PV-Powered Desalination in Australia: Technology Development and Applications

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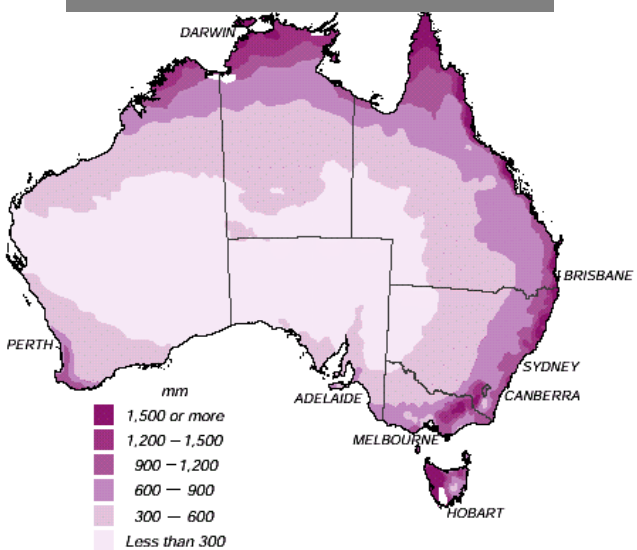
Introduction

- Background to Australian context
  - Environmental factors
  - Social factors
- The Reverse Osmosis Solar Installation (ROSI)
  - System description
  - System optimisation
- Socio-technical issues for successful operation
- Future work planned

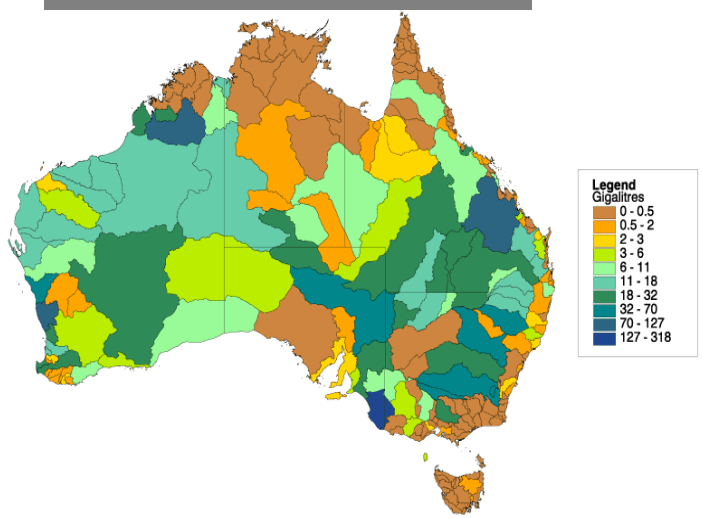
Australia's Environment

- Driest continent on Earth – minimal fresh water
- Groundwater is available and commonly used

Rainfall



Groundwater



Water Quality

- Groundwater: high salinity & other contaminants
  - Arsenic, uranium, boron
- Surface / dam water: high turbidity, microorganisms

		Community				
Component	**ADWG Guideline**	**Iwantja**	**Yalata**	**Pukatja**	**Iga Warta**	**Oak Valley**
TDS	1,000	2,240	10,100	898	1,000	3,290
Chloride	250*	683	5,190	NR	275	1,560
Sulfate	500	565	1,150	NR	175	365
Total hardness	200*	1,275	3,650	423	688	707
Iron	0.3*	9	NR	NR	1	NR

ADWG = Australian Drinking Water Guidelines (values in mg/L)

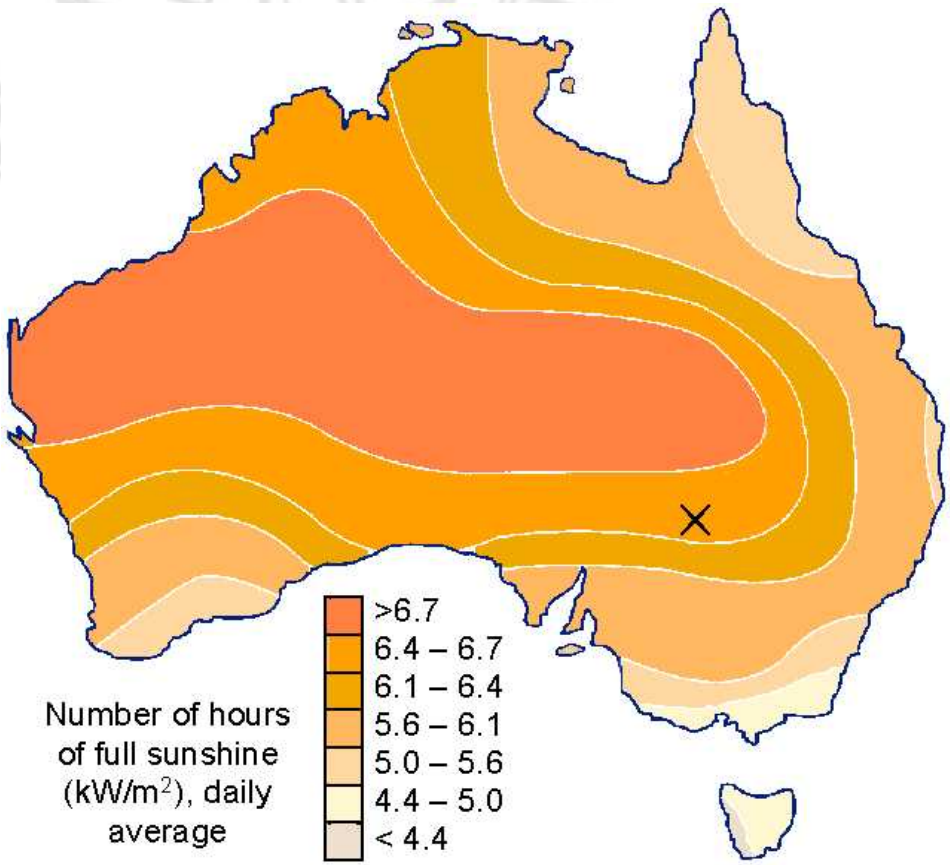
TDS = Total Dissolved Salts

Hardness = $CaCO_3$

* = aesthetic guideline only

NR = Not Reported

Solar Resources

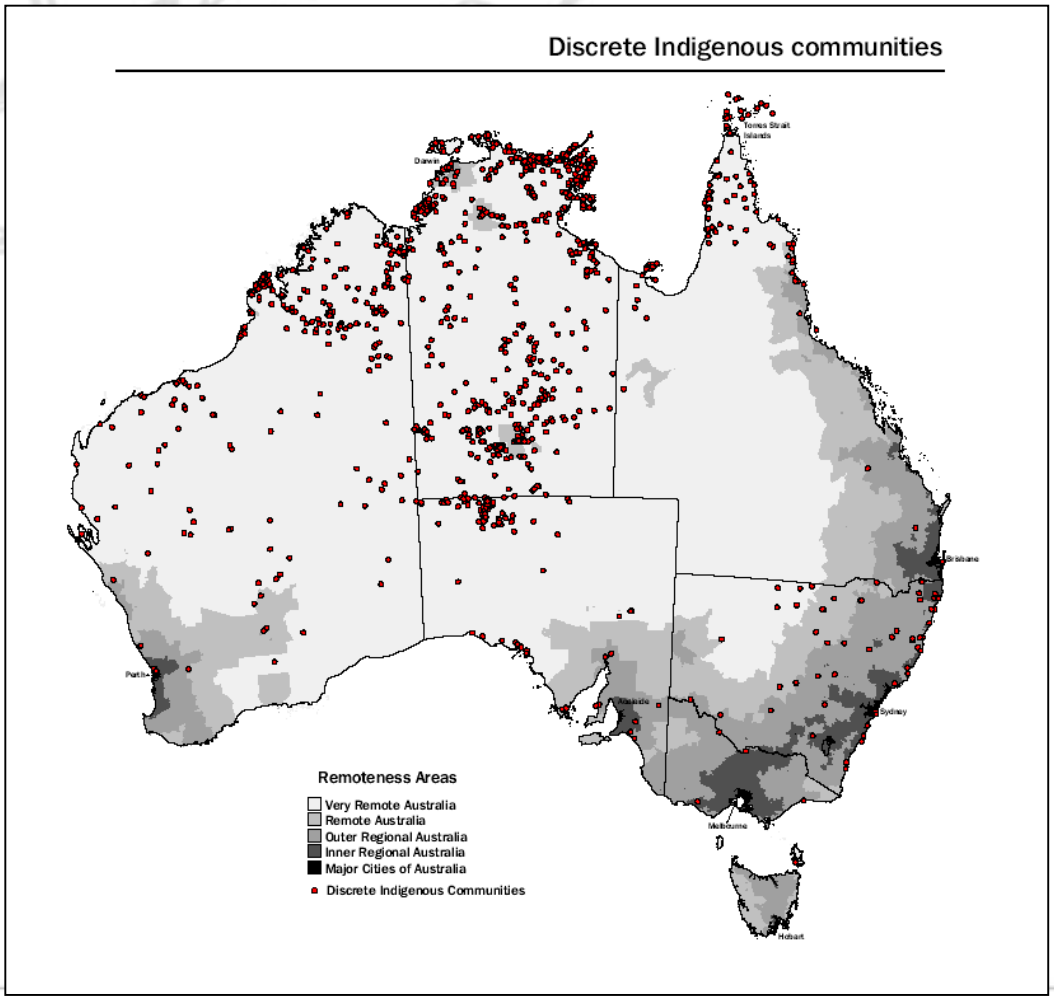


- High levels of solar insolation in Central Australia
- Solar power used in some settings as an energy source

Social Factors in Central Australia

- Different groups living/travelling in remote areas:
  - Farmers
  - Indigenous (Aboriginal) communities
  - Roadhouse operators and visitors
  - National Parks rangers and visitors
  - Smalls towns with an influx of tourists
- Diverse purposes, socio-economic & cultural features
- Complexity of service provision responsibility
  - Dependent on location, community size, land ownership etc.
  - Different States & Territories involved

Remote Indigenous Communities



- 85% of Indigenous communities (1030) in ‘very remote’ areas
- 73% of communities have population <50
- Most communities in the Northern Territory and Western Australia

Source: CHINS 2001

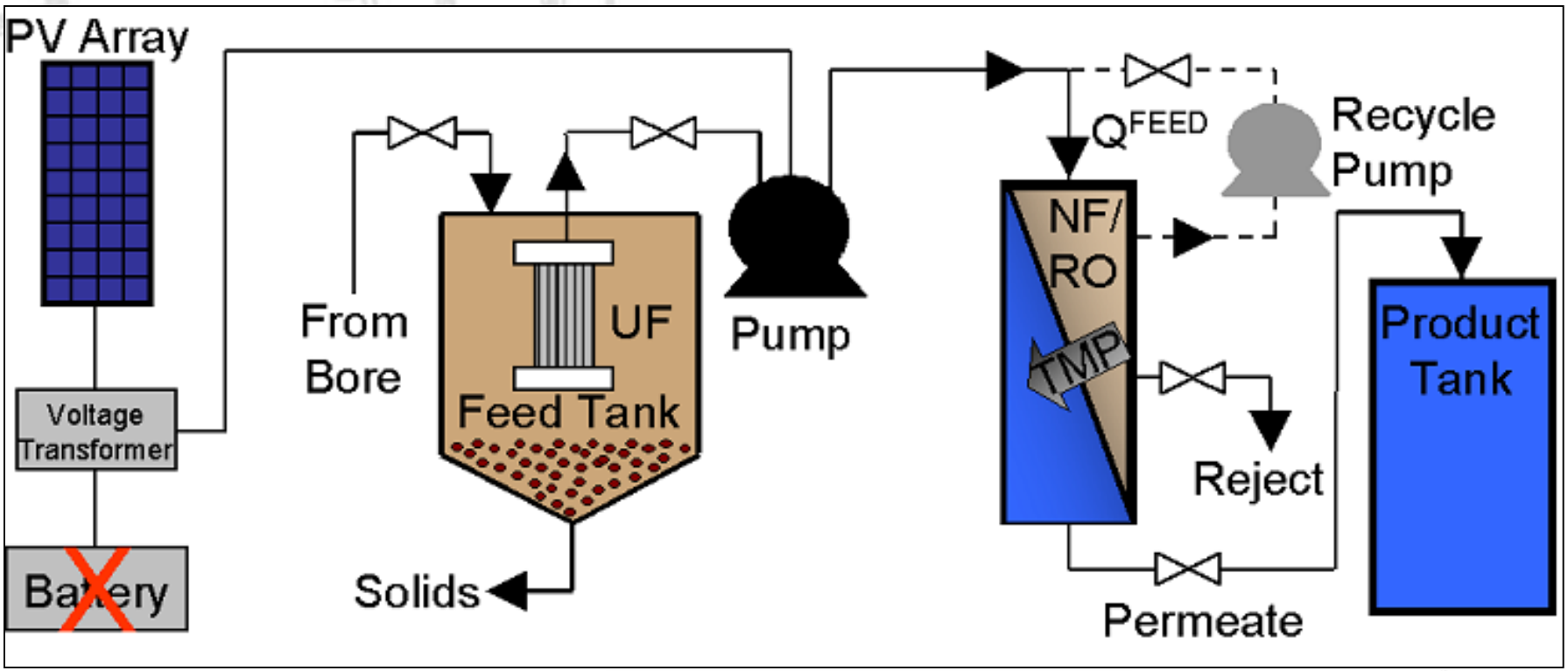
Reverse Osmosis Solar Installation

ROSI

- Membrane Filtration + Solar Power
  - Stage 1 Membrane: Ultrafiltration
    - Removal of viruses & bacteria: physical disinfection
  - Stage 2 Membrane: Nanofiltration / Reverse Osmosis
    - Membrane choice depends on water quality
    - Removal of salt & trace contaminants
  - Solar panels (600W) with tracker provide power for:
    - Pumps
    - Logging equipment (sensors) & computer

Flow Diagram of ROSI

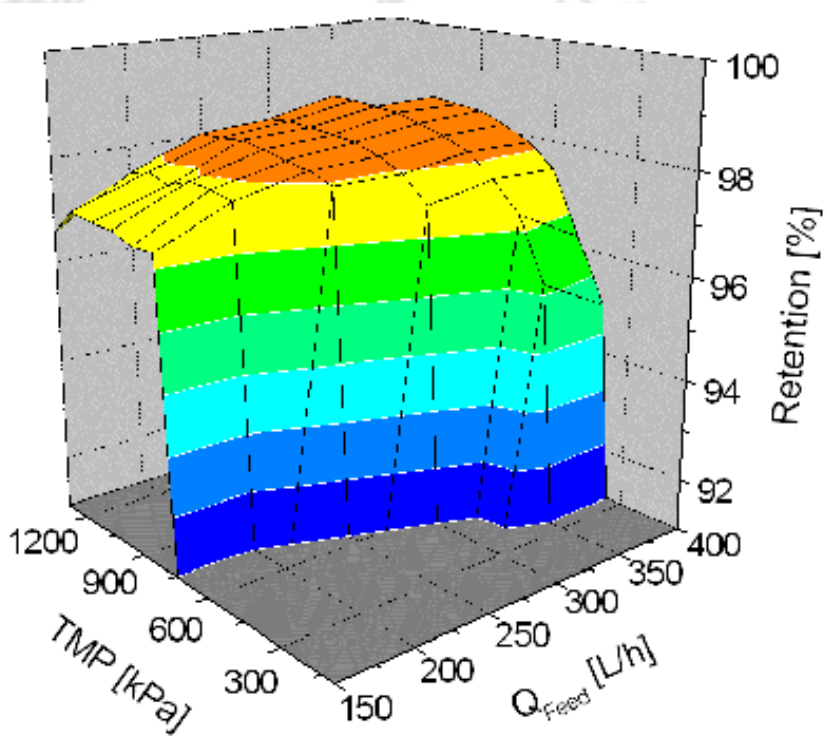
- Output: up to 1000L of fresh water (permeate) & 9000L disinfected but not desalinated (‘reject’) per day



ROSI Configuration

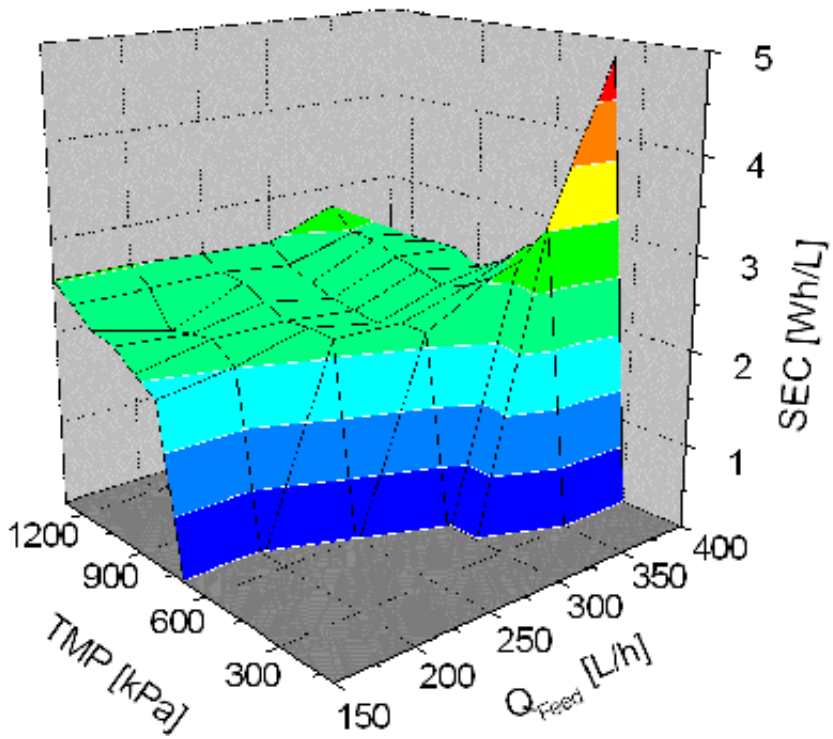
- Proposed configuration:
  - 90% of water physically disinfected (through UF)
    - Suitable for cleaning, showering etc
  - 10% of water purified through NF / RO
    - Suitable for drinking
  - Centralised distribution point
- Requirements:
  - Existing infrastructure: bore, pump, feed tank
  - Maintenance: Under investigation

System Optimisation: Salt Retention



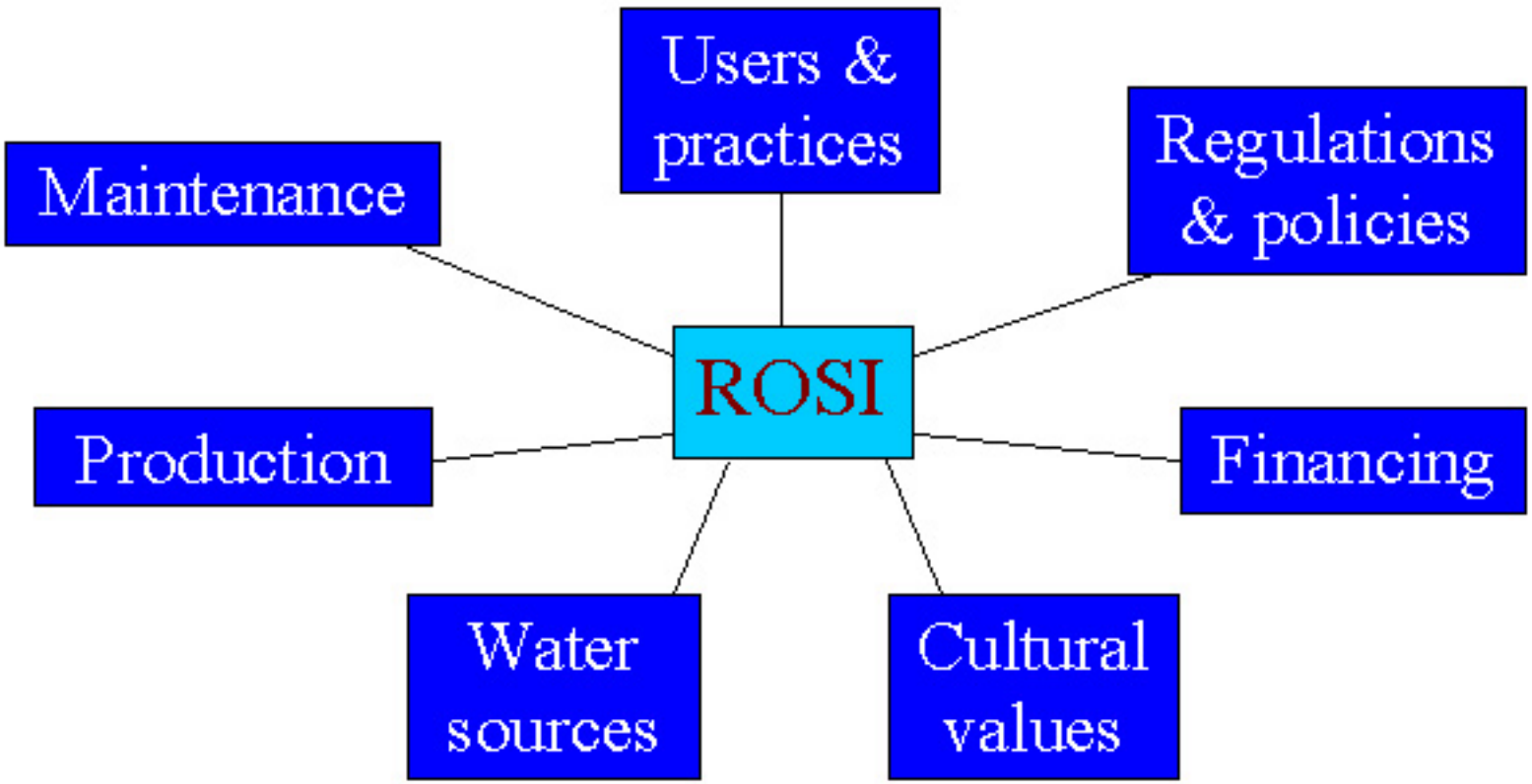
- Retention has to be as high as possible (at least 90%) to produce high quality drinking water
- Tested using 5g/L salt solution.

System Optimisation: Energy Consumption



- Aim: to minimise specific energy consumption (SEC): the amount of energy required to produce 1L of drinking water
- Method: Vary TMP and feed flow to produce 3D map of SEC.

ROSI in a Socio-Technical System



Issues to Address

- Exploration of socio-technical issues to:
  - Identify barriers and opportunities for sustainable use
  - Develop strategies for ROSI's development & implementation
- Issues such as:
  - Maintenance
    - How much is required? Who could it be performed by?
  - Users & Practices
    - Current water use practices? Will ROSI support or change them?
  - Financing
    - Where will funding for purchase / ongoing costs come from?
  - Regulations & Policies
    - Does ROSI meet H_20 requirements? Are supporting policies required?

Future Work Planned

- Field trip to Central Australia Sept/Oct 2005
  - Technology development:
    - System optimisation for different sources: bores and dams
    - Testing of As, U contaminated water sources
    - Membrane & pump performance, energy consumption investigated
  - Socio-technical investigations
    - Community water needs & responses to the technology
    - Capabilities in terms of operation and maintenance, finance etc.
- Investigate potential pilot sites
  - Assessment of most viable applications from field trip
  - Investigate potential sites for an extended trial and analysis
- Continue work with commercialisation partner
  - Approaches to production, service network, costing

Configuration for Field Trip