



Is Produced Water a “Waste” or an “Resource”

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The Water Challenge

- Half the world's population is living without access to clean water (UN report).
- Next 20 years, the total electricity consumption of water will increase by 33%
- The petroleum industry is impacted by availability, cost, and quality of fresh water at many points along their 'value chain' particularly in refining & chemicals

There are alternative sources for energy

but

There are no alternatives to fresh water

The World Business Council for Sustainable Development (WBCSD), 2005

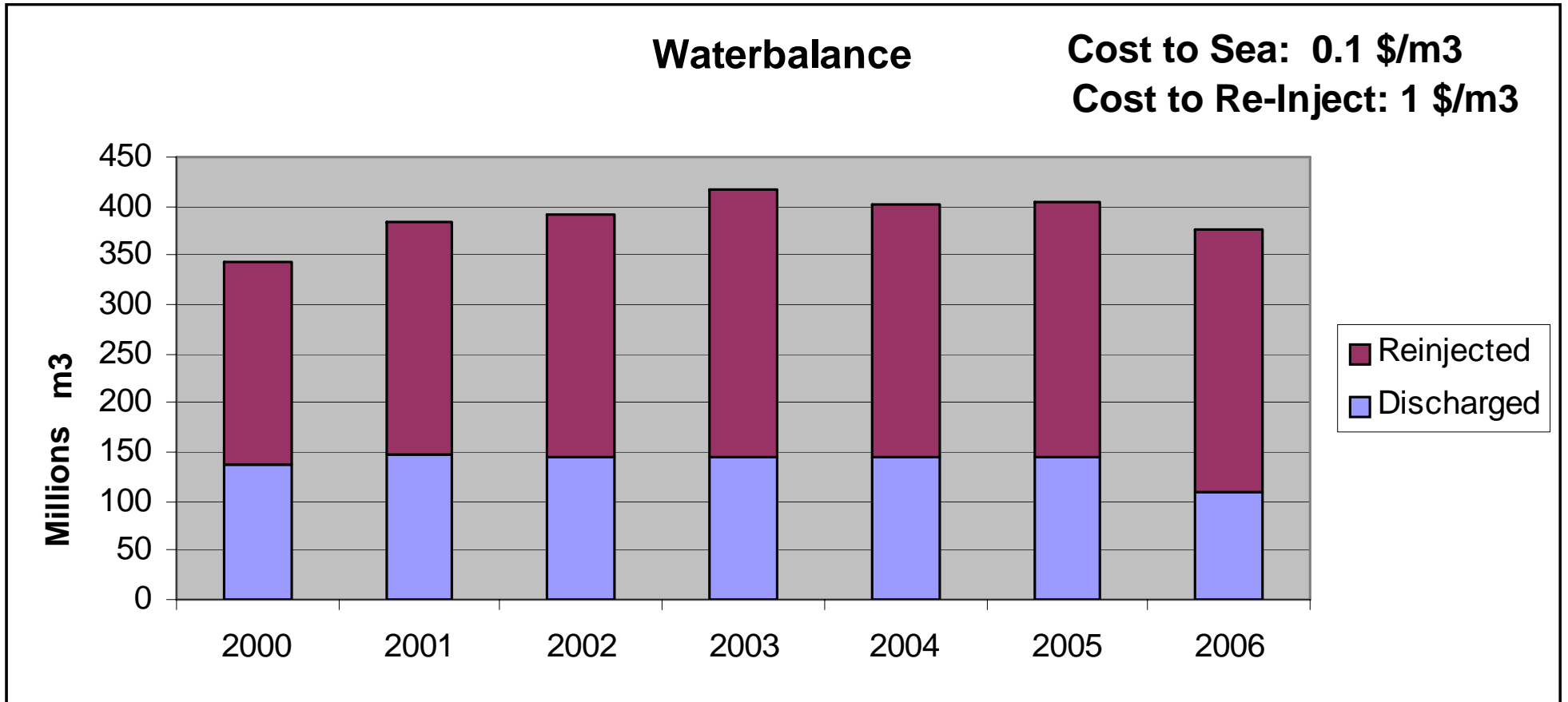
**Can Produced Water
become an alternative option
for reducing fresh water use?**

Average Produced Water Volumes increased by 20% in two years

Average Water production increased from 33.39 (70 million BOPD) to 39.64 MMm3/d (84 million BOPD)

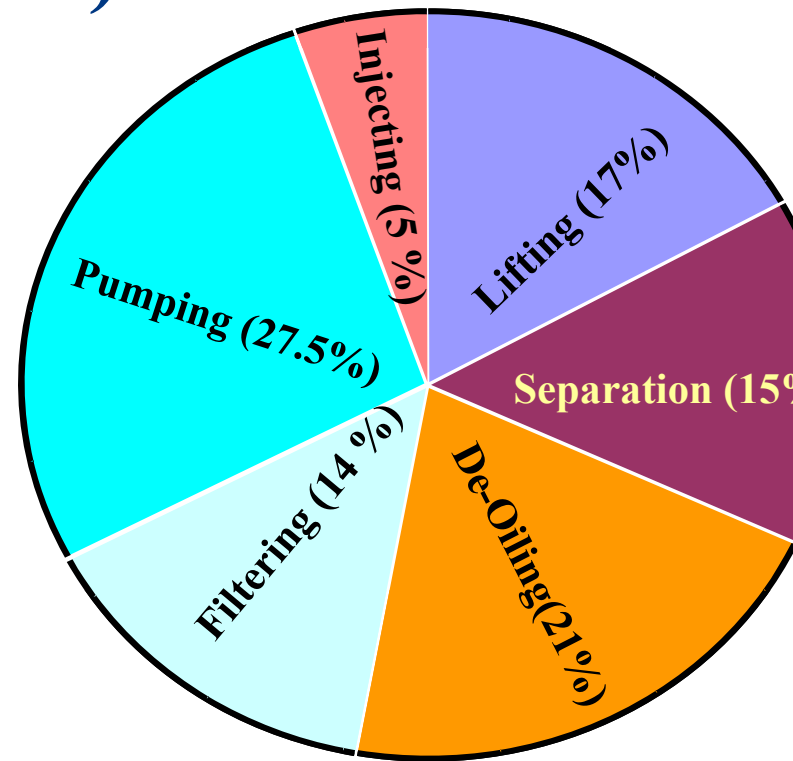
Countries	Year	Oil , Millions m3 OPD	Average WOR	Average Water production, MMm3/d	Fate of Produced Water
Canada	2003	0.17	14.0	2.36	Half injected for RP and WF and rest in disposal wells
United States	2005	0.82	9.8	7.97	Mostly injected either for RP/WF or disposal
Norwegian Sector	2004	0.40	0.9	0.36	25% injected and rest marine discharged (avg. 16 mg/l)

Shell's Produced Water world wide



Produced Water Handling is Costly (about \$50 bln worldwide)

In US: For each 1% reduction in water production, the cost-savings to the oil industry could be between \$50,000,000 and 100,000,000 per year (DOE 2005 report)



Is there an opportunity for minimising cost and maximising value?

Shell's Integrated Water Management Strategy

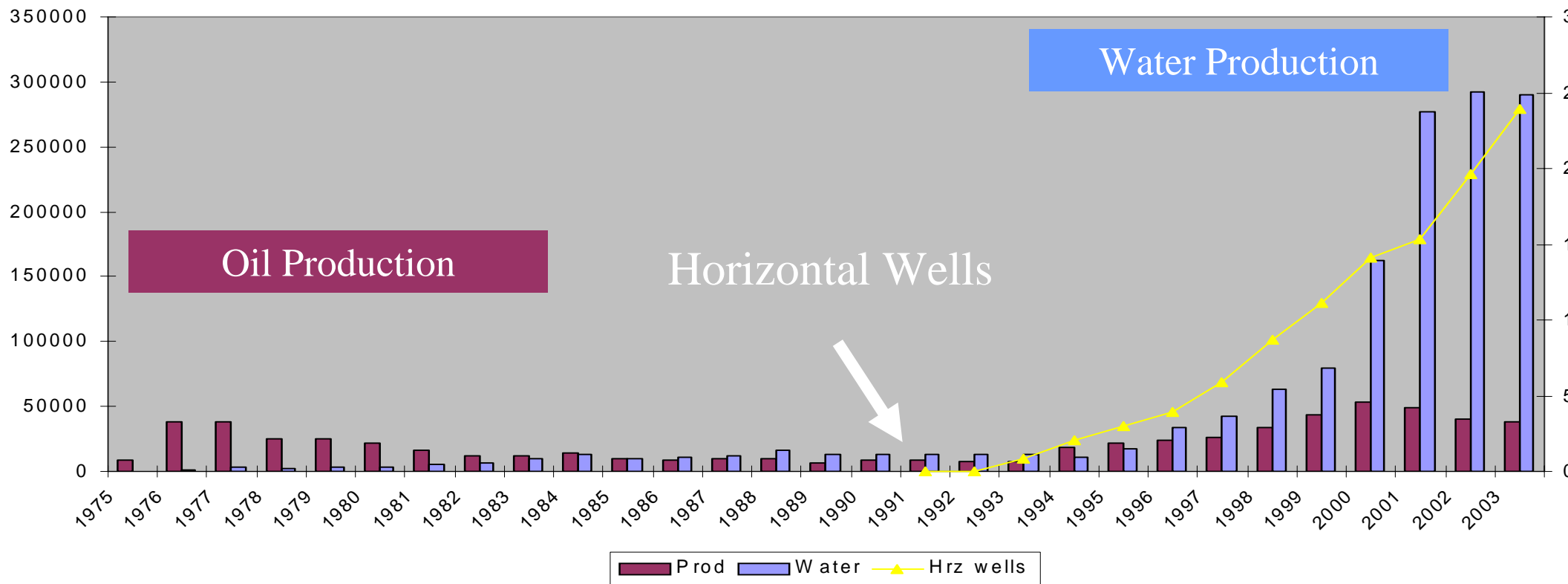
- ***Minimising the volumes*** to Surface
- ***Maximising re-use*** of water by injecting it to oil producing formation
- ***Safeguarding open waters & potable water aquifers***
- ***Beneficially using all resources*** including produced water to reduce energy, and fresh water demands
- ***Reducing capital investment, footprint & cost***

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Increased Water Production during Infill-Drilling of Tight Carbonate

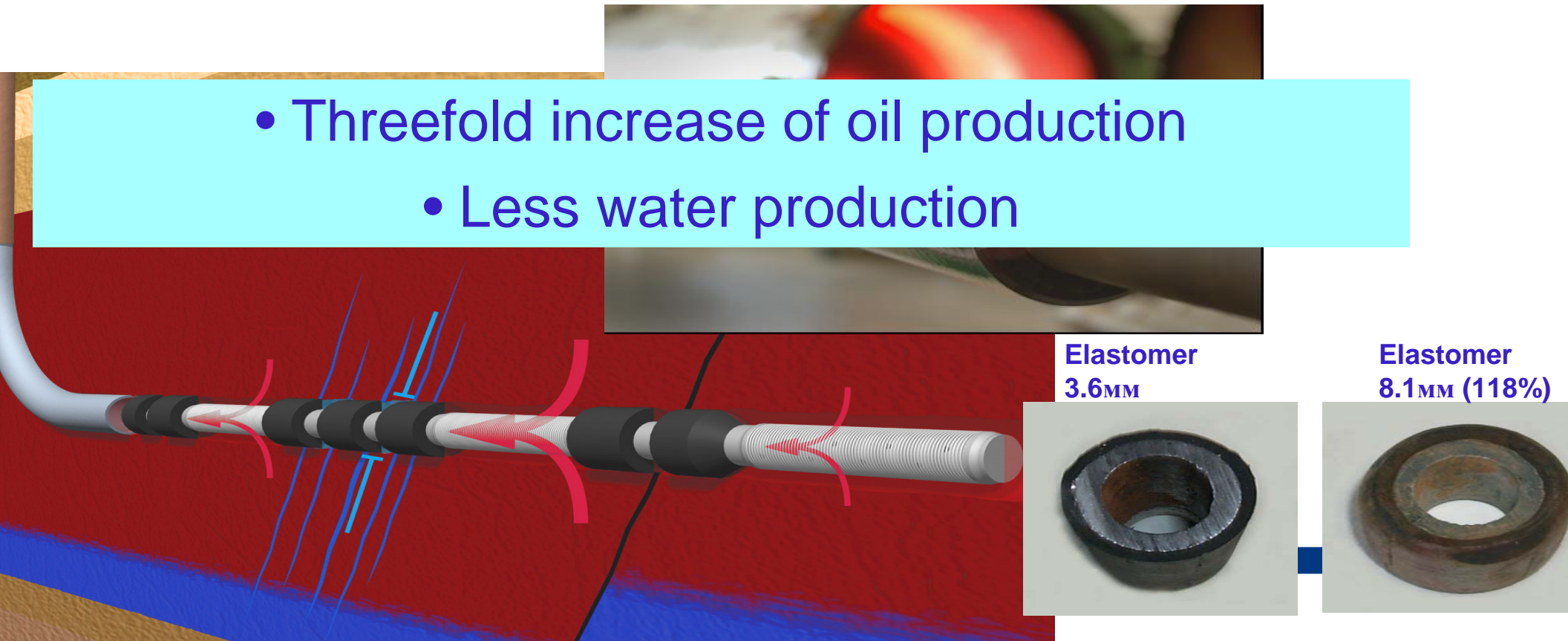
SR Drilling & Production



New Technology: Swelling Elastomer Completion

Novel Zonal Isolation completions in the horizontal section of a well for efficient and effective water shutoff

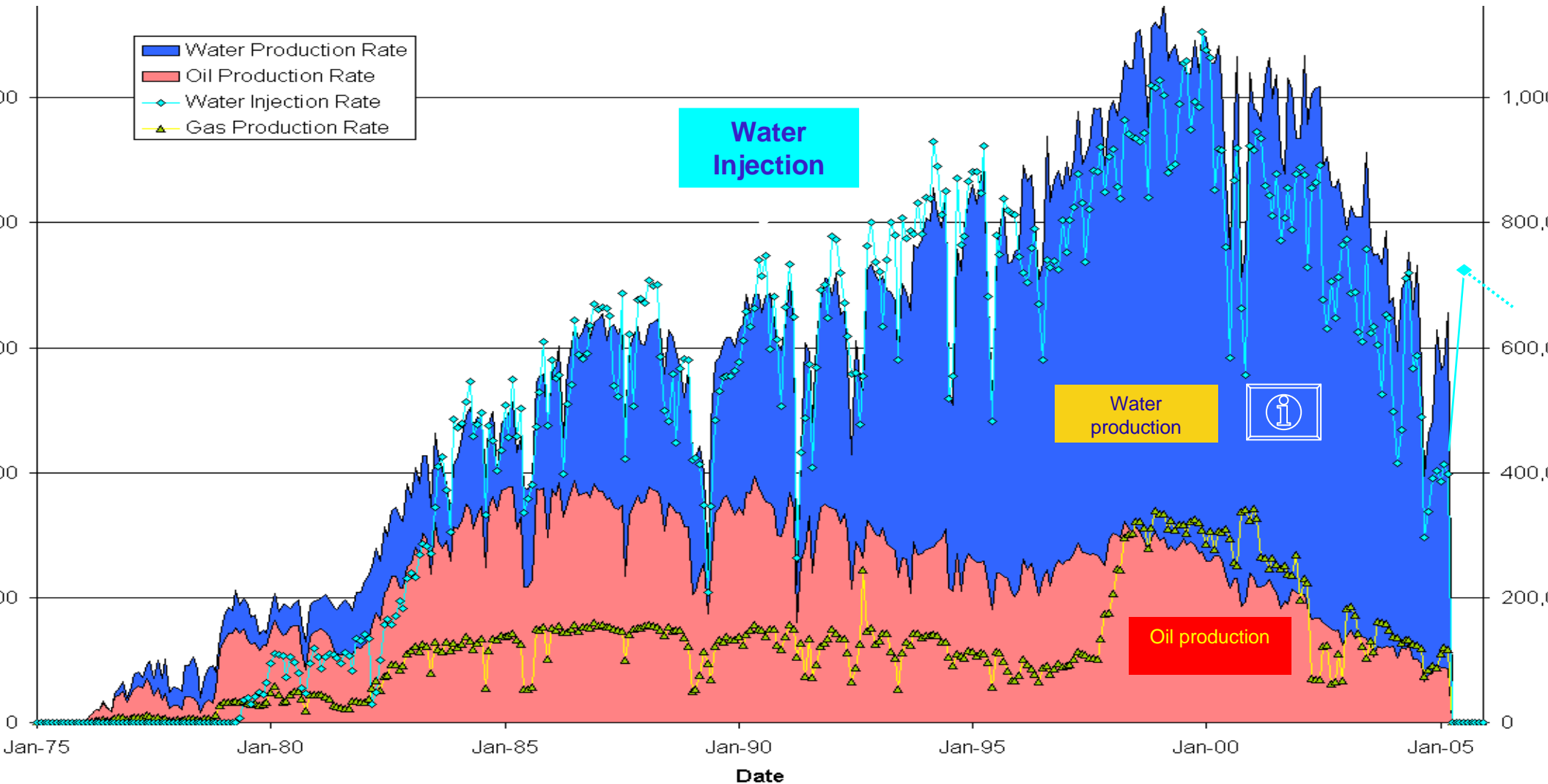
- Threefold increase of oil production
- Less water production



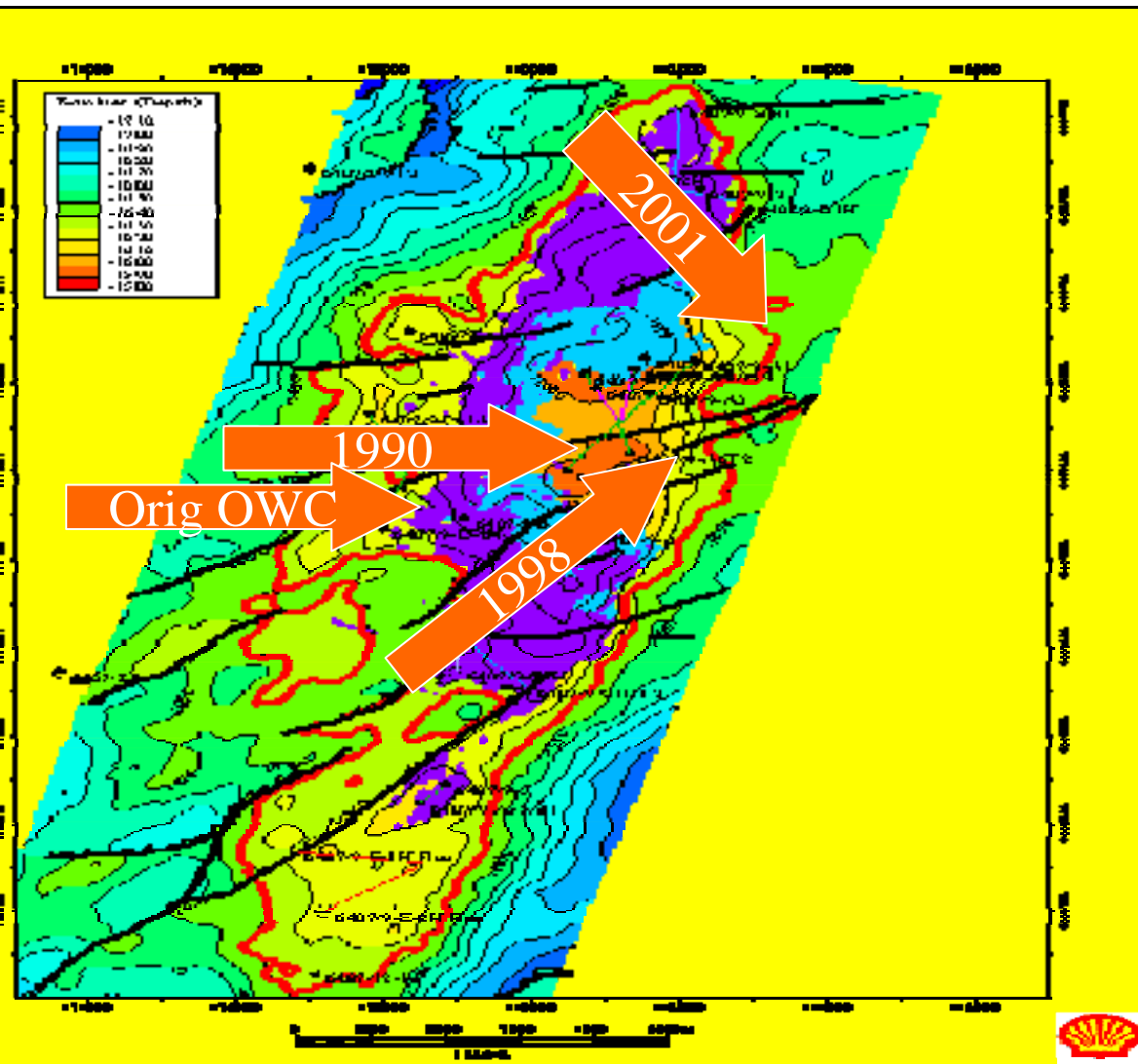
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North Sea– Without Water Injection there is no Oil Production in Mature Asset fields



Technology: Coupled 4 D Seismic/Reservoir Modeling for WaterFront Management



Offshore
Northsea
Waterflood



Better Well Strategy

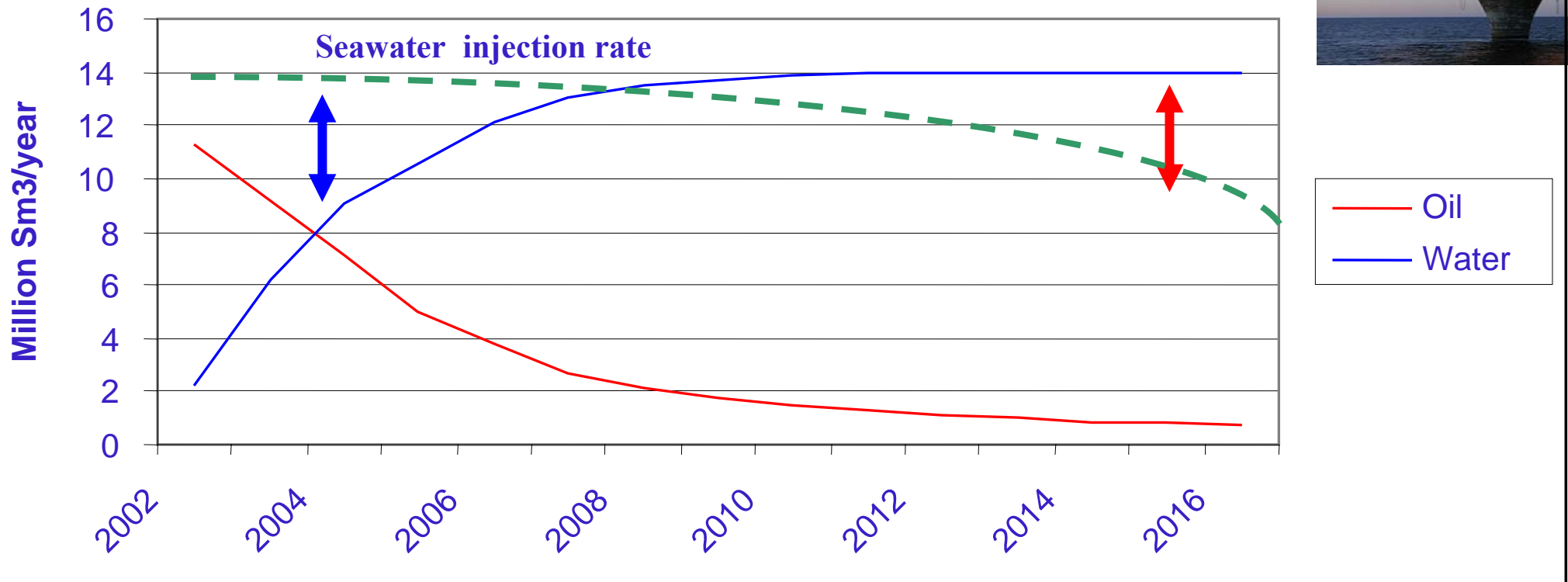
- ✓ Increase intensity of injection to south wells
- ✓ High watercut producer converted to injector
- ✓ Use Produced water injection instead of Seawater in the North

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Using Produced Water for Injection and Phasing out of Seawater Injection

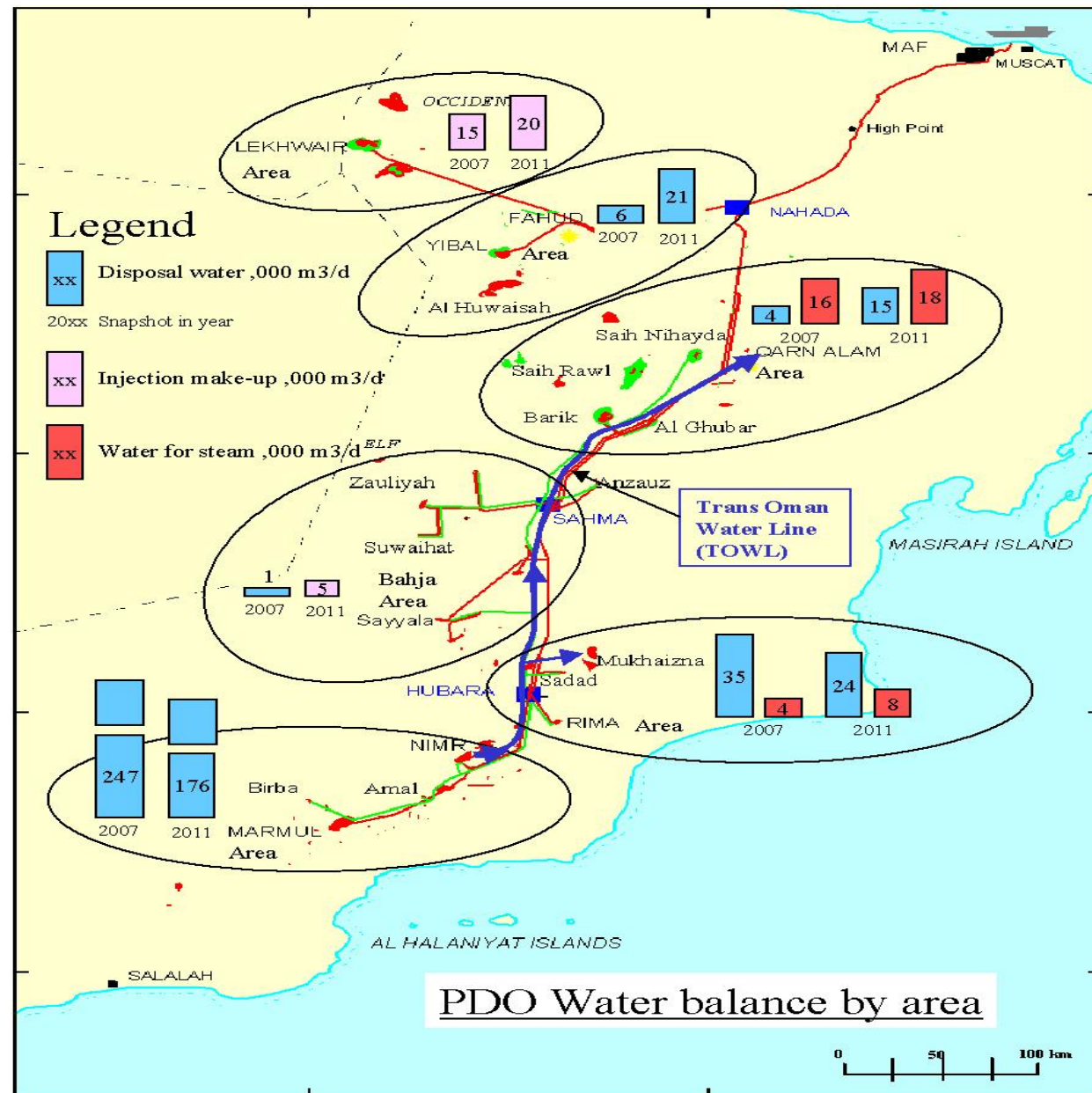
In Draugen approx. 40.000 Sm³/d of associated Produced Water can be re-injected



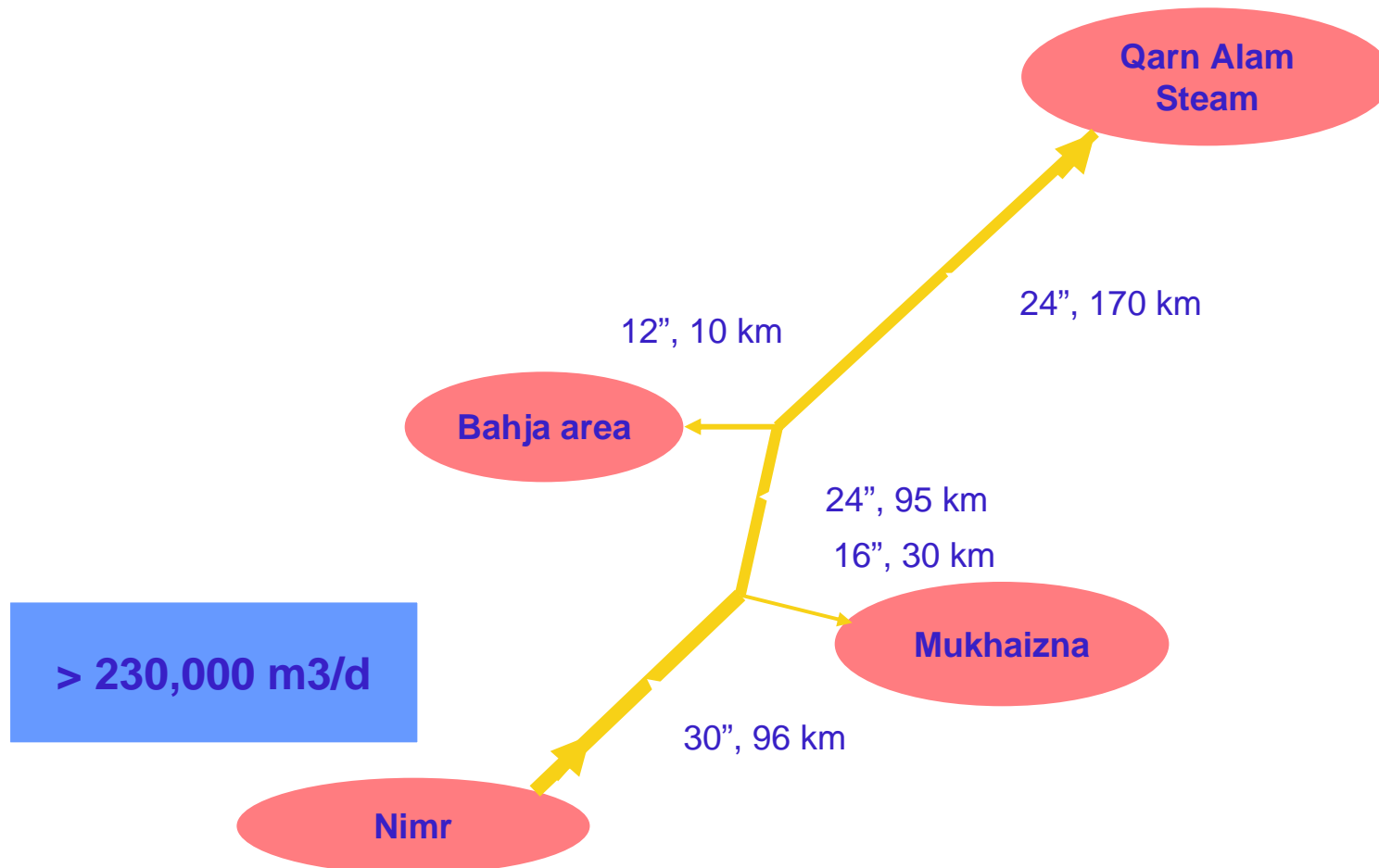
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Collistic View of Water Supply and Demand in Oman



Trans Oman Water Line (TOWL)



Greening the Desert, GtD

Reed beds at Nimr Site, Oman





Acasia Trees in Oman



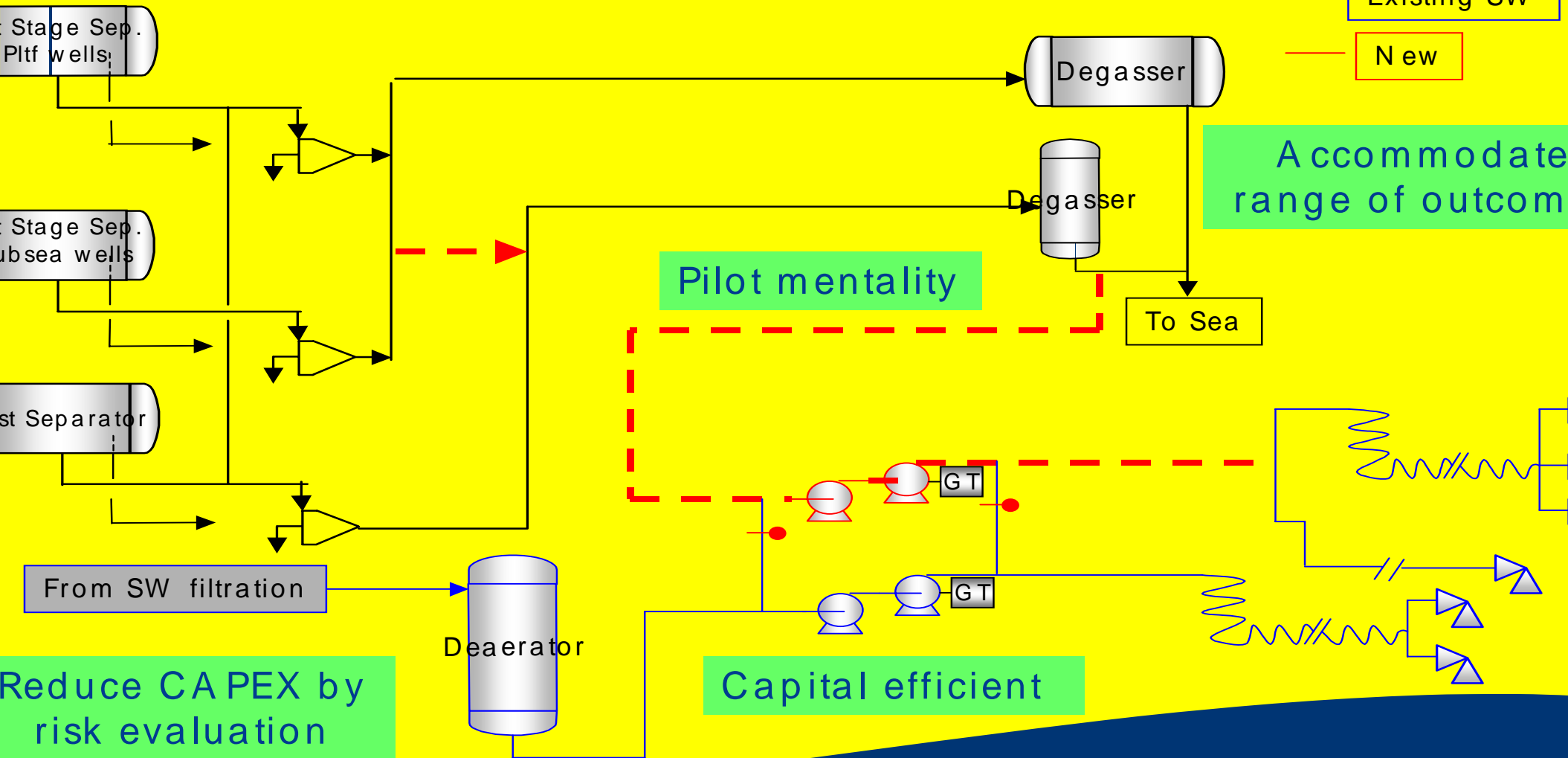


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Produced Water Injection & Seawater Phaseout

Maximum reuse of existing facilities



Key Statements for Challenge

- **Produced water cannot be considered a by-product but a valuable resource** for O&G companies particularly in an increasingly constrained fresh water world
- **Integrating water management within well and reservoir management is a value preservation** and a responsible practice for minimising waste
- **Developing cost-effective and environmentally sound produced water management solutions based on water balance** is part of the strategic thinking that the industry has to adopt for sustaining oil and gas field development
- **Adding the water management plans into the energy master plan would accelerate the acceptance** of using produced water as a valuable resource and lead to respecting and safeguarding surface waters and aquifers while benefiting communities through beneficial use

Thank you

