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60 Years

Atoms for Peace and Development

Nuclear Desalination for Sustainable Development

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Humanity's Top Ten Problems for next 50 years



R. Smalley, the Terawatt Challenge, Nobel prize chemistry 1996

1. ENERGY
2. WATER
3. FOOD
4. ENVIRONMENT
5. POVERTY
6. TERRORISM & WAR
7. DISEASE
8. EDUCATION
9. DEMOCRACY
10. POPULATION



2004	6.5	Billion People
2050	~ 10	Billion People

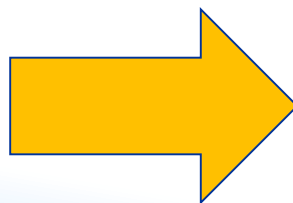
Nuclear Desalination

1973 USSR: operation of the first nuclear reactor coupled to 3 MED plants having 5 effects producing a total design capacity of 145 000 m³/day

Aktau, Kazakhstan



a development
Stimulus !!!



Success Story on Nuclear Desalination

Plant name	Location	Gross power [MW(e)]	Water capacity [m ³ /d]	Reactor type/ Desal. process
Shevchenko	Aktau, Kazakhstan	150	80000 – 145000	FBR/MSF&MED
Ikata-1,2	Ehime, Japan	566	2000	LWR/MSF
Ikata-3	Ehime, Japan	890	2000	LWR/RO
Ohi-1,2	Fukui, Japan	2 x 1175	3900	LWR/MSF
Ohi-3,4	Fukui, Japan	1 x 1180	2600	LWR/RO
Genkai-4	Fukuoka, Japan	1180	1000	LWR/RO
Genkai-3,4	Fukuoka, Japan	2 x 1180	1000	LWR/MED
Takahama-3,4	Fukui, Japan	2 x 870	1000	LWR/RO
Diablo Canyon	San Luis Obispo, USA	2 x 1100	2180	LWR/RO
NDDP	Kalpakkam, India	2 x 170	6300	PHWR/MSF/RO
Karachi	Karachi, Pakistan	175	1600	HWR/MED

On-going nuclear desalination projects

Country	Reactor type/desalination
Argentina	CAREM/RO
Japan	GTHTR300/MSF
Rep. of Korea	SMART/MED/RO
Russian Federation	KLT-40/MED/RO
China	PWR/RO
Saudi Arabia	SMART!!!!
Egypt	PWR!!!!
Jordan	NuScale!!!!
USA	NuScale/RO/MED/MSF
Kazakhstan	KLT-40!!!
Pakistan	CNP-300/CNP1000/ MED/RO!!!
South Africa	PWR/RO
Algeria, Tunisia, Morocco, UAE...etc	!!!!

Challenges for nuclear desalination

- **Disparity:** Countries vs. nuclear energy technology
- **Public perception:** on NPPs & Product water
- **Economics:** competitiveness with fossil

Nuclear Desalination can help improving economics

10% of 1000 MWe PWR for desalination

To produce 130 000 m³/day of desalinated water using 1000 MWe PWR

Total revenue (Cogeneration 90% electricity +10% water):

	Standalone	MED	RO
Electricity	7166 M\$	6771 M\$	7062 M\$
Water	0	888 M\$	672 M\$
Total	7166 M\$	7660 M\$	7700 M\$
		+7%	+7.5%

Using MED:

- Easier maintenance & pre-treatment
- Industrial quality water

Using RO :

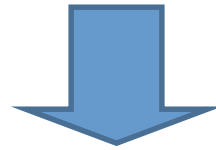
- Increased availability
- No lost power as in MED
- Using waste heat to preheat feedwater by 15°C increases water production by ~13%

Harnessing waste heat from High Temperature Reactor

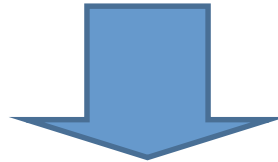
for desalination: The case for Pebble-Bed Modular Reactor PBMR

PBMR rejects heat from the **pre-cooler and intercooler** = **220 MW_{th}**
at 70 °C

+ MED desalination technology



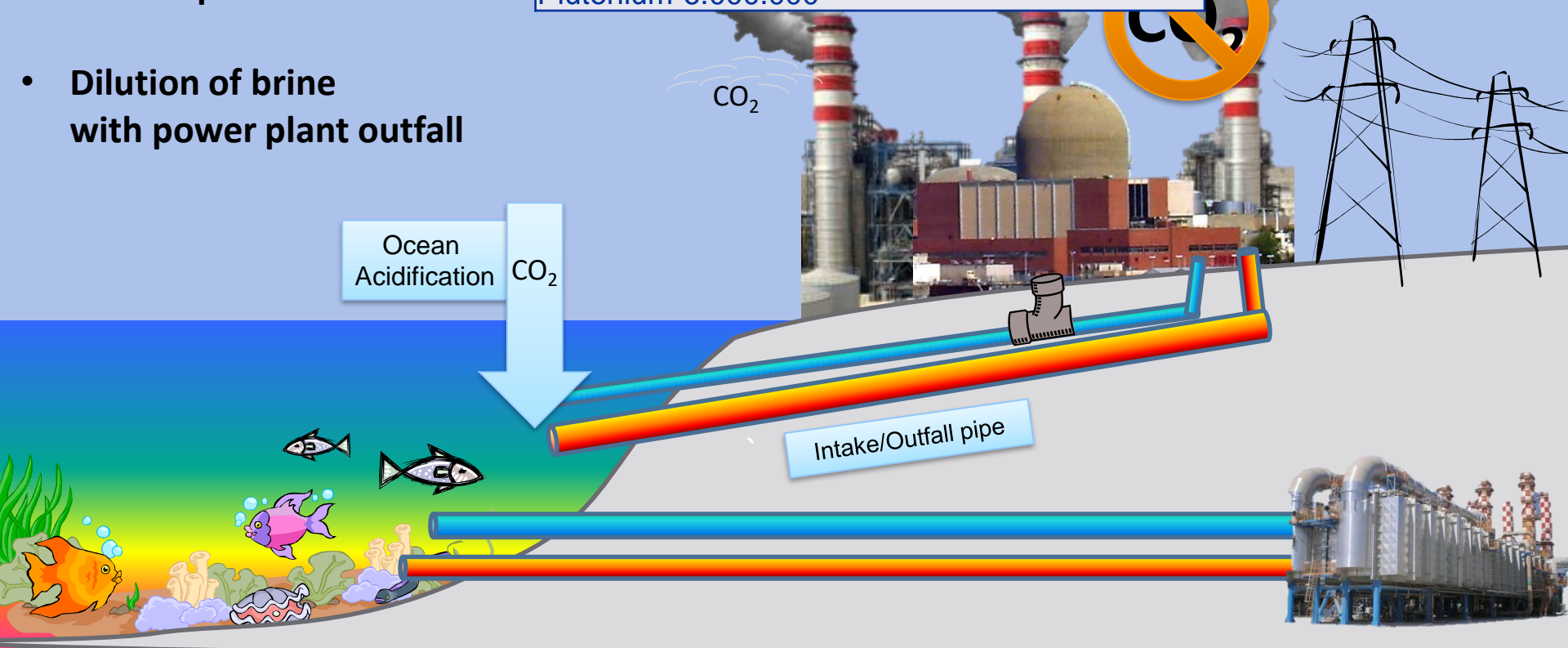
Desalinated water 15 000 – 30 000 m³/day



Cover the needs of 55 000 – 600 000 people

- Zero carbon footprint CO_2
- Smaller visual impact
Less construction materials CO_2
- Resource sharing with power plant
- Less energy consumption
- Dilution of brine with power plant outfall

Technology	CO2 Emission of different energy sources (gr/kWhe)
Nuclear fuel cycle (mining to waste disposal)	10 – 50
Wind Power	10 – 50
Fossil fuel Cycle	450 – 1200
Firewood	~1
Coal	3
Oil	4
Uranium	50
Plutonium	6.000.000





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Nuclear power plants produce



Electricity

Waste
Heat

with efficiency of 33 %



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Thank you!

