among the local companies that lead in this area. The Ariel water

[20] Based on Ayalon, 2009:
http://www.neaman.org.il/Neaman/publications/publication_item.asp?fid=946&parent_fid=490&iid=8343

[22] Email communication from Hezi Bilik, June 2011.

corporation for example, spent 3 Million NIS ($875,000) to implement this program, almost all of it on the products and services of Israeli technologies.

If we were to assume that this were replicated across the whole country and assume further a 20% overall cost reduction in the program across the country through economies of scale in larger water corporations, this implies additional revenue for Israel companies **of $272 Million.**

Assuming further that $150,000 of revenue translates into one job[23], the widespread adoption of this program would create **1800 person year job equivalents**. (Note that the majority of these would be good quality and well paid jobs in Israel's high tech sector.)

The water authorities surveyed claimed that they employed directly a small number of extra staff to implement the program. Ariel responded that they had hired one extra worker to do the additional work. Translated across the whole country, this implies **400 Jobs.**

Assuming further that the full program was implemented nationally over ten years, this would imply a total of **$27 Million per year** in revenue, and **580 jobs** per year through 2020.

Conclusion: Implementing the water loss reduction program fully through 2020 could save 66 MCM of water per year, creating 580 jobs per year: **8.8 jobs/MCM.**

5. Legalizing and Encouraging Grey Water Use.

Grey water refers to water that is produced in the home after use for bathing, showering, cooking and laundry, that can, technically, be recycled and reused for gardening and toilet flushing. FoEME's 2010 report found that grey water recycling could potentially yield 100 MCM of water by 2020 and 203 MCM of water per year in 2040 based on medium range assumptions for the range of implementation. Although some argue that since a very high proportion (around 70%) of Israeli sewage is already recycled, grey water recycling will not save much additional water, this objection misses an important point; that grey water recycling can allow water to be used not just twice, but three times, reducing overall fresh water needs. Also, those reductions in recycled water to agriculture as result of water saving in the domestic sector, will be will balanced by recycling of ~180 mcm/yr of sewage water that are not yet recycled and the Israelis demographic growth.

On a national level, water produced by grey water recycling is estimated to be currently more expensive than water produced by desalination.[24] However, for domestic consumers facing rising water prices, grey water may already be cost effective. Furthermore with the costs of grey water systems falling, it may be expected to become cost effective for many more householders in the future

Grey water recycling is currently illegal in Israel. There are several reasons for this situation:

- Household grey water systems require new separate piping, storage facilities and new building codes, entailing infrastructure and administrative costs,
- The Ministry of Health opposed grey water recycling until 2011.
- Reuse of grey water for gardening and irrigation could likely have a negative effect on soil

[23] In other water industry areas we received different estimates of the revenue/job ratio.
[24] Pareto Engineering, 2007 http://www.sviva.gov.il/Enviroment/Static/Binaries/index_pirsumim/p0495_1.pdf

quality and ground water quality.
- Although less sewage would be produced, the sewage that is sent would be of greater organic load concentration, increasing the costs of treatment per cubic meter.

However, a private members bill sponsored by MK Nitzan Horowitz that is currently before the Knesset aims to make grey water recycling legal for private construction and mandatory for new public buildings in Israel. The bill has broad support across a range of political factions.

FoEME has expressed strong support for the legalization of grey water recycling in Israel, with appropriate health and environmental regulation. In this paper we will leave aside the arguments around the regulatory issues and focus on the employment and economic benefits of adopting grey water recycling in Israel.

Economic and Employment Benefits:

The estimates that we have used come from IGRA, a consortium of nine Israeli companies with an interest in grey water recycling that is promoting the Knesset bill. IGRA, of course, has an interest in advancing grey water use. However, their figures are based on transparent assumptions, data and estimations and are open to external validation and criticism.

IGRA claims that: all homes in Israel were obliged to recycle grey water, then the market would be approx. 20,000 NIS per home, with close to 1 million homes.

This implies a domestic market of $5.8 billion. Assuming that this is implemented over 10 years – that is $0.58 billion p.a.

Assuming an acceptable and conservative employment benchmark across all industries ($200K) per worker, this implies 2500 full-positions of which only a small percentage are minimum wage jobs. IGRA assumes: about 25% for engineers and managers, 40% in manufacturing, 15% for servicing technicians and 20% in sales and marketing.

Estimates of 100% penetration of grey water recycling in Israeli homes by 2020 are surely overoptimistic. Yet if the figure were 50%, this would still yield an impressive $290 Million per year market, and 1250 full time, good quality jobs.

In addition, there is a significant export market for grey water recycling systems. One may assume that the widespread domestic implementation of Israeli systems will help local companies to scale up their technologies and products for the international market.

Conclusion: Adoption of grey water recycling by 50% of Israeli homes by 2020 could save 100MCM of water per year, and create 1250 mostly good quality jobs. (**12.5 Jobs/MCM saved.)**

Overall Conclusions:

1. BAU: Expanding desalination as currently planned would make available an additional **430 MCM** of water/year and create approximately **1260 jobs per year** of which around 25% would be skilled, high quality positions, and 75% would be in construction. 2.84 jobs/ MCM. – 0.91 jobs MCM excluding short tern construction jobs.

2. Expanding Water Saving Policies. Aggregating the "medium" scenario water saving potential of the four wedges that we consider: expanding water saving policies in these four areas would yield an additional **316** MCM[25] of water by 2020. It would create an additional estimated **5200 jobs per year** (16.4 jobs/MCM) of which approximately 63% would be high skill, "green jobs" and 37% would be low-skill minimum wage jobs.

3.3 Employment and Economic Opportunities from Water-related Exports.

The estimates above attempt to evaluate the potential *domestic* economic employment advantages of implementing a greener water economy in Israel. However, it is important to note that the potential advantages in terms of exports are far greater.

To see this, consider that current global demand for water is around 4500 billion cubic meters per year. [26] Israel's consumption comprises a mere 0.04% of this total. Whereas the total global resources of fresh water are more or less constant, the numbers of people sharing in these resources is steadily growing. This creates a huge market for products and technologies that can conserve water or make new sources available. Last year, the global water industry chalked up sales of **$500 billion** and is growing annually at about 7%. The industry's technology segment (in which Israel has a particular advantage) is growing at double that pace and already accounts for a quarter of all revenues.

Israel has world leading technologies and companies in many water related fields including desalination, drip irrigation, water purification and filtration water efficiency technologies, including AMR (Automated Meter Reading technologies). Today Israel's water-related exports are roughly $2 billion per year. Watech, a joint public private initiative aimed at promoting the Israeli water industry believes that with appropriate planning and support, the water industry in **Israel can easily achieve $10 billion in exports by 2020**[27] (which would still represent only 1% of the projected global market size at that stage.)

It is historically evident that one of the things that government can do to encourage exports in a sector is to create a domestic market for the product. The domestic market serves as an arena in which companies can test and scale up their products and technologies, improving quality and reducing costs. This enables them to emerge as strong players in the world market. Two examples from the Israeli water experience bear this out.

1. Israel was a global pioneer in drip irrigation. The system was implemented almost universally in Israel in the 1960's and 1970's. Today Israeli companies control around half of the $1.5 billion a year global market in drip irrigation.
2. Through its decision to address Israel's water shortage primarily through desalination, the government has given the Israeli company IDE a major advantage in the global market. IDE has been a 50% partner in constructing the largest desalination plants in the world, at Ashkelon, Palmachim and soon in Sorek. Partly on the strength of this experience, IDE, has won contracts to build mega-desalination plants worldwide, including in China, India and Spain. With the larger plants costing $400 Million to build, IDE is poised to gain export earnings.

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[25] If we include adjustment 15% reduction in the potential grey water as result of awareness raised it would be 301 mcm/yr

[26] Mckinsey and Company, 2009.

[27] Interview with Booky Oren Co-founder and Chairman Watech, June 2011.

Players in the Israeli water industry point to the potential for Israeli companies to capture major global market share in other areas including water efficiency, smart metering and grey water re-use. They note the **potential for the Israeli government to help /Israeli companies to capture global markets by creating a strong domestic market for these products through adopting sustained, long term policies that promote water saving measures in Israel.** [28]

To be sure, creating a local market is not the only thing that government can do to help access the global market. Watech recommends in addition the following steps aimed at bridging the gap between Israeli technological innovation in the water industry and practical implementation:

1. Create a national centre for information sharing on water industry, research and technology.
2. Improve mechanisms for scaling up, developing and implementing new technologies.
3. Create a body that markets Israel's water expertise to the world.
4. Upgrade the Water Authority so that it can take on some/all of these roles.

It is a very complex task to try and quantify the potential export benefits of creating a large domestic market for water saving technologies. To do so requires estimating the potential global market in those areas and the likelihood of Israeli companies capturing significant segments of those markets by 2020. Only a very rough estimate will be possible in the context of this paper. A very useful report on the local and global water industry carried out by Trigger Foresight for the Standards Institute of Israel in 2006[29] gives an idea of the trends and magnitudes involved. This report found that in 2006 the global market for waste and waste water treatment products and services was around $35 billion growing at 6.6%/year. This would suggest a market of around $45 billion in 2011 and $85 billion by 2020. The water supervision and control products market was around $3 billion in 2006. growing at 6.5 %/ year, implying a market worth around $8 billion in 2020 Within this category, AMR technology was worth $700 million/year and growing annually at 10% suggesting a potential of well over $2 billion by 2020. The Trigger SII report noted particular export potential for Israeli water and waste water and water security companies (a new but fast growing field.) The report was cautiously optimistic regarding potential for Israeli supervision and control products (in which Israeli firms such as Arad Technologies have since put out world leading products.

Based on these trends and figures, we might roughly estimate that Israel could potentially achieve additional annual exports by 2020 in water saving related fields of

$3.5 billion in water and waste water treatment.
$500 million in supervision and control
$500 million in water security
$500 million in other water saving related fields, e.g. measurement and analysis.

Total $5 billion.

[28] *Advancing the Water Industry in Israel: Policy Paper in the Framework of the Master plan for Water Industry,* Booky Oren, 2011 (Hebrew)

[29] Trigger Foresight Consulting for Standards institute of Israel. *Strengthening the Israeli Water Industry; a Path for Focusing and Building Capacity in Water Technologies.* (2006)

Assume further that 40% of this $5 billion in extra exports comes from creating a strong domestic market in water saving technologies. [30]That implies that vigorous government action to adopt water saving technologies and products in Israel could contribute to increasing water-related exports by an additional **$2 billion dollars** per year. Assume further (conservatively) that $200,000 in revenue translates into one job. This suggests job creation potential of **10,000 additional jobs in water-related exports** by 2020. Note that most of these jobs would be in the high-tech sector with relatively high pay and good conditions.

Although these projections are necessarily rough, they give an example of the orders of magnitude in economic and employment benefits that could derive from water saving related exports.

4. Adoption and implementation of policy wedges to create a sustainable water economy in Israel

4.1 Obstacles to Implementation of Water Saving Wedges in Israel.

We can identify specific obstacles to implementation in each of the water saving wedge areas above. Each of them is a variation on one general, overarching obstacle:

The challenge is to engender the political will and the cultural shift necessary to move water saving from being a short term crisis response to a central and permanent role in Israel's water policy.

Education and Awareness Raising: The principle obstacle to instituting permanent water saving campaigns is the political will to allocate the budget for this purpose; which requires a decision to making water saving a permanent priority.

Water Efficient Plants in Public and private Gardens. Here the challenge is to maintain the tight water allocations to public gardens, even if the current crisis passes. For example, after additional desalination capacity comes online in 2013, there may be a temptation to relax the quotas. This should be resisted. Further increase in the higher ('overuse tariff') would facilitated the transformation also in the private gardens sector.

Reducing Wastage in Municipal Systems. The challenge in moving from current < 10% implementation of the wastage reduction program to 100% implementation is one of incentives and political will. The problem here is not budget – funds for implementation have been allocated to all water corporations. Currently there are insufficient financial incentives for local water authorities to implement water savings measures. Appropriate financial incentives should be created. Furthermore, in some towns there are entrenched cultural traditions against measuring and collecting payment for water use.[31] These need to be overcome.

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[30] This is more or less a guess, but probably a reasonable one. All of the figures we interviewed from the water industry affirmed that creating a strong domestic market for water saving technologies would help Israeli exports in those sectors very signficantly, but none was able to say exactly by how much. Booky Oren of Watech was fairly typical in saying: "There is *no chance* of Israel gaining significant export markets in a water sector where it has no domestic market." (Interview, June 2011.)

[31] According to Water Authority figures, in Shefaram, only 30% of residents paid for water in 2009. In Harei Natzret the figure was 33%.In 2010, the percentages rose to 56% and 55% respectively showing that this issue can be effectively tackled.

Grey Water Recycling. Clearly the immediate challenge is to pass legislation legalizing grey water recycling in Israel. Concurrently there is a need to devise and implement appropriate regulation to make this option safely available to all Israeli homes.

After the 2009 crisis Israel took initial, encouraging steps in all of these areas. **It is essential now that they are viewed not as temporary stop gap efforts until new desalination plants kick in, but as permanent features of the country's water economy.**

4.2 Shortage of Qualified Water Engineers and Technicians in Israel.

An additional obstacle to implementing water saving policies in Israel that was pointed out to us by a number of interviewees[32] was the shortage of qualified water engineers in Israel.

An extensive report on this situation was compiled in 2004 by Dr. Giora Alon.[33] The report found a severe shortage of qualified personnel in the water industry. At that time 780 water engineers were employed in all branches of the industry in Israel. However, 2900 qualified water engineers were registered by the Engineers Institute. The report projected that by 2015, 1150 working water engineers would be required. Moreover, over half of the working water engineers in 2004 were due to reach retirement age within a decade! This implied an additional flow of 80 per year from engineering faculties. The actual production of new water engineers in Israel was about half of that number. The report shows similar shortages amongst qualified water technicians, chemists and microbiologists.

The apparent reasons for this shortage were the declining relative wages and prestige of water engineers compared to other competing sectors. The very large proportion of water engineers employed by public, government bodies as opposed to the private sector, leads to a large salary differential compared to other sectors. As of 2011, a normal starting salary for a water engineer on completion of a demanding four year course of study is 6000 NIS per month. By contrast, starting salaries for engineers employed in the high-tech sector can easily be 2-3 times as high.[34] Given this discrepancy, and the erosion of the glamorous, pioneering image that attached to water engineers in the early years of the state, the shortage of personnel is understandable.

Alon's report makes a number of recommendations for rectifying this situation, including:

- Create a strategic government initiative for training water professionals.
- Raise salaries for water engineers in the public sector.
- Israel universities to expand courses for training water engineers and other professionals, and also take measures to attract more students (provide stipends for water engineering students, help find internships and job placements.)

To date these recommendations have not been implemented. The current situation is certainly no better than in 2004. It is not uncommon for local Israel water corporations to contract with foreign water engineering firms (especially from Eastern Europe) for routine pipeline and infrastructure maintenance work.[35] The shortage of qualified water engineers and technicians is inevitably an obstacle for Israel to implement fully water savings policies (especially in infrastructure

[32] In particular, Dr.. Giora Alon of the Water Authority and Dr. Ron Ben Ari of the Standards Institute of Israel.
[33] *Plan for Training Manpower in the Water industry,* Dr. Giora Alon, Ministry of National Infrastructure, 2004 (Hebrew)
[34] Interview with Dr. Giora Alon, May 2011.
[35] Ibid.

maintenance) and to achieve the place of global leadership in water technology that it could reach. Therefore we endorse the recommendations for a comprehensive effort to rectify this situation. However, it should be noted that many of the water saving policies that we have noted here as well as potential export markets do not depend heavily on engineering capability. For example much water efficiency technology relies on software and digital capabilities in which Israeli companies excel.

5. Conclusions and recommendations

Our research points to the following conclusions:

A. We estimate that water saving and conservation policies more than five times more jobs per cubic meter of water produced than does desalination, which is highly capital intensive. We estimate that water saving polices could create 5300 jobs domestic jobs per year by 2020 Furthermore a much higher proportion of the water saving positions would be high skill-high wage jobs (approximately 65% compared to 25% in desalination.) Even allowing for the subjectivity of our estimates, this is an order of magnitude difference.
B. Furthermore, adoption of water saving and conservation polices could create domestic markets for Israeli water saving technologies worth approximately $320 Million/year by 2020
C. In addition and far more significantly adopting domestic water saving technologies would, by creating a large domestic market for Israeli water saving products and technologies help Israel gain a much larger slice of the huge international water market in these areas. Rough, back of the envelope calculations suggest that this advantage could be worth $2 billion in export revenues by 2020, creating 10,000 high quality jobs. Just as Israel's embrace of drip irrigation and desalination locally has helped Israeli companies and technologies gain billions of dollars in overseas orders so too, embracing water saving could help capture billions worth of foreign business in the water efficiency field.
D. FoEME 's earlier research has shown that water saving and conservation could produce water more cheaply than desalination; the current report shows that doing so will create more, better quality jobs and position Israeli companies to earn billions in foreign exports. Israel could thereby emerge as a world leader in the critical challenge of enabling humanity to use water more wisely.
E. Though desalination will always be an element of Israel's water economy, we have aimed to shown that there are compelling environmental, economic and employment arguments aggressively expanding water conservation and efficiency policies that will diminish the need for desalinated water.

To achieve these benefits, we recommend:

1. Ongoing, public education campaigns to make permanent the 15% decline in domestic consumption achieved in water crises.
2. Continuing the successful policy of tight allocations to public gardens to incentivize a shift to more efficient plant types. .
3. Increase the differential between the lower and higher tariffs on consumption of water so that the higher price on overuse will engage people to transform their gardens to more water efficient plants and irrigation.
4. Fully implementing the program to reduce water loss in municipalities; implementing adequate financial incentives to local water corporations to save water; rationalizing the organization of local water corporations to facilitate these policies.

5. Legalizing grey water recycling and safely regulating its operation.
6. Implementing Watech's proposals to advance the Israeli water industry.
7. An aggressive program to recruit and train more water engineers and other water professionals so that Israel can regain its position as a world leader in the field.

The 2009 water crisis presented Israel with an opportunity to correct decades of waste and mismanagement in the water sector and make water saving a central and permanent part of Israel's water economy. It is essential that bringing online of more desalination capacity does not induce a foolish complacency about the state our water resources and a return to old, wasteful ways.

Moving water saving and conservation to the center of the water economy help safeguard the country's natural capital, create many thousands of high quality jobs, position Israel to capture billions of dollars in exports and to take a leading role in one of the critical global challenges of the 21st century.

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Appendix A: List of interviewees.

Yaakov Lev, Israel Water Authority, Head of Water Saving Division
Ron Beeri, IWA[36], agromomist, Water Saving Division
Hezi Bilik, Head of Water Efficiency in the Water Corporations Supervision division at Israel Water Authority
Dr. Giora Alon, IWA, Head of Sewage and waste water
Uri Schor, IWA, Spokesman
Avraham Tenne, IWA Head of Desalination
Regev Yannai, CEO of Water Corporation, Kiryat Shemoneh.
Mr. Rosenthal, CEO of Water Corporation, Ariel
Dr. Sinaia Netanyahu, Chief Scientist, Ministry of Environmental Protection, formerly Tahal
Esti Brenner, Head of Education, Science Museum, Jerusalem
Naomi Tsur, Deputy Mayor for Environment and Planning, Jerusalem
Yishai Blumental, Director of Education SPNI, Jerusalem
Dr. Yaron Benari, Standards Institute of Israel
Professor Hillel Shuval, Hebrew University
Professor Paul Kay, Environmental Sciences, University of Waterloo, Canada
Book Oren, Chairman, Watech, Former Chairman, Mekorot
Paul Steiner, CEO, Huliot, Coordinator, IGRA
Amit Shiloni, VP Business Development, Kinrot Water Technologies
Oded Distel, Ministry of Trade, Industry and Labor
Hezi Moula, Director Israel Gardening Association

[36] Israel Water Authority