10th GRIHA Summit

Session 14: Water Stress – Perplexing possibilities

UNSW SYDNEY | Australia's Global University

Never Stand Still

Global Water Institute

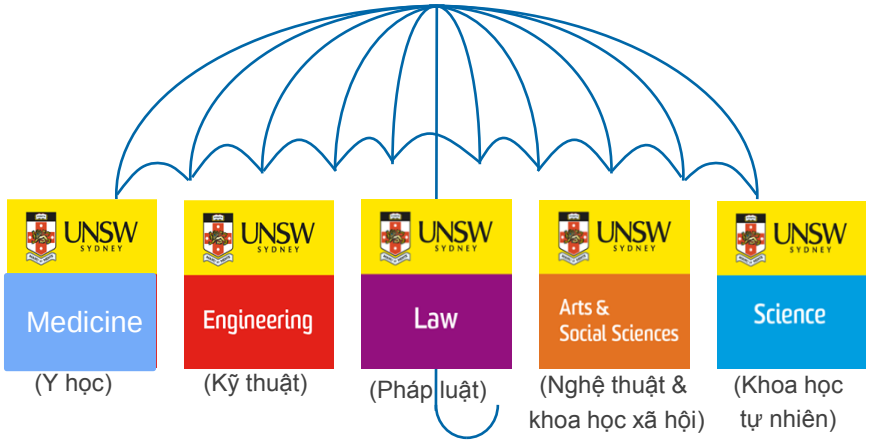
Today's Questions

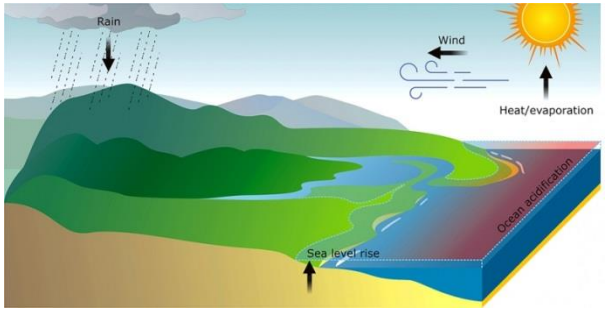
How do we secure more climate independent water for urban environment in without increasing carbon footprint?

How do we deliver water services in remote and informal developments?

Who we are

An umbrella institute for 400 water related researchers across 5 faculties
(Viện nghiên cứu về nước bao gồm 5 ngành khoa học

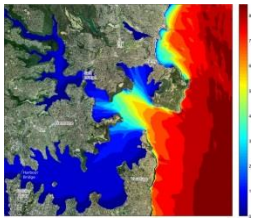




Our activities go from “The catchment to the coast”.
(Từ lưu vực đến biển ven bờ)

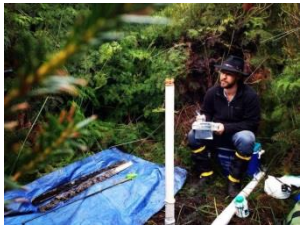
Catchment Hydrology
(Thủy văn học về hút thoát nước)

Marine ecology
(Hệ sinh thái biển)



Coastal Engineering
(Kỹ thuật công trình bờ biển)

Groundwater
(Mạch nước ngầm)



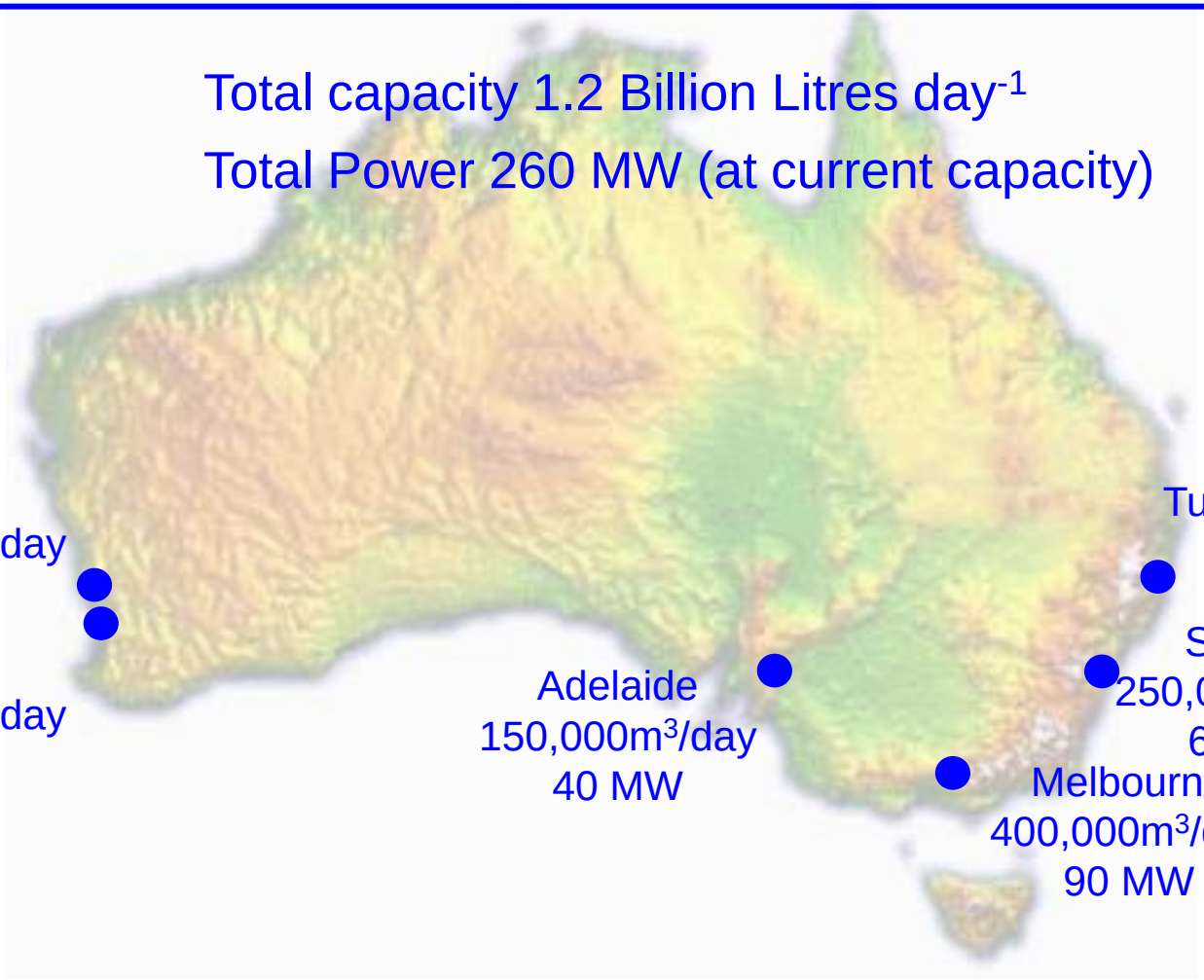
Freshwater ecology
(Hệ sinh thái nước ngọt)

Urban water & wastewater
(Nước & nước thải đô thị)

Mine water management
(Quản lý nước về khai khoáng mỏ)

UNSW SYDNEY

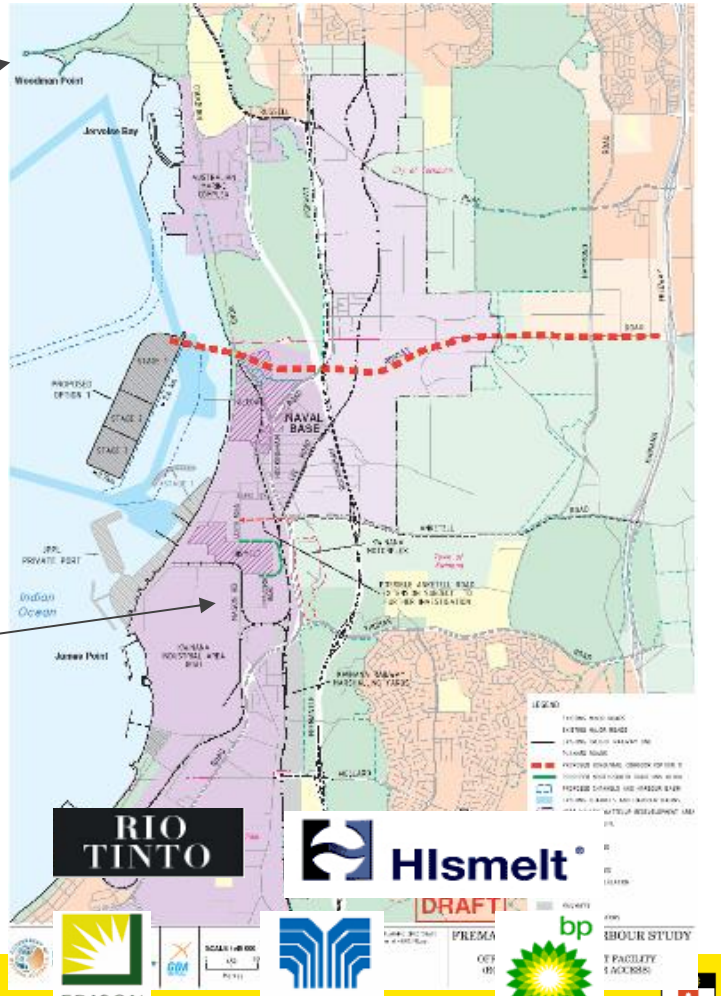
Desalination has grown from 45 GLA to 500 GLA in 5 years



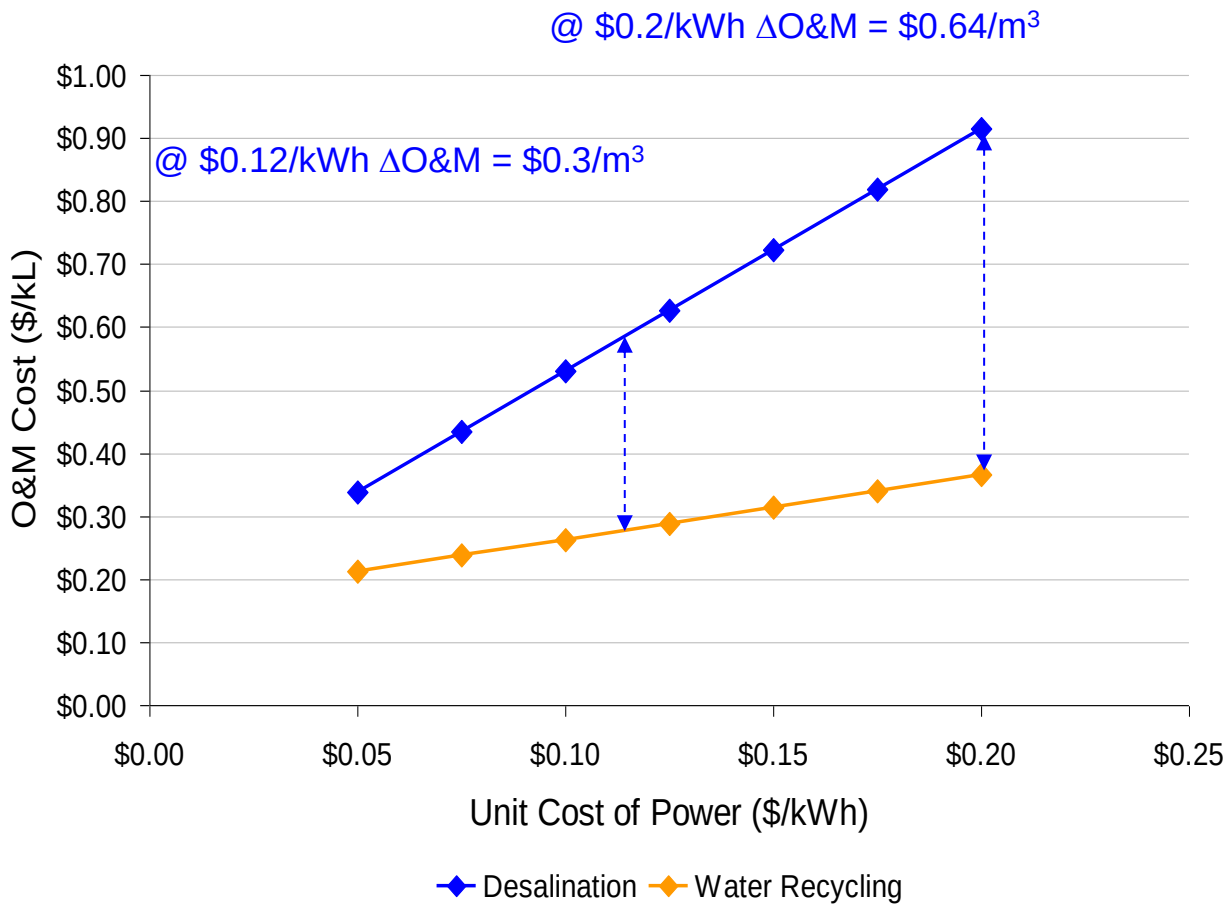
Water recycling and reuse capacity has also increased over same period

Woodman Point STP

Kwinana Water Reclamation Plant



How sensitive is cost of recycling and desal to price of power?

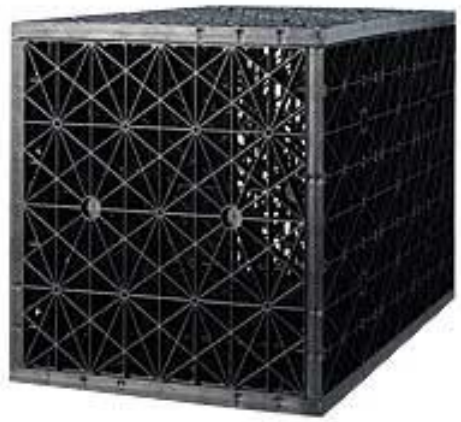


What is the greenhouse component of each option ($kgCO_2/m^3$)?

Option 2. Apply a carbon tax based on $kgCO_2/m^3$

	Desalination	Recycling
Power	6.2	1.7
Chemicals	0.22	0.16
Membranes	0.12	0.09
Total	6.52	1.95

How does stormwater harvesting compare with desal and reuse?



How does stormwater harvesting compare ($kgCO_2/m^3$)?

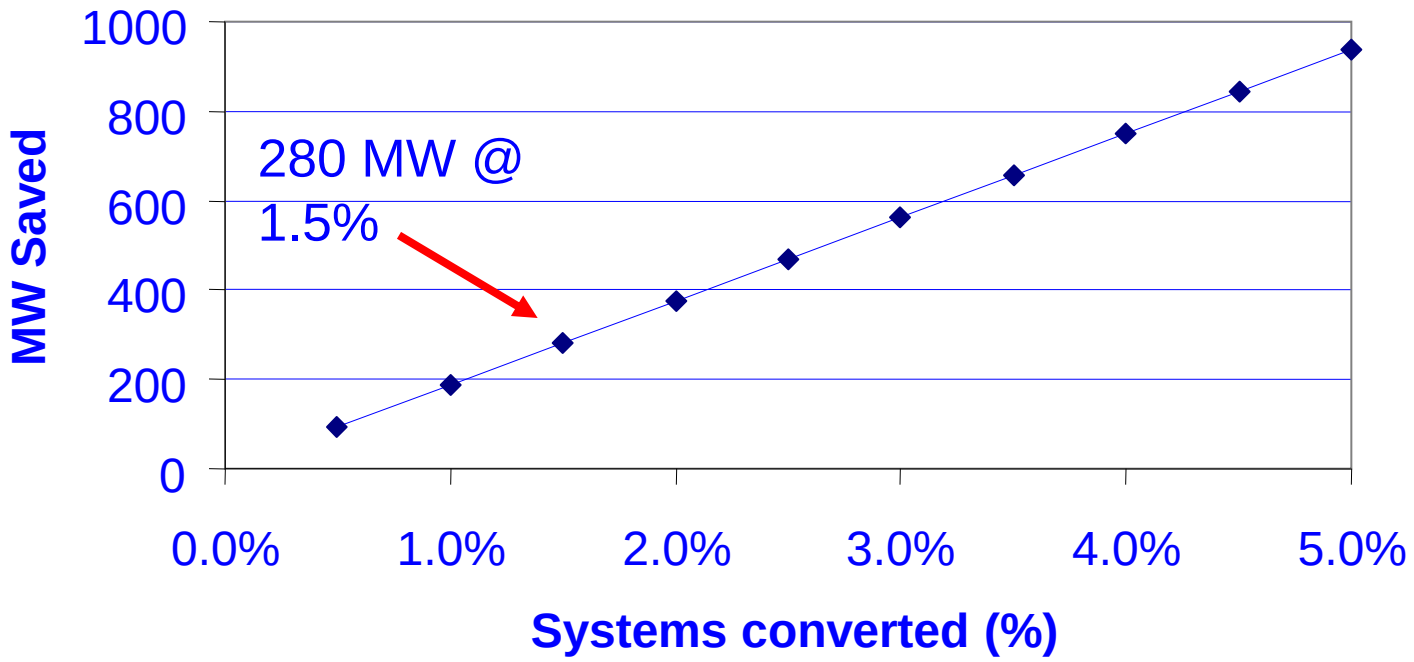
	Desal	Recycling	Stormwater
Power	6.2	1.7	0.2
Chemicals	0.22	0.16	0.01
Materials	0.12	0.09	0.02
Total	6.52	1.95	0.23

Development of new water supplies must be accompanied by efforst to reduce the energy associated with water use in the home

Lessons from lighting systems

Hot water systems offer largest savings

Power saving from conversion of electric to solar hot water system



Assumes a total of 3,125,000 million EDU's in Australia located in cities with desalination plants

Today's Questions

How do we secure more climate independent water for urban environment in without increasing carbon footprint?

- Maximise stormater capture where possible
- Good design and conservation measures essential
- New sources of water (desal) need to be recycled to greatest extent possible (needs waster water infrastructure)

How do we deliver water services in remote and informal settlements?

- Empower community to develop social enterprise around water services?

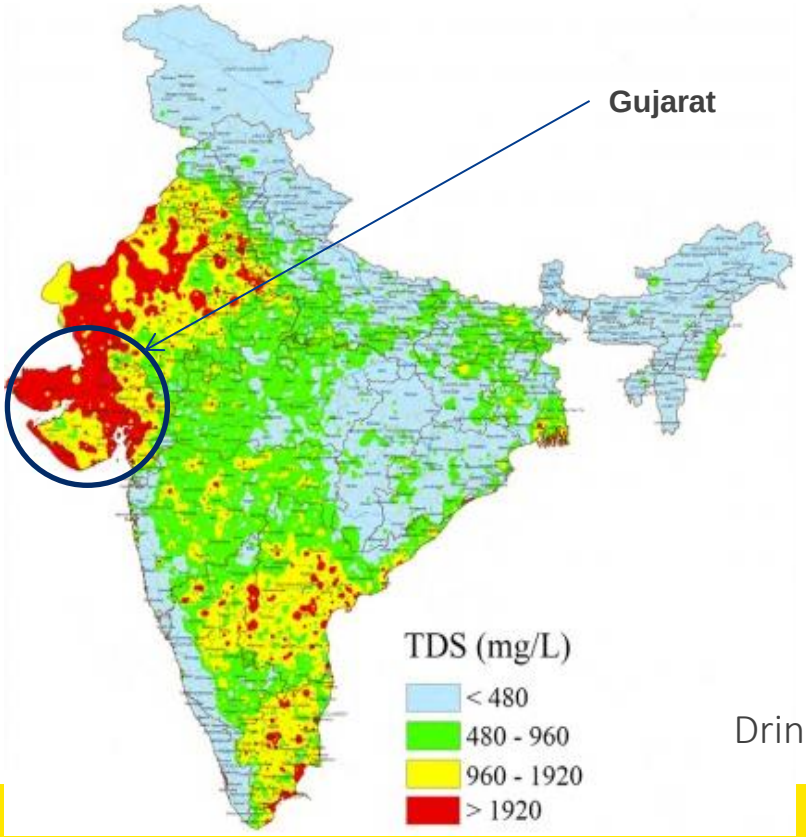
TATA WATER MISSION

To provide access to safe and contamination-free drinking water across 12,000 villages in 3 years.

INTRODUCTION TO THE PROBLEM

- Ingestion of saline groundwater has been linked to kidney stones (urolithiasis)

Salinity levels of the groundwater underlying India
(Image: World Resources Institute)



Drinking water acceptable salinity level <500 ppm

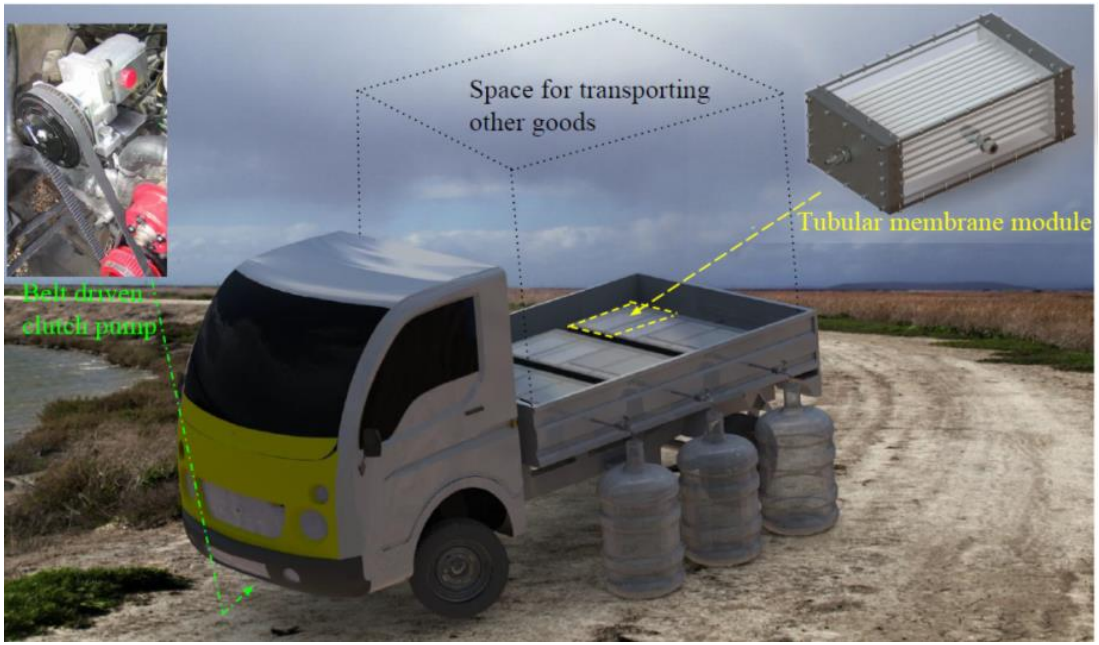
THE CURRENT SOLUTION, STATUS QUO

- Centralised treatment solutions that utilise reverse osmosis (RO) techniques are attended by high power, chemical and maintenance costs, which drain limited community funds.
- The villagers (mostly women) accessing the treated water are still relied on to provide the manual labour for carrying the water home.

OUR SOLUTION

To develop a simple, mobile desalination process for point of use treatment as part of a community based enterprise centred on exchange of goods and produce between villages, not water sales.

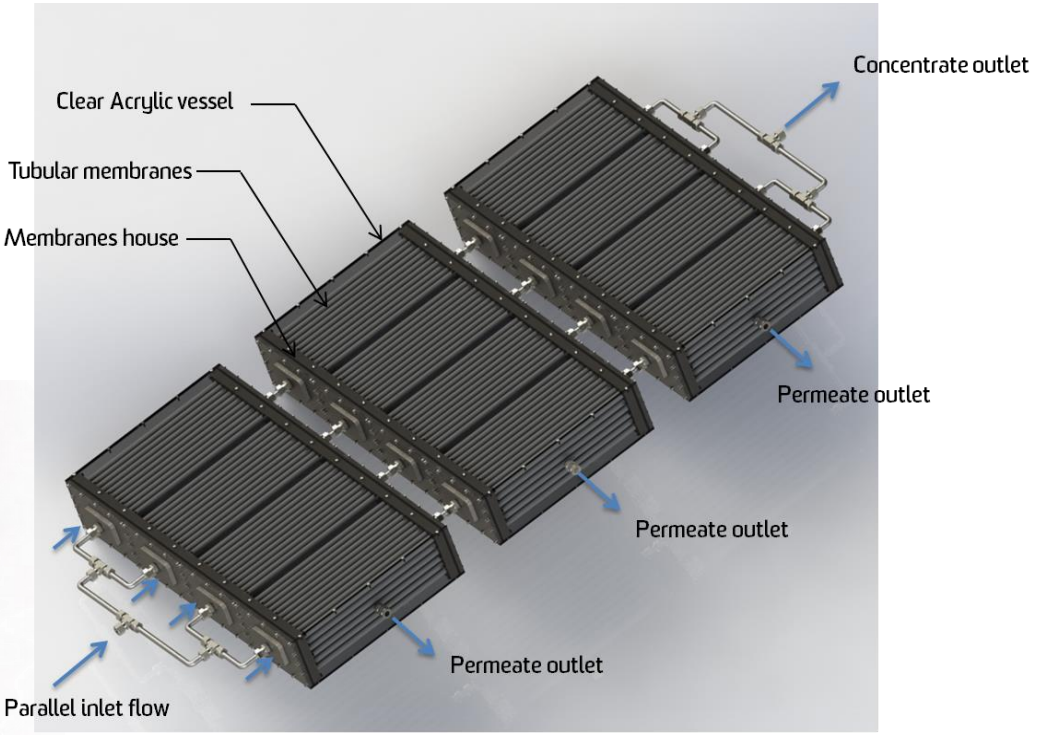
- Dual function (transport + water treatment)
- Tubular RO module (does not require pre-treatment)
- Utilise power from the truck engine
- Simple system (can be operated by non technical workers)
- Create social enterprise and empowerment



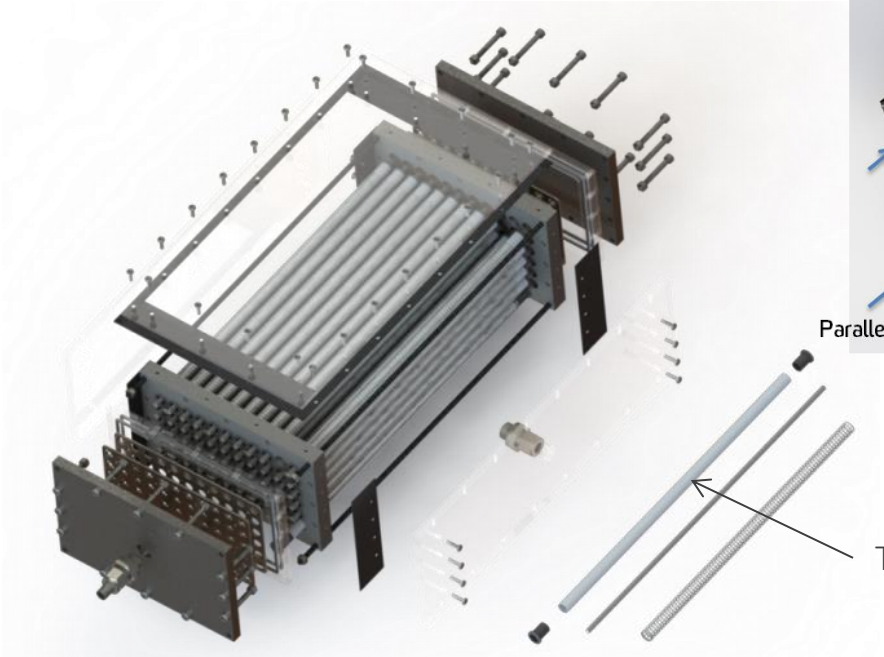
Built on the platform of existing Tata products

CHALLENGE 2
DESIGN MODULE WITH LOW WEIGHT COMPONENTS

- Employing tubular membranes (12 mm in diameter)
- Design optimization
  - Length (0.4 m): Reduce the concentration polarization
  - Minimize the weight



Membrane module assembly view (11.5 m^2 RO tubular membranes)

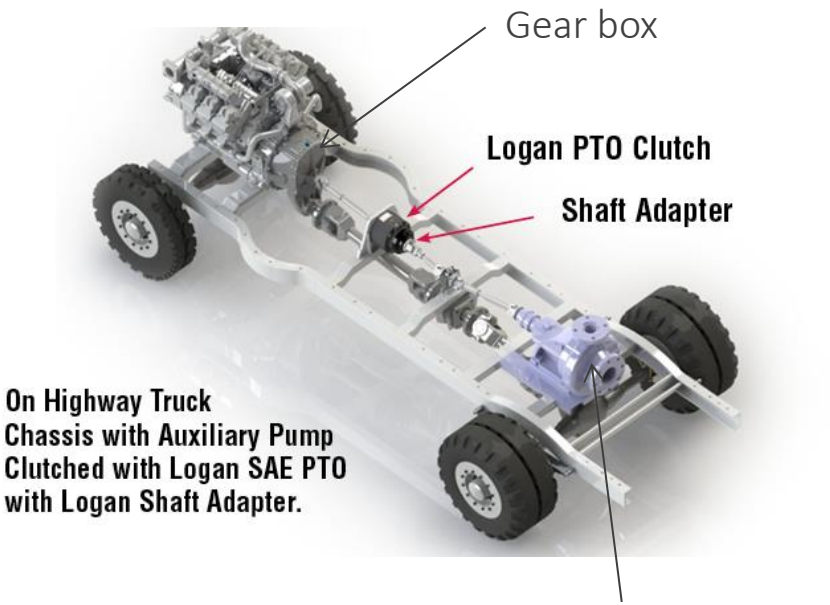


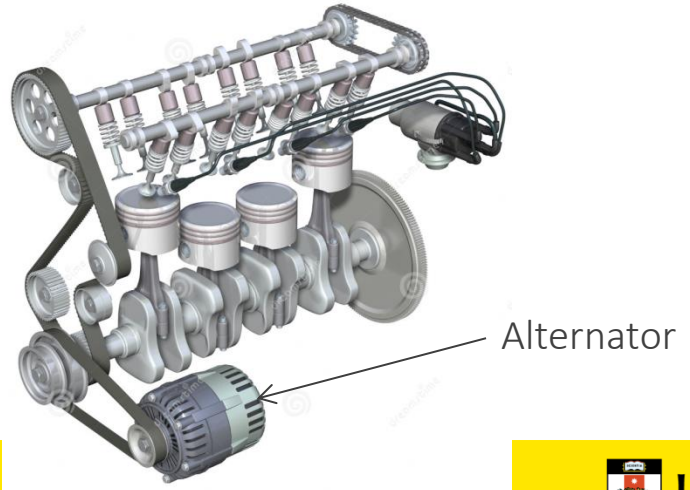
Tubular membranes (diameter: 12 mm)

1 unit Membrane module explosive view

CHALLENGE 3 – INTEGRATE INTO TRUCK

- Suggestion 1: Coupling pump with engine's shaft by using a belt driven clutch
- Suggestion 2: The pump is attached to the gear box of the truck
- Suggestion 3: Power taken from truck alternator





CHALLENGE 4
BUILD TECHNOLOGY INTO A SOCIAL ENTERPRISE

Demographics & Local Economy

District of Junagadh, Gujarat

- Population of Junagadh: 2.7 million
  - 70.6% live in rural communities
  - 77.3% of population is aged below 45
- More than 50% of villages have population between 500 to 2,000 people.

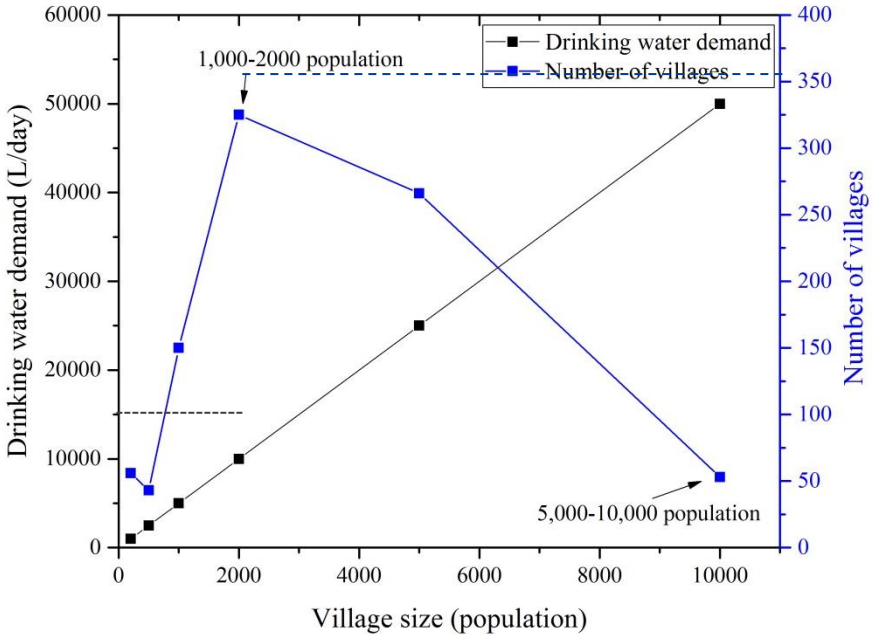
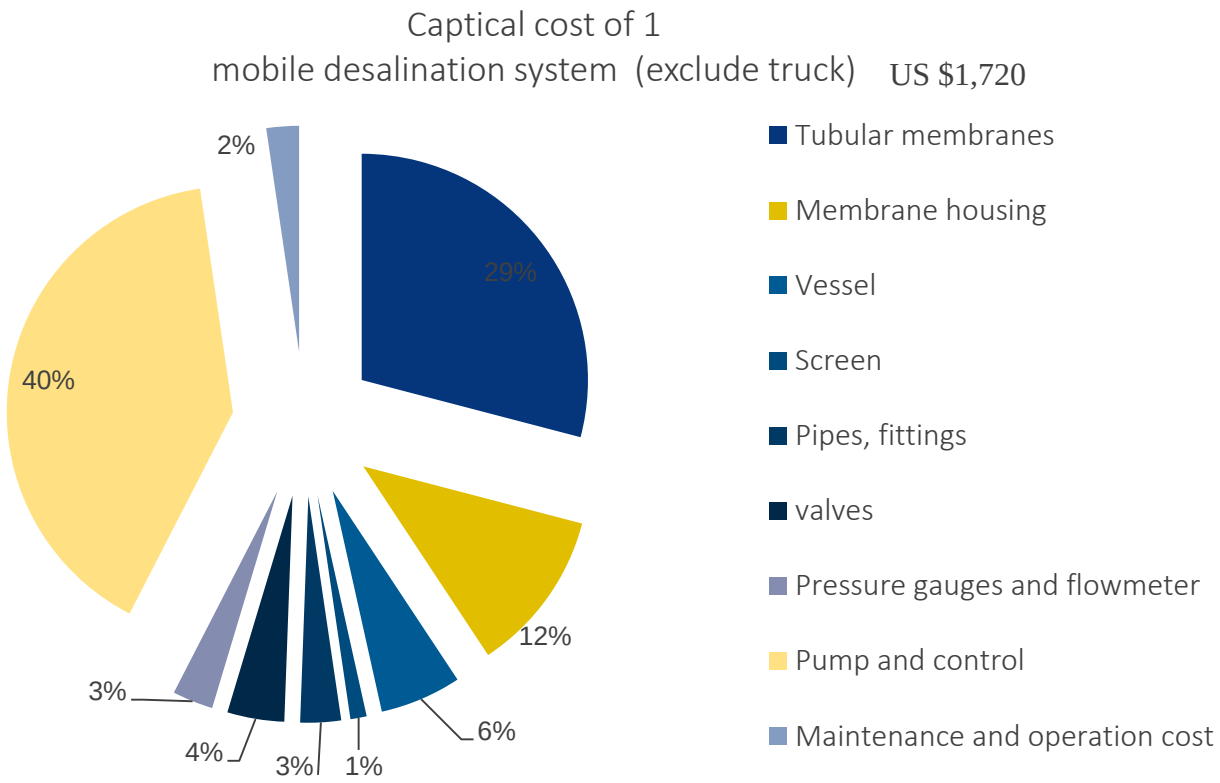


Fig. 4 Drinking water demand as function of village size and demographics of **Junagadh district, Gujurat**

TECHNO-ECONOMIC STUDY

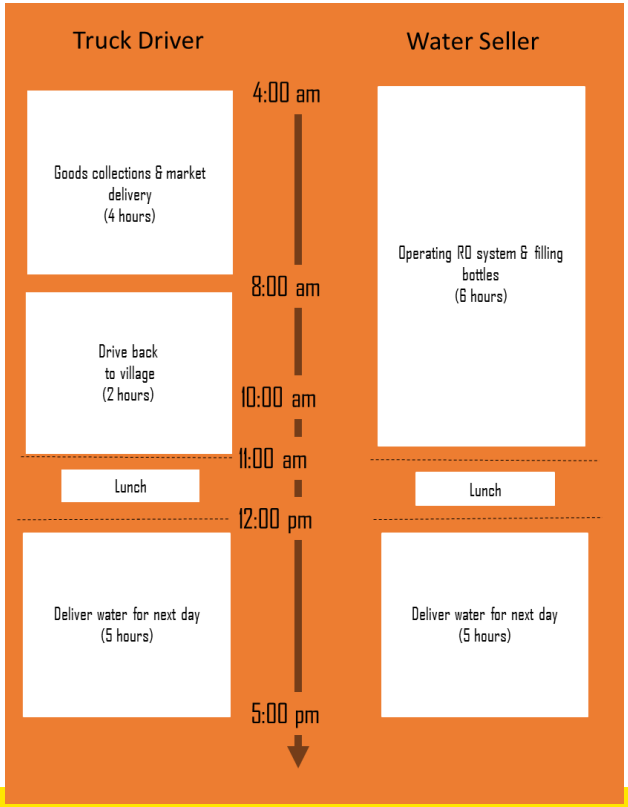
- Production rate: 16 LMH (at 8 bars), 200 L per truck per hour
- Salinity level of treated water: less then 200 PPM
- Cost of a desalination system : US $1,720 (excluding truck), and $8,200 (including a truck).



- System Water Production rate (per system per hour): 200 Litres
- Capital cost for whole system (including truck) for providing water to a village (1,000 residents, 2.5 Litres water per person per day):
  - US$ 49,200 (6 sets) if truck operates 2 hours for water treatment per day)
  - or US$146,000 (3 sets) if truck operates 4 hours for water treatment per day)
- Water production cost: ~2.5 US$/$m^3$
- Payback period (years) :
  - 1.5 years (if potable water price: US$ 0.2 per 20 Litres)
  - 3 yeas (if potable water price: US$ 0.1 per 20 Litres)

SOCIAL BUSINESS MODELLING - Winning team (Impact Engineers)

- A student event 'Global Water Hack' has been held for this project with 7 teams participating.



	Impact Engineers
Business	• Produce clean water, provide electricity, create a distribution network, and improve income • Tata trucks can transport 400 kg of crops/goods and 100kg of teachers/medics to establish a localised medical clinic
Technology	• Generator, pump, and RO module system to produce potable water at wells. The water will then be delivered to villages by truck (separation of desalination and truck)
Social Impact	• Mixture of 20% microfiltered groundwater and 80% RO treated water (50 ppm) to create safe drinking water of 440 ppm (which is less than the threshold TDS of 500 ppm) • Schedule of work for truck driver: collect goods and delivers to market (4 hrs). Drive back to village (2 hrs). Deliver water to villages for the next day (5 hrs) • For the water seller: operate RO system and fill bottles (6 hrs). Deliver water for the next day (5 hrs). These schedules align with their established schedules of working from 4am-5pm, making it sustainable. • Farmers will receive market price for crops rather than low prices from middlemen, women will not spend hours walking to get water and will have the opportunity to contribute to the village economy. Logistics entrepreneurs will emerge to deliver clean water.

SOCIAL BUSINESS MODELLING- running up team (WAuTER)

Water Hack Team WAuTER

	WAuTER
Business	• Produce clean water, provide electricity, create a distribution network, and improve income • Tata trucks can transport 400 kg of crops/goods and 100kg of teachers/medics to establish a localised medical clinic
Technology	• Using solar panels to provide sufficient electricity for water filtration and basic electrical needs • Install 2.5 kwh lead acid battery and solar panel. Surplus electricity can be sold at $0.05/kwh • Implementing LORA (Long range) communication system to track Tata trucks and allow delivery times to be known • Installation of an ETH Smart Contract Server that optimises transportation routes and facilitates communication between buyers and sellers via SMS. It will also act as a billing system
Social Impact	• Facilitate buying and selling of goods with better communication between buyers and sellers • Improved billing system that also tracks the prices at which goods are being sold. In this way prices can be maintained at fair levels and producers are being paid fairly without potentially being exploited by middlemen • Educational facilities and localised medical clinic