ARWADEX-11
CAIRO
EGYPT – APRIL 2017

CONSULTING ENGINEERING CO.

DESALINATION TODAY AND FUTURE IN A CHANGING WORLD

KEYNOTE SPEECH

Presented by

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EGYPT SHARE IN DESALINATION

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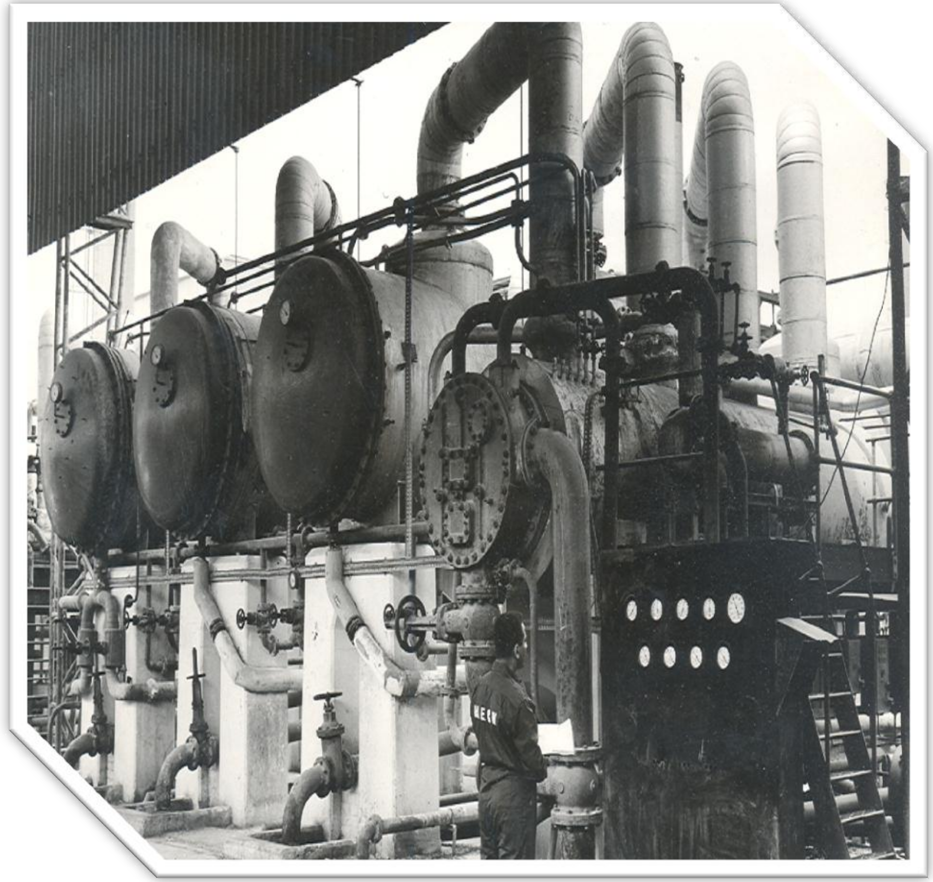
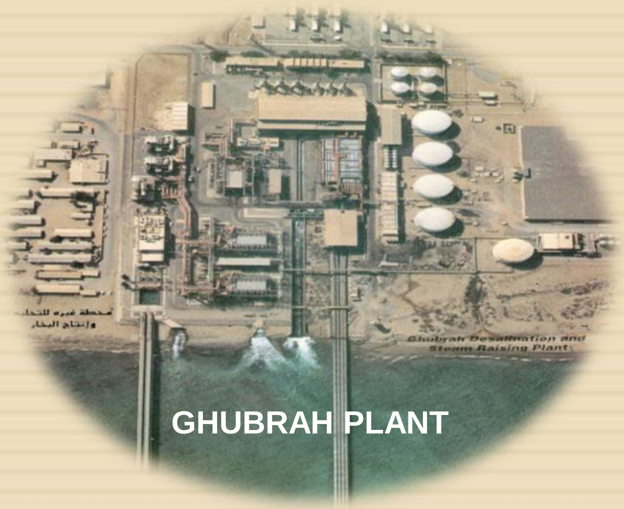
- **WORLD'S FIRST** SUCCESSFUL LAND BASED MSF DEVELOPMENT, **EGYPTIAN SUPERVISED** 1957 – SHUWAIKH – KUWAIT UNDER DEVELOPMENT CONTRACT WITH M/S WESTINGHOUSE (REPLACES OLD UNSUCCESSFUL SUBMERGED TUBE DESIGN). THIS TECHNIQUE PROVED TO BE THE MOST **RELIABLE** TO DATE.
- DESIGN DEVELOPMENT – MSF (***KUWAIT, ABU DHABI, KSA, BAHRAIN, OMAN, LIBYA***): *250,000 IGPD TILL 7 MIGD UNIT SIZES*

SHUWAIKH (A) DISTILLATION PLANT



EVAPORATOR SHUWAIKH (A) DISTILLATION PLANT

DESALINATION SECTOR



WORKS

MSF

TVC

RO

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TYPICAL THERMAL PLANTS CONFIGURATION

Dual purpose plants

- Extraction Condensing (EC) Steam Turbines (ST) coupled to MSF or TVC
- Back Pressure (BP) Steam Turbine (ST) coupled to MSF or TVC
- Gas Turbine (GT), EHR Boiler (HRSG) and MSF or TVC.
- Combined Cycle Power Coupled to MSF or TVC

AL TAWEELAH (A) GAS TURBINE POWER & DESALINATION PLANT

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3 GAS TURBINE 117 MW ISO RATING

DESALINATION UNITS 3X6/7.2 MIGD

SEAWATER INTAKE & OUTFALL

COMPLETED 1989

UNIT 4 7.2/8 MIGD, 160 T/HR AUXILIARY BOILER

COMPLETED 1996

LOCATION ABU DHABI

GHUBRAH POWER & DESALINATION PLANT - OMAN

PHASES:
I 1X5/6 MIGD,
II 5/6 MIGD,
III 1X5/6 MIGD,
V 1X5/6 MIGD,
VI 1X6/7 MIGD
COMPLETED 2000

UMM AL-NAR POWER & DESALINATION PLANT – ABU DHABI

UMM AL-NAR EAST 3X5/6 MIGD
EAST EXT. 3X6/7.2 MIGD
UMM AL-NAR WEST 6X4 MIGD
WEST EXT. 7&8 4X5/6 MIGD

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Thermal desalination *optimization*.

- *Scaling.*
- *Top brine temperature*
- *Antiscalants*
- *Materials.*
- *Gain ratio.*

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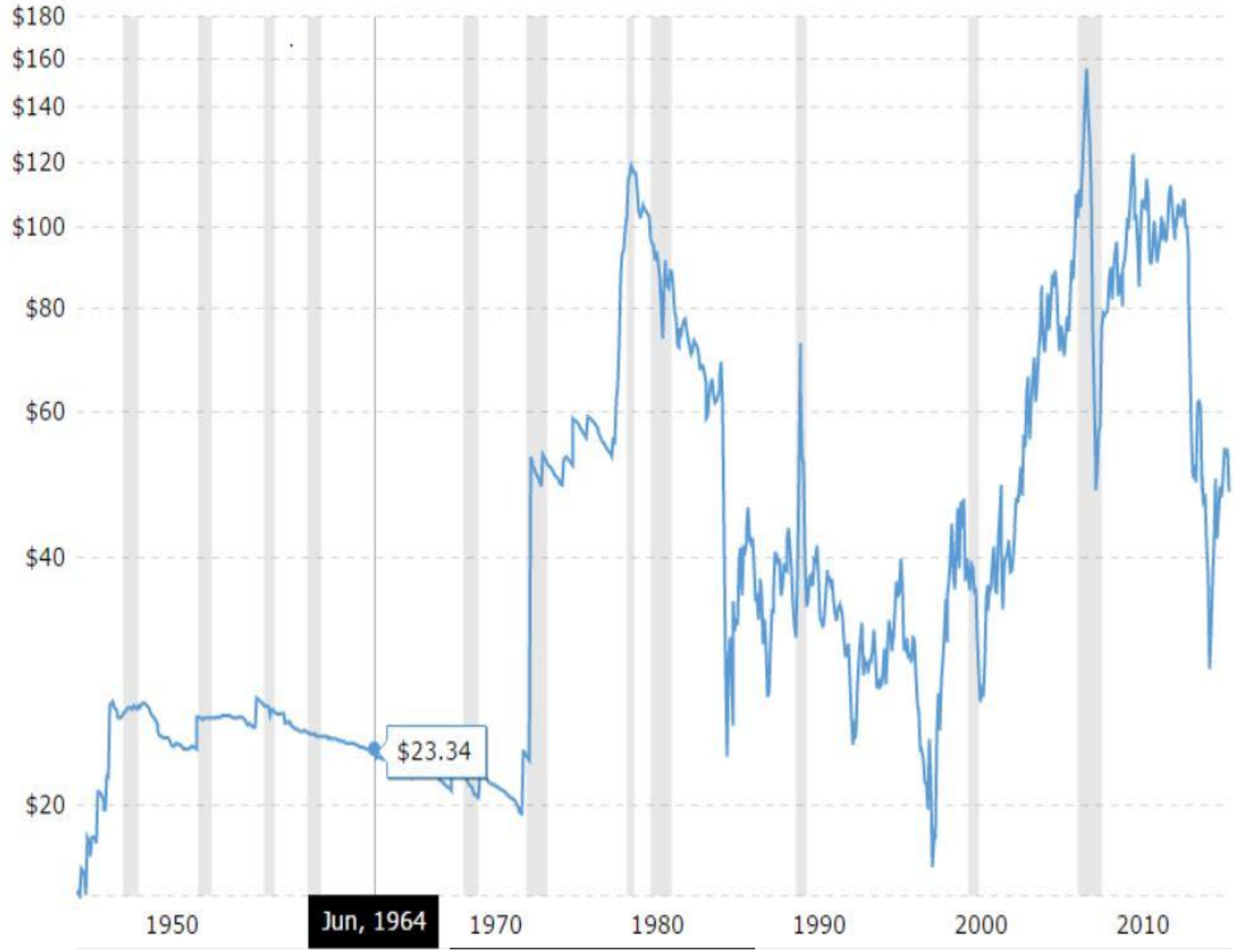
Oil Price Variation in past 60 Years (US$/Barrell)



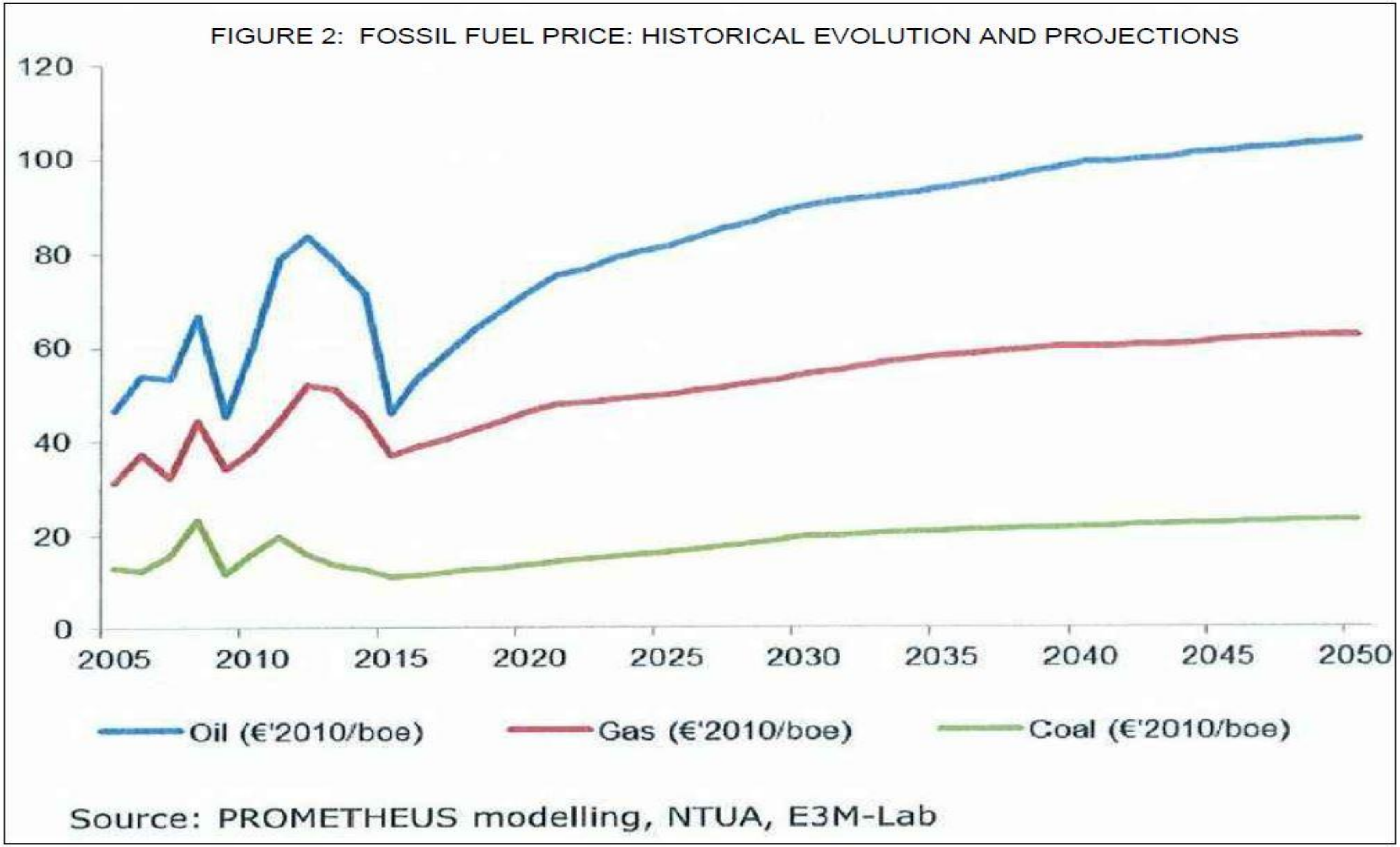


FIGURE 2: FOSSIL FUEL PRICE: HISTORICAL EVOLUTION AND PROJECTIONS
120
100
80
60
40
20
0
2005
2010
2015
2020
2025
2030
2035
2040
2045
2050
Oil (€'2010/boe)
Gas (€'2010/boe)
Coal (€'2010/boe)
Source: PROMETHEUS modelling, NTUA, E3M-Lab

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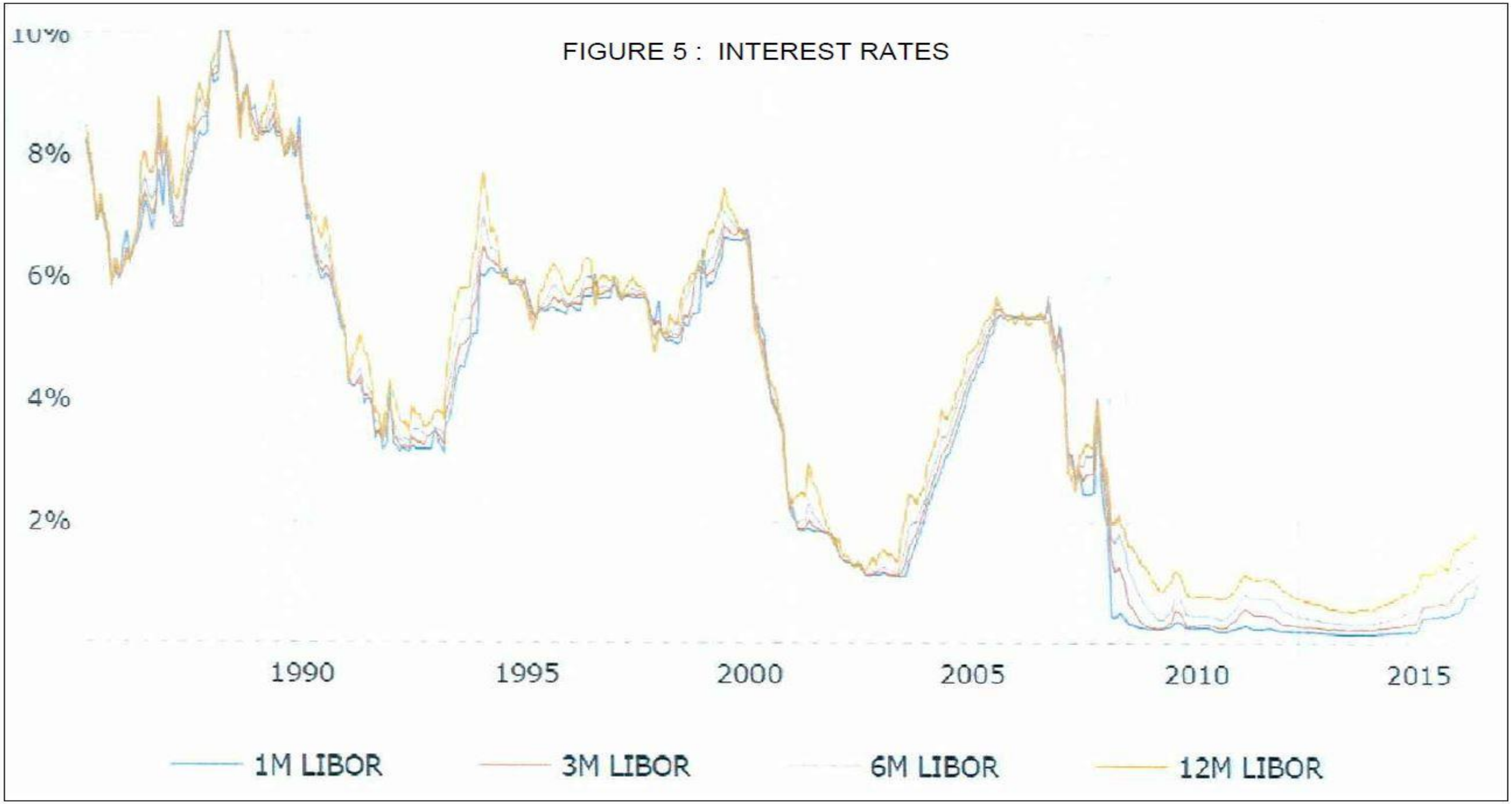

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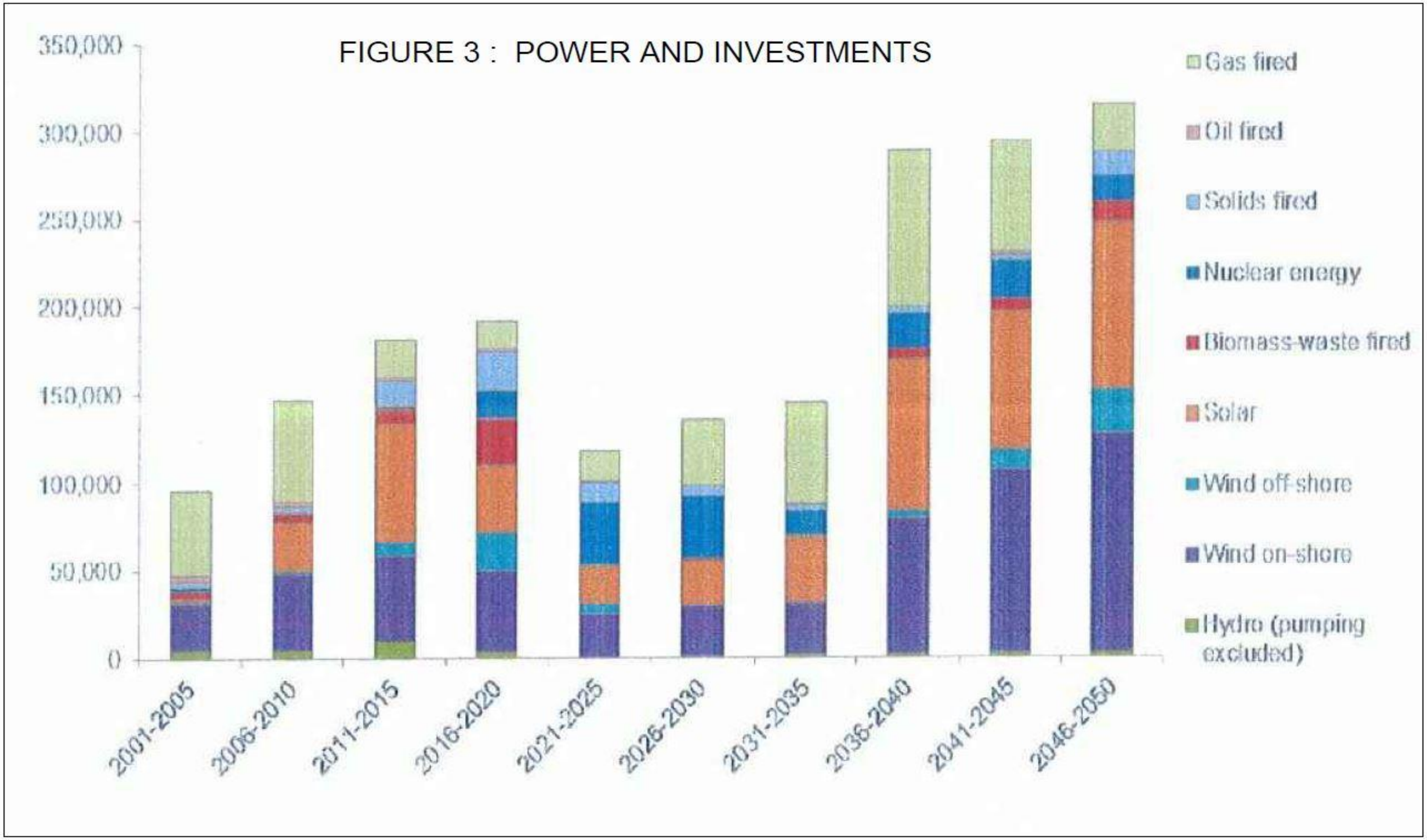

Figure-6 Typical Comparison Between Thermal Desalination And Reverse Osmosis (RO) For Capacity 20,000m^3/Day

S.N.	ITEM	THERMAL DESALINATION PLANTS		RO PLANTS
		MSF	TVC	
1	Raw Water m^3/ m^3 Product Factor	12	6	3
2	Raw Water Pretreatment	Normal	Normal	Extensive pretreatment
3	Capital Cost Millions US$	30	26	24
4	Required Steam	Requires steam from waste heat (e.g. in combination with gas turbines, steam turbines, APG, NPP, CSP OR CC) for better Economy	Requires steam from waste heat (e.g. in combination with gas turbines, steam turbines, APG, NPP, CSP OR CC) for better Economy	Not Required
5	Power KWH/m^3 Product	4	1.5	3
6	Spare Parts	More Wear & Tear Parts	Wear & Tear Parts	- Less Wear & Tear Parts - Membrane Replacement (high cost)
7	O&M	Normal	Normal	Chemist is required continuously
8	Reliability	Excellent	Good	Operation errors present high risk

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MIRFA POWER & DESALINATION PLANT – ABU DHABI

4X61 ISO MW GAS TURBINES
3X5.4 MIGD
COMPLETED 1997

ABU TARABA DESALINATION PLANT - LIBYA

CAPACITY 3X2.9 MIGD (40,000 M3/D)
COMPLETED 2007

1st PASS RO – DELMA ISLAND AT ABU DHABI - 3.3 USMGD
Pass 2 completed 2012

SUR IWP RO PLANT 150,000 M3/DAY – OMAN
DEVELOPER: VEOLIA & BEC

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Middle East & North Africa (MENA) (*FROM Fichtner*)

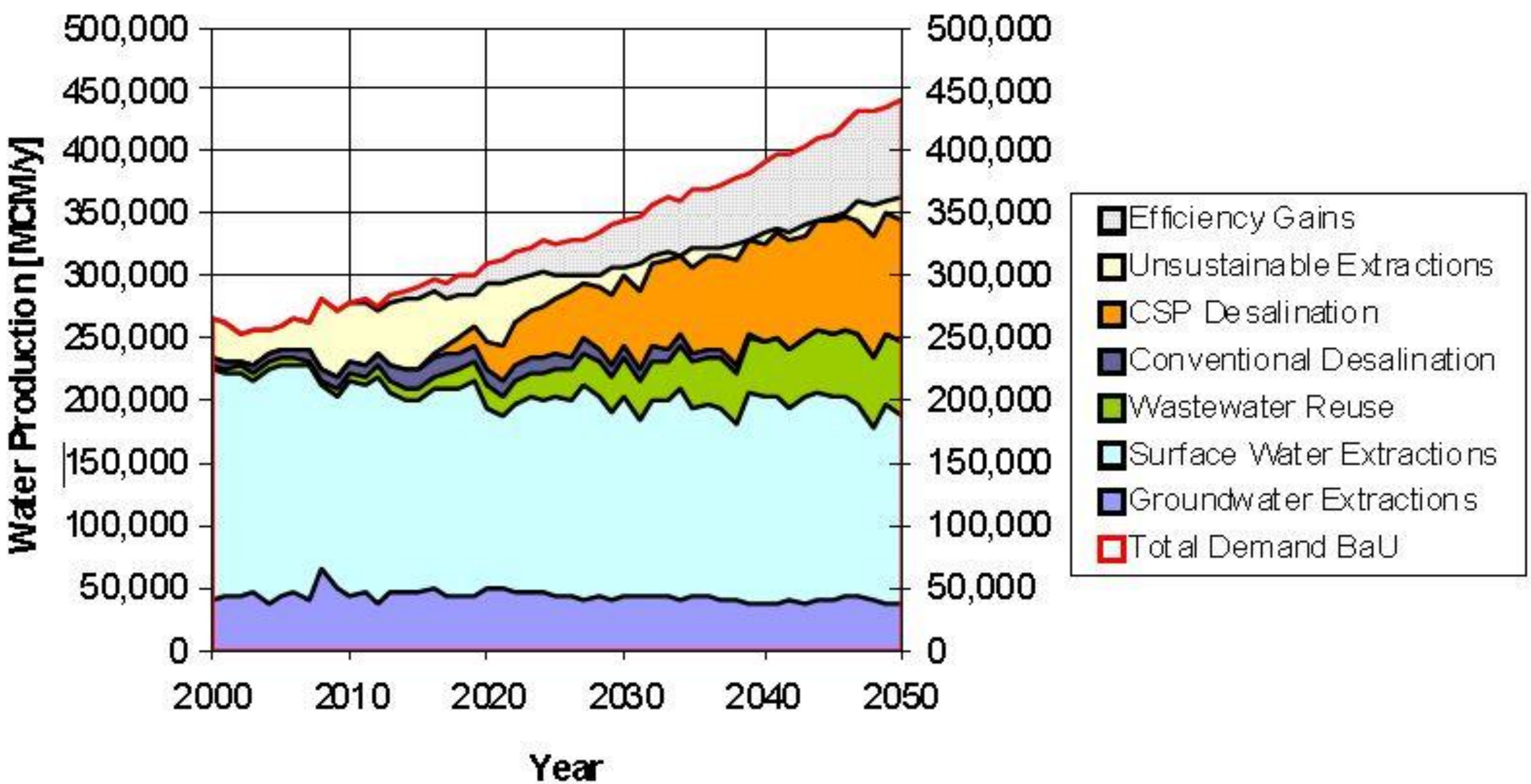

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Figure 8 - Table of capital costs per KW, types of fuel Current Outlook

Type	Capital $/kW	Life (Y)	Efficiency	Fuel Type	Fuel Cost US$/M-BTU
Steam	1000	30	40	NG	3
GT	800	25	33-35	NG	3
CC	900	25	50-55	NG	3
Coal	2500	30	36	Coal	3-4
CSP	4000	25	N/A	IR	-

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CRITERIA FOR FUTURE SCENARIOS

- Fuel type & cost variation
- Capital cost decrease & economies of scale
- Intake & Outfall
- Dual and/or CC mode
- PV or CSP renewables as source of future power
- Intake water salinity
- Energy storage (CSP)
- Lifetime of main equipment

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LOCALISATION

- Thermal Plants   Similar to shipbuilding, available facilities in shipbuilding
- RO Plants

  Most BOP can be locally manufactured except:

  Membrane (on going trials to establish future facilities)

  HP pump (can be manufactured under license)

  Energy recovery device

- Training   A dire need. Should be institutionalized & promoted

SEAWATER INTAKES

- Open Channel Rubble Mound structure
- Pipelines Trestle Structure on Piles with offshore intake pumping chamber
- Pipe on Seabed with onshore pumping stations
- Beach Wells

INTAKE RECIRCULATION STUDIES

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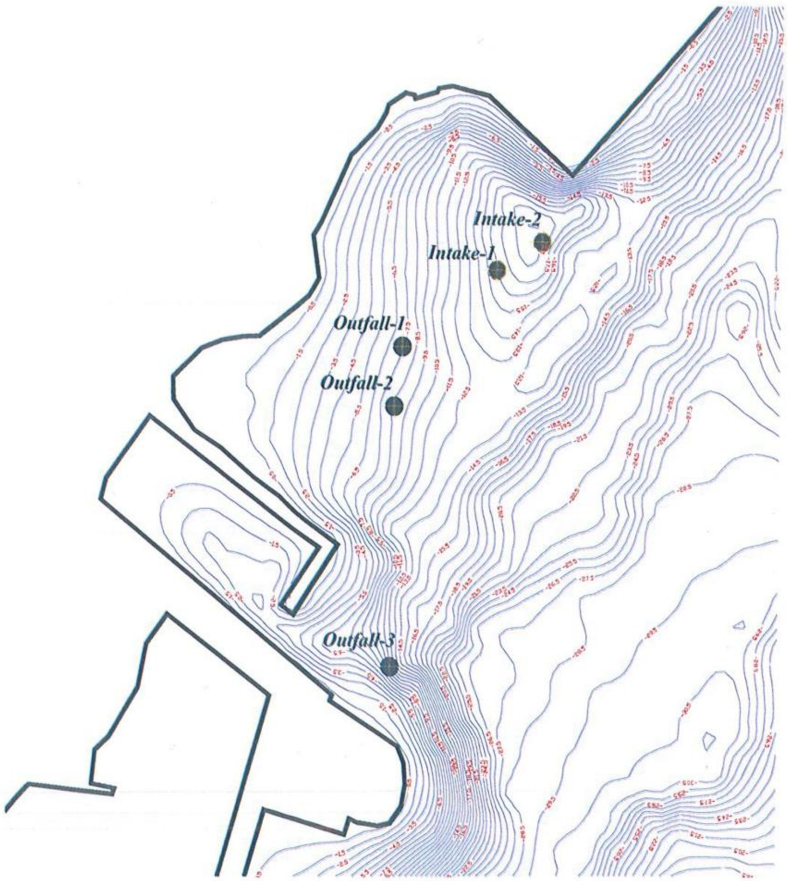


Figure 1: The location of the intakes and outfalls pipelines in Alternative-1

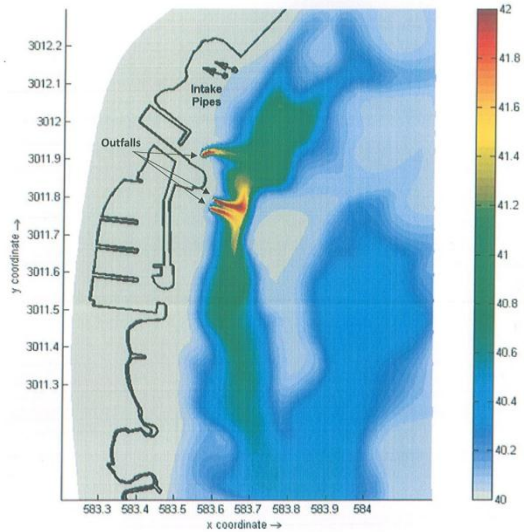


Figure 2: Salinity distribution (mg/l) at layer 5 (Near to bottom) with low water level (ebb tide)

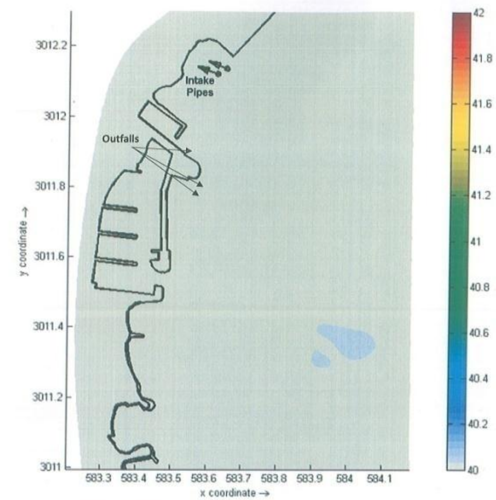


Figure 3: Salinity distribution (mg/l) at layer 2 (under surface layer) with low water level (ebb tide)

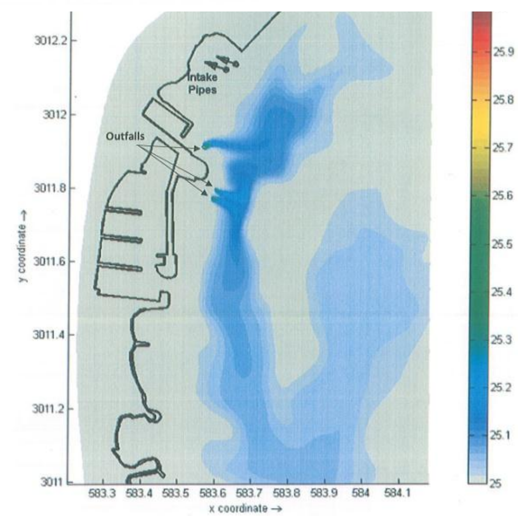


Figure 4: Temperature distribution at layer 5 (Near to bottom) with low water level (ebb tide)

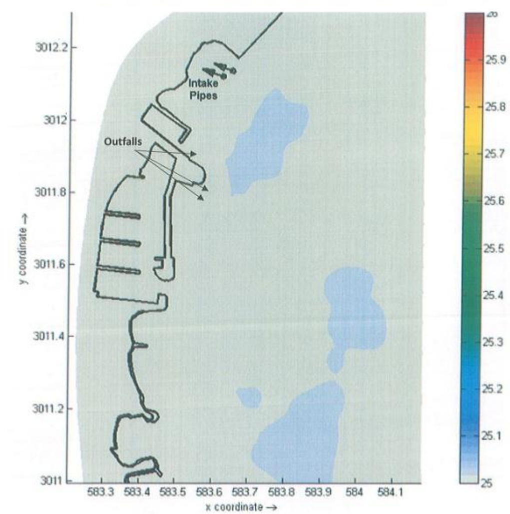
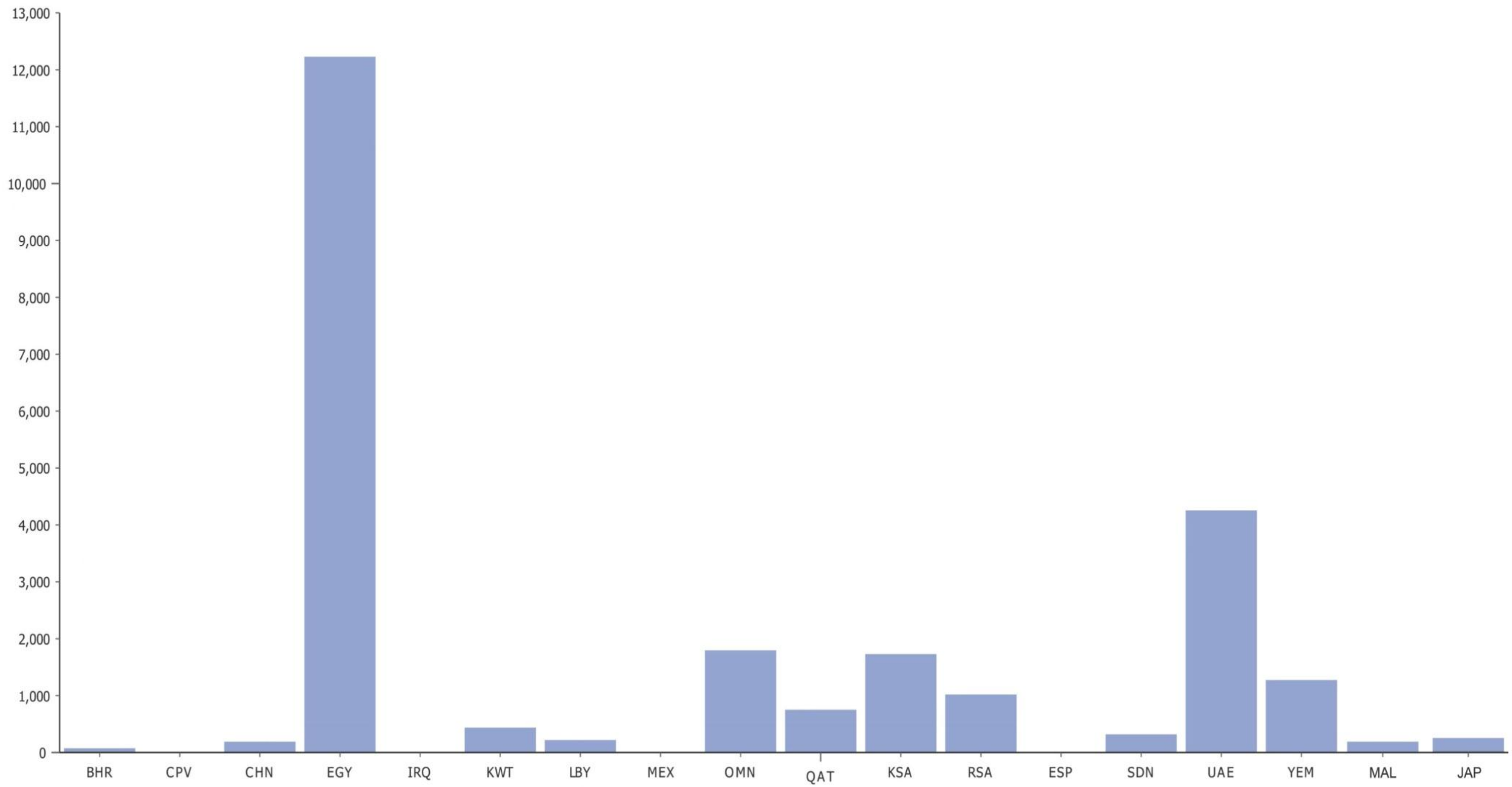


Figure 5: Temperature distribution at layer 3 (at middle depth) with low water level (ebb tide)

VALUE ($M) OF PROJECTS AROUND THE WORLD



Total value of projects 24,467,000,000 $
Accumulated 5,500,000 m3/day

THANK YOU!

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END OF SESSION