



SWCC

Taxonomy of Carbon Capture and CDR Credit
- New business case for desalination plant

Status of Footprint Analysis for Desalination

Quantification and analysis of CO2 footprint in KSA

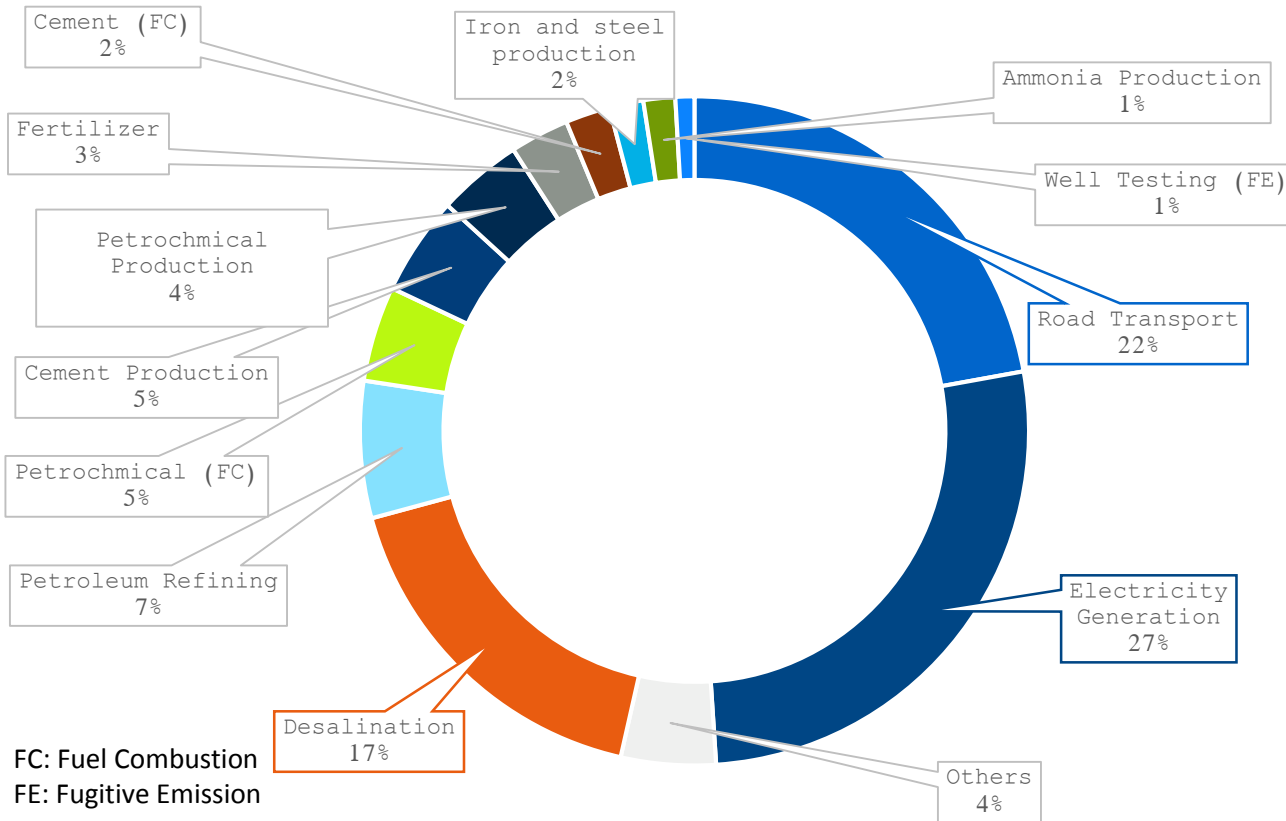


Fig-1 Saudi DNA reported the relative contributions of Major CO2 emission in KSA in 2016

STATUS – Desalination in KSA

- According to the graph Desalination industry is one of the major industry in Saudi Arabia, uses major stake of energy consumption

Facts

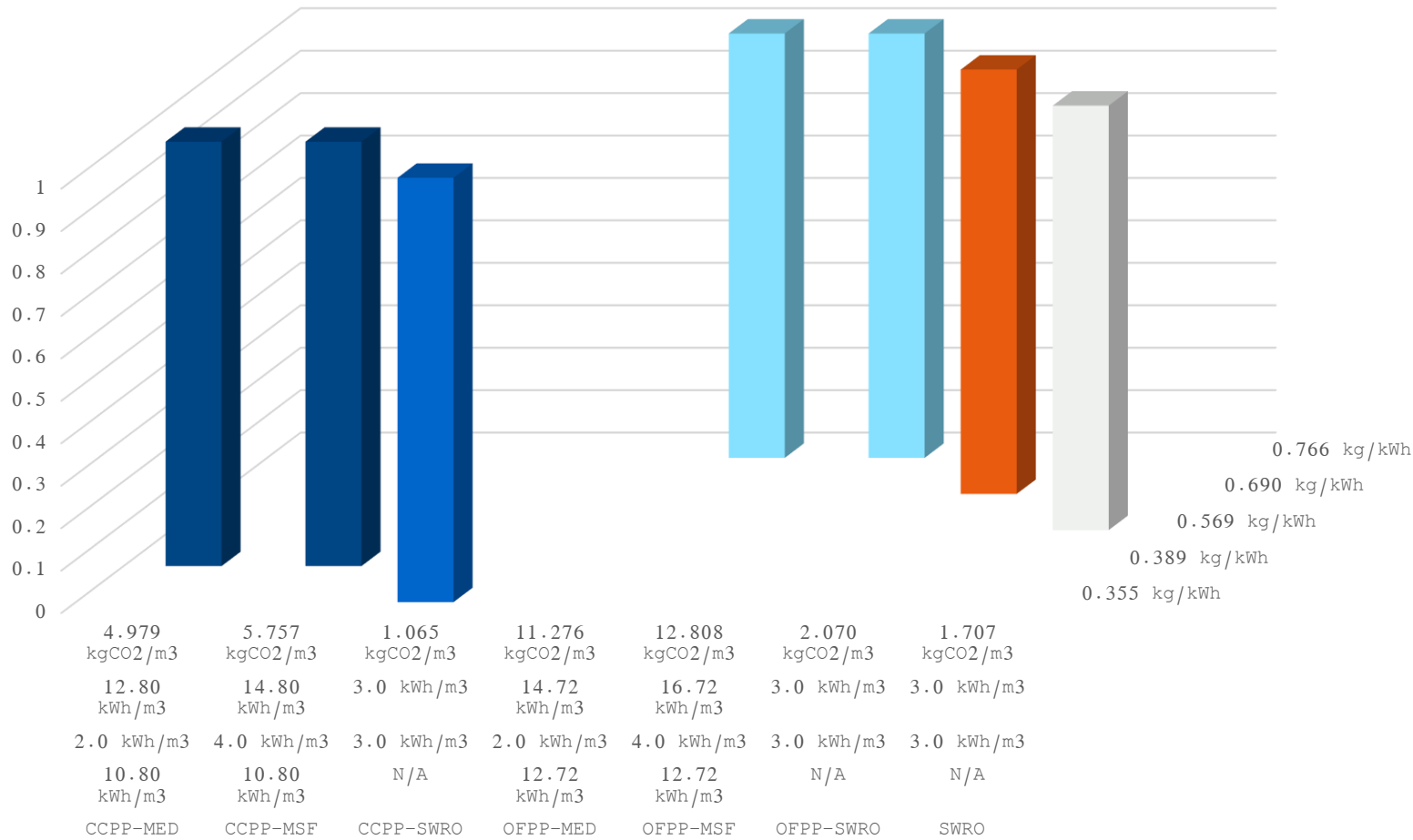
Fuels in KSA	Carbon Content (wt%)	HHV (MJ/kg)	LHV (MJ/kg)	Average (MJ.kg)
Natural Gas	70.0%	52.2	47.1	48.0
Heavy Fuel	85.1%	43.4	41.1	42.0

Configuration	Fuel Type	Heat Range (kJ/kWh)	Fuel Consumption	CO ₂ Emission
Simple Cycle	Heavy Fuel	9,300 (38.7%)	0.221 kg/kWh	0.690 kg/kWh
Combine Cycle	Natural Gas	6,600 (54.5%)	0.138 kg/kWh	0.355 kg/kWh

Average carbon footprint of grid power in Saudi Arabia is about [0.569 kgCO₂/kWh in 2021](#) which was substantially reduced from 0.703 kgCO₂/kWh in 2019 due to the increased portion of combined cycle power plant.

Status of Footprint Analysis for Desalination

Configuration by CO2 Emission

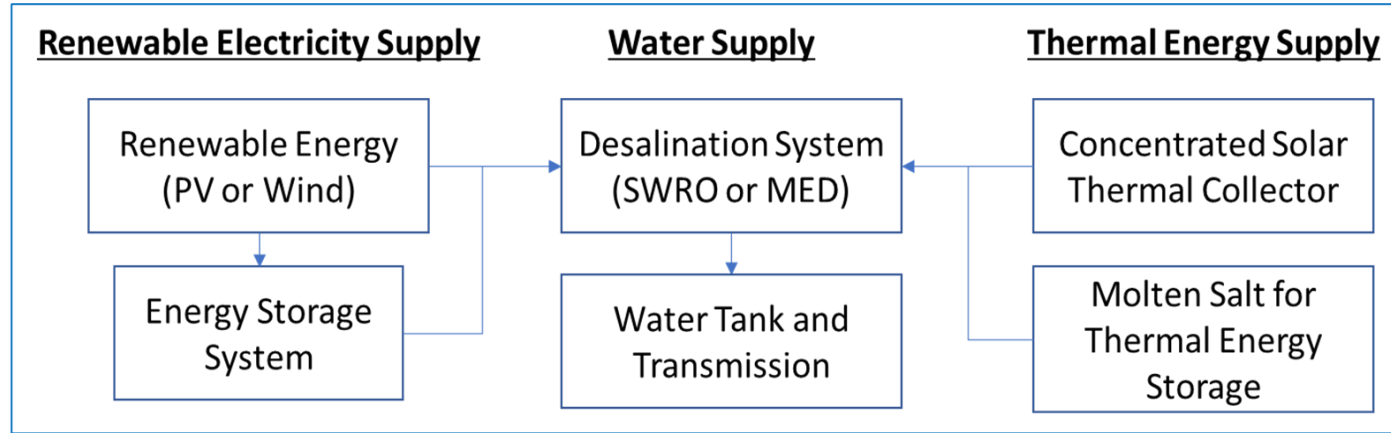


STATUS – Desalination in KSA

Portfolio of desalination technology matters

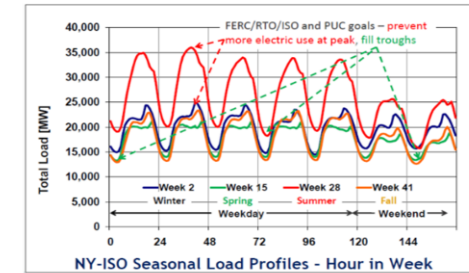
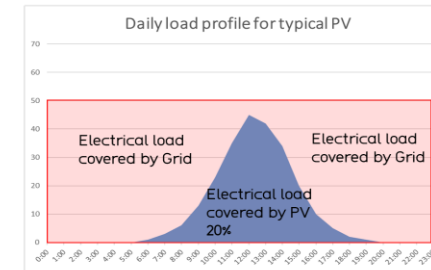
- SWCC is gradually phasing out thermal desalination technologies and moving forward for SWRO
- SWCC is pursuing further reduction of energy consumption in SWRO technology (2.27 kWh/m3)

GREEN DESALINATION – Configuration



Renewable Penetration

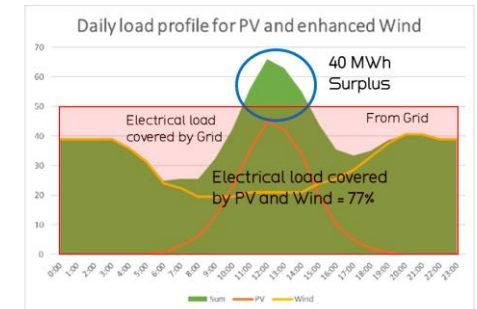
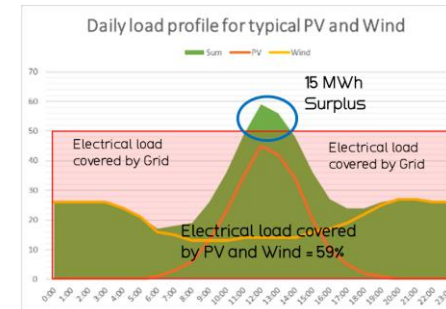
For typical SWRO (400,000 m3/day, 3.0 kWh/m3)
Average daily electrical energy consumption is 1200 MWh



This concept could make sense because tariff of grid power usually expensive during daytime and cheap during nighttime.

No new technologies for Green desalination system
Question is how to make this configuration financially feasible

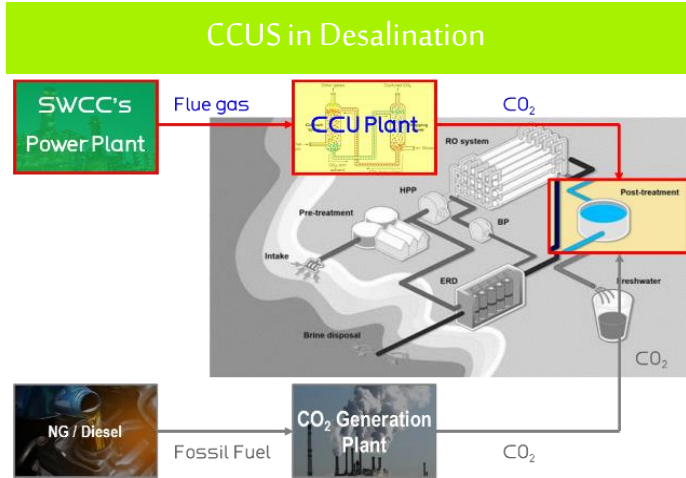
	SWRO	Electricity by Renewable [A]	Electricity by ESS [B]	Renewable Capacity [C=(A+B/0.8)/24/CF]
Renewable with CF=0.5 (Wind Case)	400,000 M3/day (288 mil.USD)	600 MWh	600 MWh (247.2 mil.USD)	112.5 MW (147.5 mil.USD)
Renewable with CF=0.2 (PV Case)	400,000 M3/day (288 mil.USD)	240 MWh	960 MWh (395.5 mil.USD)	300 MW (264.8 mil.USD)



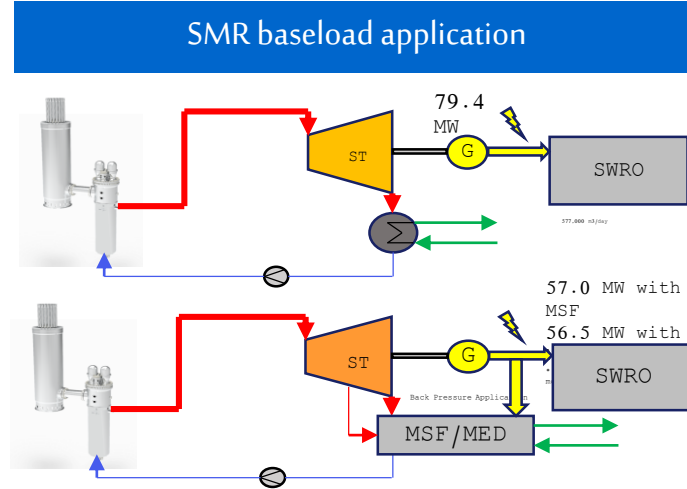
- With 50 MW PV (CF=0.2) and 50 MW Wind (CF=0.4-0.6), renewable penetration rate can be increased to 59 - 77% (Later stage after accumulating operation data of area specific Wind turbine from demo. Plant)
- Surplus electricity can be used in hydrogen production and sell it to industry to subsidize water production cost

SWCC – WTIRA technologies developments for CO2

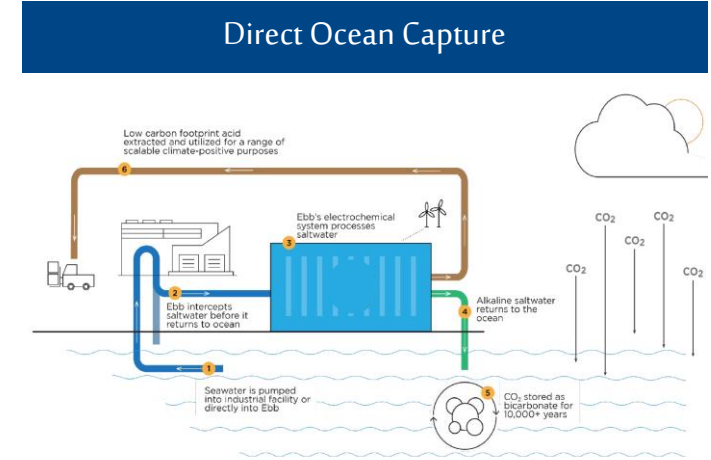
Technologies insights



- 200 t/day of liquid CO₂ is required to recarbonate desalinated water in post-treatment system
- utilizing captured CO₂ in the post-treatment system, daily 87,000 liters of diesel can be saved
- Annual savings more than 23 mil.SAR



- Can eliminate electrical interface
- Contain electrical facility inside the boundary
- Power to Application
- Carbon Neutral



- Making seawater basic by adding base chemical or removing dissolved CO₂

CONCLUSION - Implication

- SWCC drives energy reduction initiatives in desalination industry by shifting technical domains, and contribute to CO2 reduction in the industry
- Green energy transition in Desalination industry might be very challenging, but there are potential to maximize renewable penetration from holistic approach
- Carbon Capture technology is still capital intensive, but adding utilization part in post-treatment in desalination process, it can add value to the industry
- Desalination plant can be a platform to apply various enhanced ocean alkalinity technologies, and CDR credit can monetize water production cost
- From decarbonizing desalination industry point of view, Small Modular Nuclear Reactor could be a potential energy source for desalination plant

Removal/Reduction	Type of Technology	Technology in Brief	Technology Trend	Carbon Credit	Players
Point Source Carbon Capture (Carbon Reduction)	Pre-Combustion Carbon Capture	Related to Chemical Process CO2 concentration is high Blue Hydrogen related (Fossil fuel cracking + Carbon Capture) NG + SOFC + Carbon Capture	Simple CO2 compression and liquefaction, or simple CO2 purification (moisture removal, O2 removal, etc.)	Industry related, RE100, Carbon taxonomy can apply, Compliance Market	Linde, Carbonco, Mitsubishi, Shell
	Post-Combustion Carbon Capture	Carbon capture from Fossil fuel burning process Power plant, Coal coking, Cement industry	Selective CO2 dissolution using special solvent Developing solvent with less energy consumption for regeneration		Linde, Carbonco, Mitsubishi, Shell
Direct Capture (Carbon Removal)	Direct Air Capture	Solid solvent	Developing more effective solid solvent	CDR from volunteer companies, or governments, Voluntary Market	Many start-up companies, Carbon Capture, etc.
		Liquid solvent	Using base chemical (NaOH), Desalination plant can be used as a platform		Capture6
	Direct Ocean Capture	Making seawater basic by adding base chemical or removing dissolved CO2	Getting environmental permit to discharge basic seawater to the ocean – Desalination plant can be used as a platform		Ebb Carbon, Banyu Carbon

