Macroeconomic benefits of onsite greywater recycling in semi-arid regions suffering from water scarcity – Israel as a case study

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Abstract
Unlike other leading water policy nations such as Australia, Canada, Germany, Singapore, the UK and the USA regulatory difficulties prevent Israel from taking advantage of a major water savings opportunity in onsite greywater recycling (GWR) to address its existing and projected long term water deficit. Despite absence of local or international evidence indicating the epidemiological risks, Israel’s Ministry of Health continues to actively block any effort to legalise GWR in the residential sector which stands for more than 90% of the national GWR potential.
The analysis in this paper relies on a simple model which has been accepted by regulators in all the above mentioned countries. It assumes greywater (i.e. shower, bath, washbasin and laundry water) is recycled onsite and reused primarily for toilet flushing and secondarily for garden irrigation. Although capital and ongoing costs are borne by the taxpayer, the average family cost of living can still be reduced by greywater recycling in the medium and long term. More significant however are the macroeconomic benefits. By 2050 greywater recycling, if widely implemented, can reduce Israel’s national water and electricity consumption by 150-250 million m³ and 1-2 TW·h (1 TW = 10⁹ kW) per year respectively. Cumulative savings to Israel’s national economy are estimated to be between 30-60 billion NIS (8-16 billion US$) by 2050. This is primarily enabled by reductions in infrastructure spending on water production and distribution since greywater recycling produces a viable alternative for high value potable water exactly where it is needed – on location in high density urban settings. On the other hand, desalination which is the mainstay of the current plan to mitigate current and future water scarcity produces water at sea level and tens to hundreds of kilometers away from the consumer in a process which requires of the order of 4 times more energy per cubic meter of water than greywater recycling. As any desalination engineer knows – it is the last and most expensive option. Onsite decentralised greywater recycling should be, but is not currently, given national priority as a measure to reduce and complement the pressing need for seawater desalination.

Key Points
The following key points will be addressed in the presentation:
• Israel is lagging behind the leaders in GWR, as opposed to other water technology areas which have historically been led by Israel, such as high efficiency irrigation, centralised reuse of municipal wastewater in agriculture, and desalination.
• The cost of GWR will be borne by the taxpayer, but will still reduce the average family cost of living in the medium and long term.
• The analysis assumes that the following legislation will be adopted:
  o GWR mandated in all new construction from 2012.
Shower, bath, hand basin and laundry water recycled.
Main reuse of toilet flushing with secondary reuse of garden irrigation.

- It is demonstrated that adopting this path would create substantial savings in money, resources and environmental costs to the state of Israel, specifically:
  - Reduce national water consumption by 150 – 250 million m³/y by 2050.
  - Reduce national energy consumption by 1 – 2 TW·h/y by 2050.
  - Reduce the number of new desalination plants to be constructed by 2 (13 plants instead of 15) plants by 2050.
  - Avoid the release of 10 - 20 million tons of CO₂ by 2050.
  - Lead to cumulative savings of 30 – 60 billion NIS (8-16 billion US$) by 2050.

- Desalination is an essential cornerstone in Israel’s current and future water economy, but it must be a last resort due to its very large footprint in capital and ongoing costs, energy consumption and environmental impact.
- GWR is a lower cost solution over desalination and must be preferred where it is an option.
- The impact of GWR on availability of wastewater for centralised reuse in agriculture is minimal, reducing the compound annual growth rate of wastewater availability from 2.1% to 1.7%.

**Fig 1.** Annual national water consumption saving by GWR in 10⁶ m³/y, assuming GWR is mandated in all new construction from 2012. Bands are different levels of recycling efficiency

**Fig 2.** Cumulative monetary savings due to GWR, assuming it is mandated in all new construction from 2012. Bands are different levels of recycling efficiency

**Fig 3.** Projected population growth and specific water consumption with and without GWR

**Fig 4.** Cumulative savings breakdown into components for recycling model of 30%