Next Generation SAGD Produced Water Treatment Technology Development

Alberta Innovates Energy and Environment Solutions

SUNCOR ENERGY

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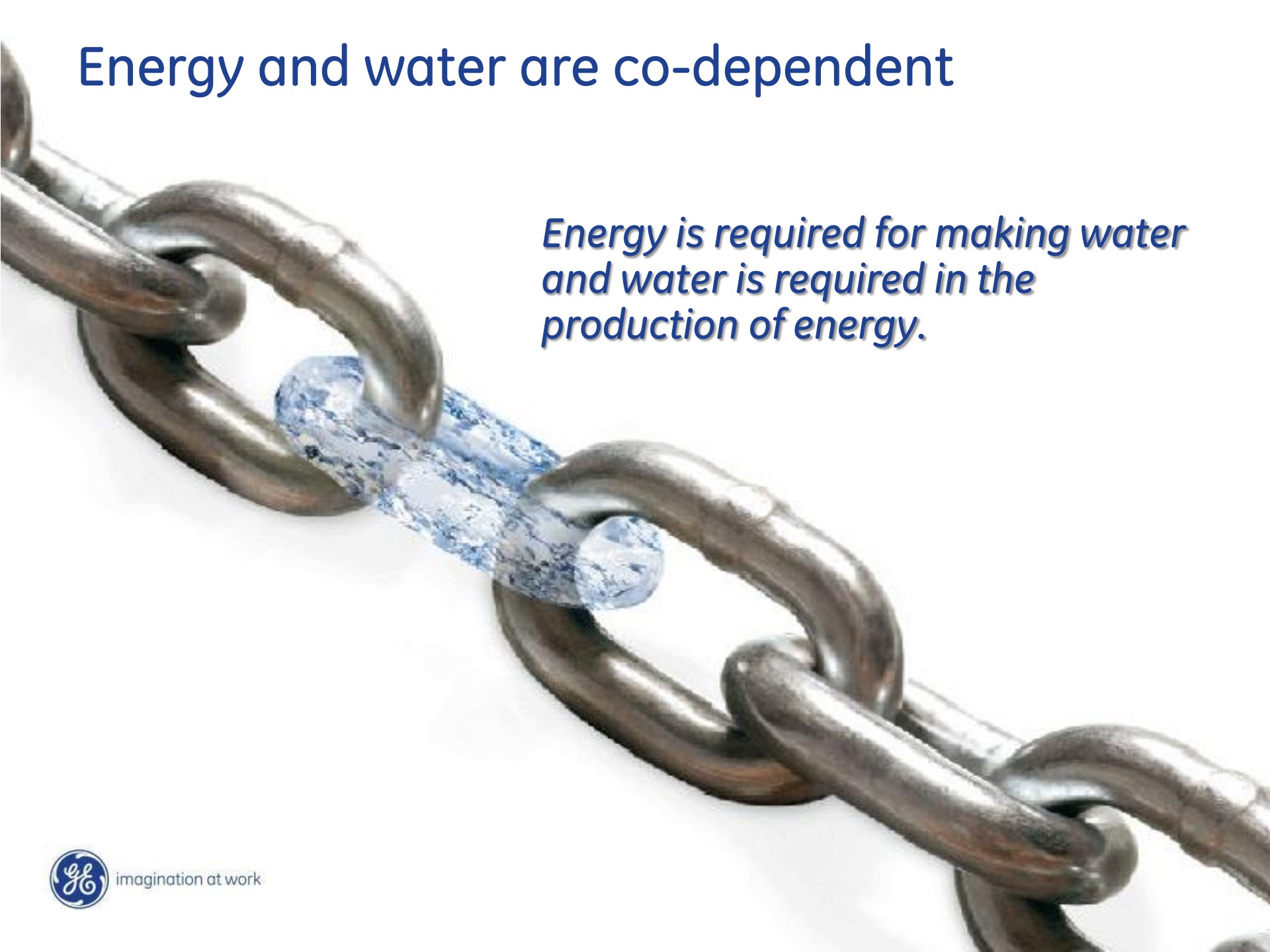
GE Power & Water
Water & Process Technologies

Energy and water are co-dependent



Energy is required for making water and water is required in the production of energy.

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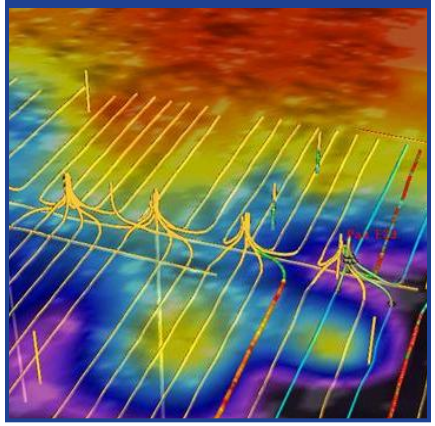
Water & energy needs are interlinked

Power production	Oil Sands	Unconventional Gas	Mining
			
90% for once through cooling	90% water recycle	30%+ process water reuse	>70% in water scarce regions

Energy production is thirsty

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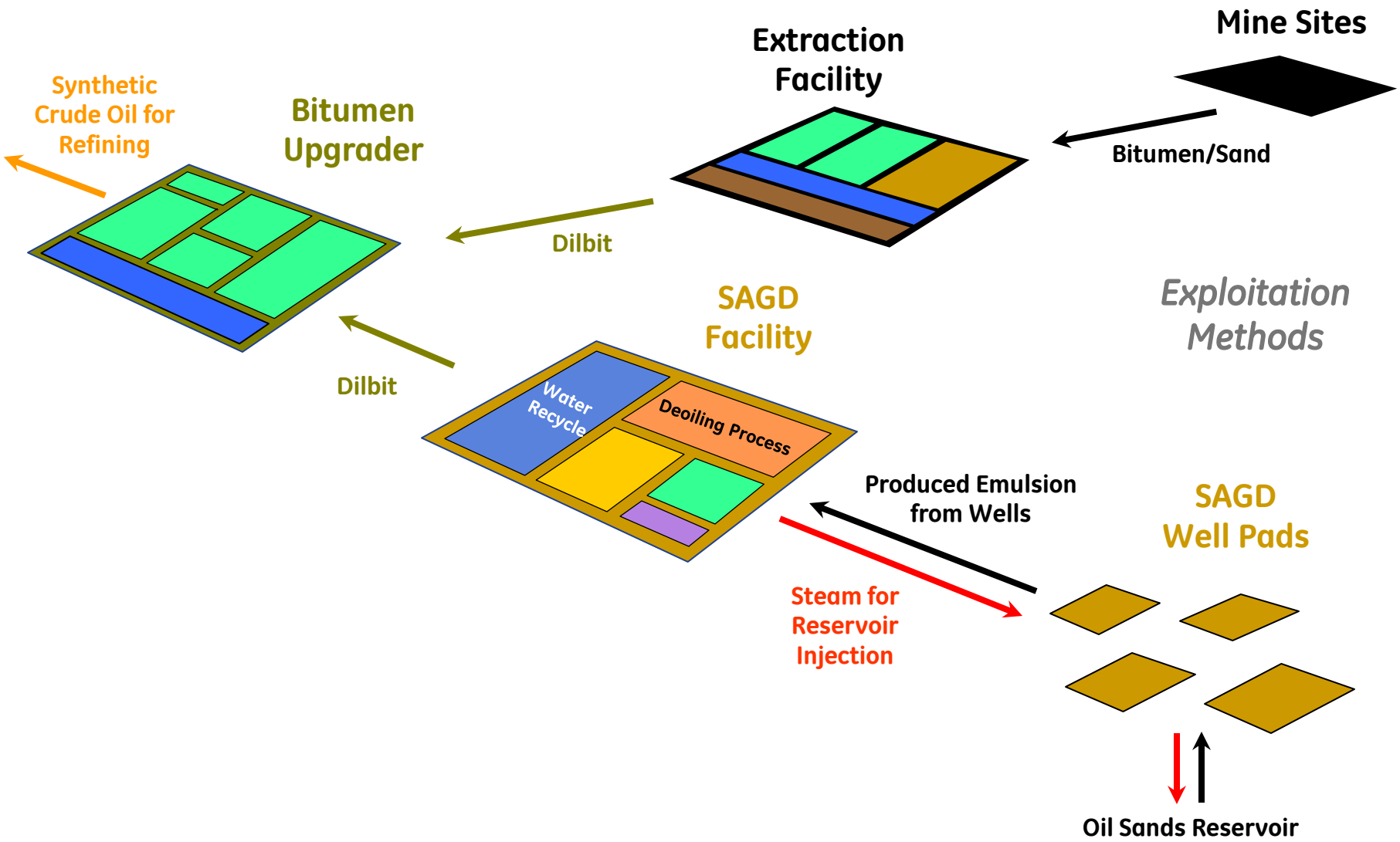
Upstream oil sands value chain



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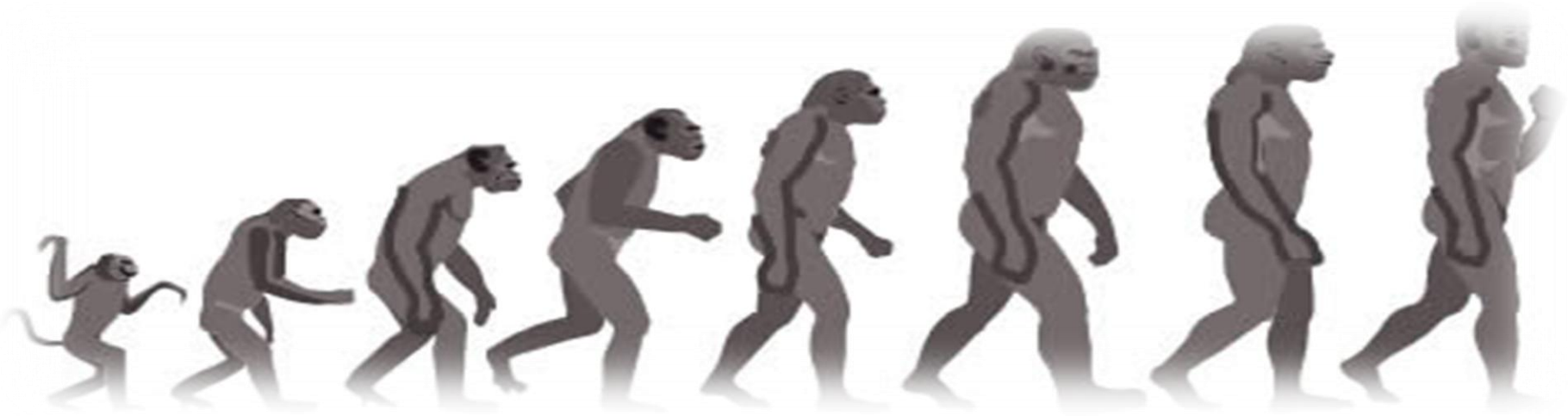
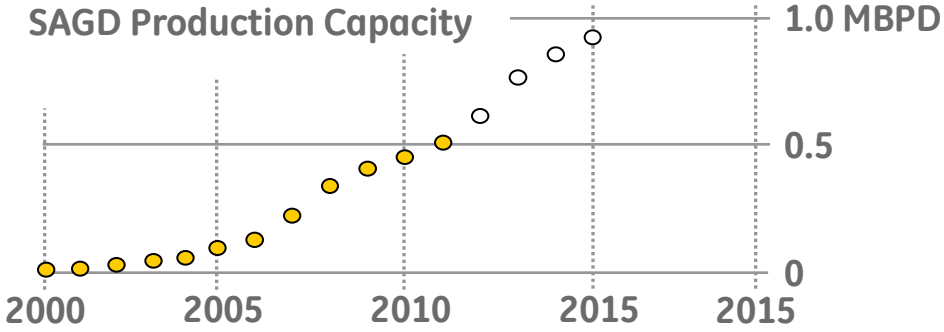
It has only been 24 years since SAGD came off the paper and 12 years at commercial scale in the field



SAGD facilities today

Survive	Operate	Optimize	Thrive



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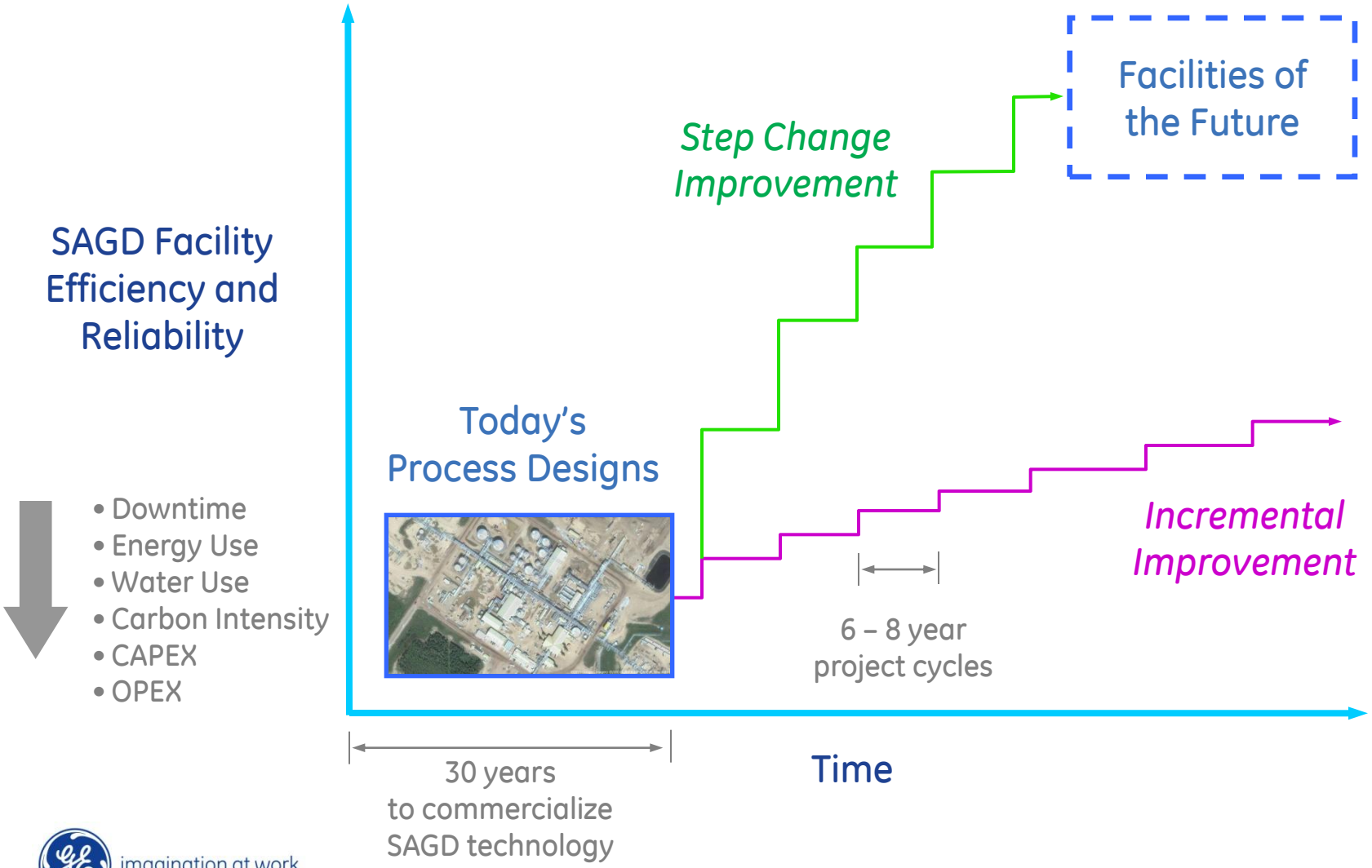
Optimizing SAGD Facilities



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Key SAGD Produced Water Issues

Discharge Ccmposition & Qqality
Water to meet 1B wells, reduced pH and silica concentration

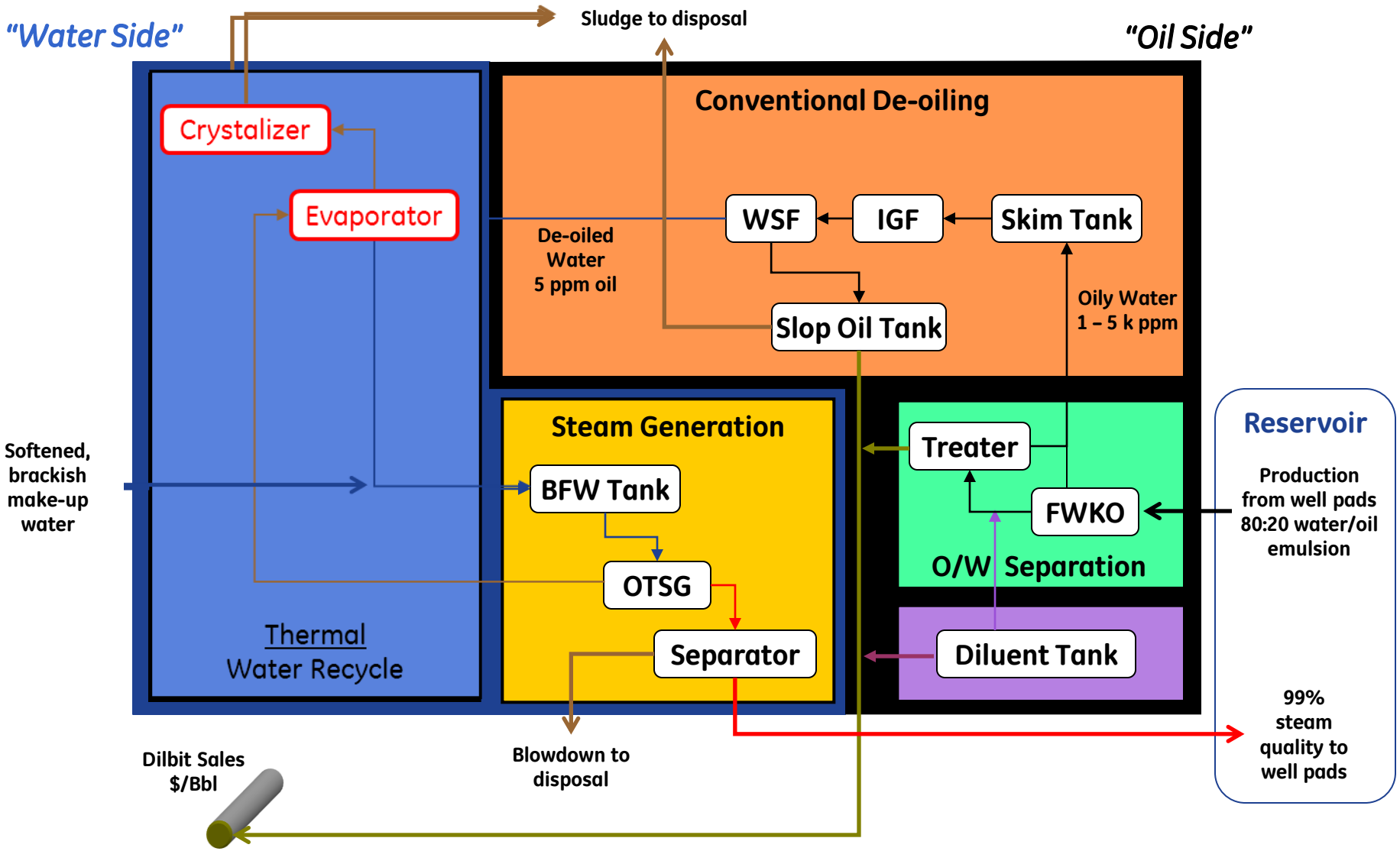
Evaporator capex & opex
Energy usage, CO_2 emissions, capital cost

Water usage…recycle, discharge, intake
Minimize discharge volume, site make-up volume, increase recycle

Deoiling efficiency
Oil-Water separation, plant operability, boiler reliability

Installation cost and time
Minimize on-site construction thru modularization

SAGD facility unit processes



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NEXTGEN SAGD PILOT PROGRAM

Program objectives

1 Deoiling field pilot - 6 months @ 20 gpm

- deliver treated water with no more than ~1ppm oil-in-water @ 90^0C
- establish optimum system design, recovery rate and operating conditions for deoiling system across a broad range of SAGD produced water inlet conditions
- determine options available for control and monitoring the efficiency of oil separation
- validate total lifecycle cost model and value proposition for existing and nextgen SAGD deoiling unit operations
- identify most promising pathways for future technology development

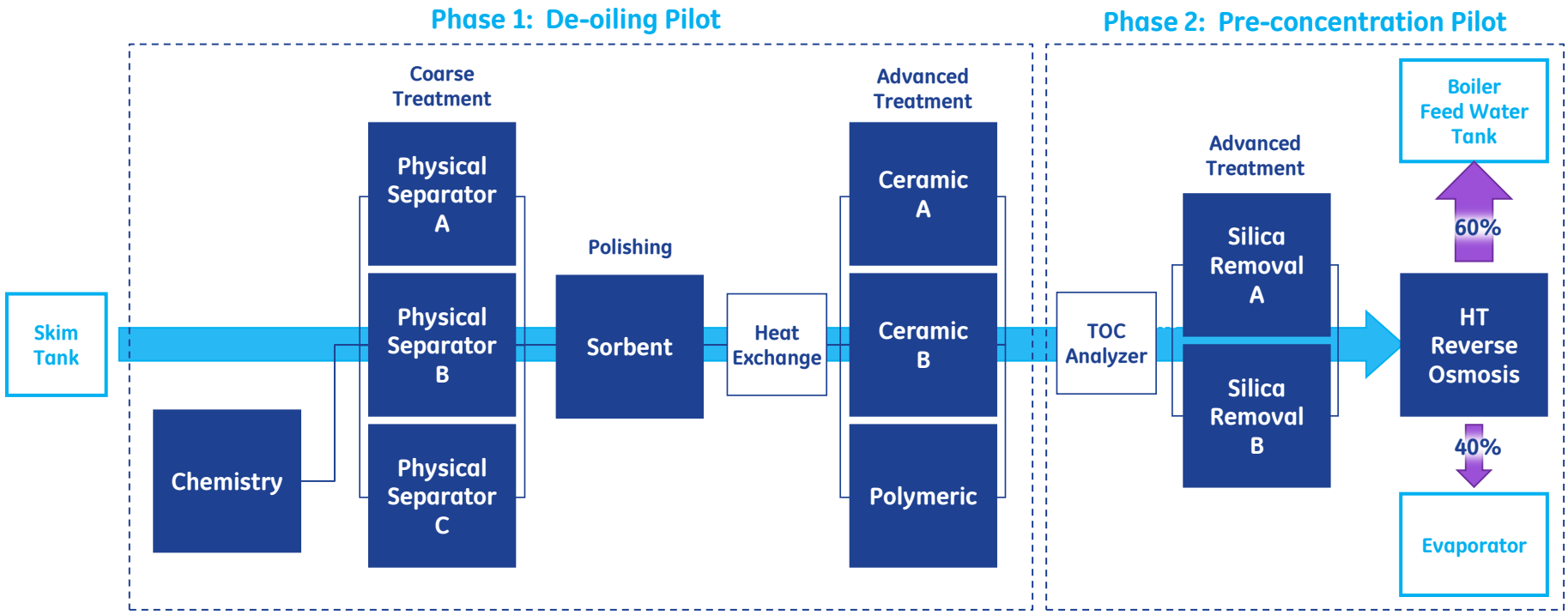
2 Pre-concentration field pilot - 4 months @ 20 gpm

- deliver boiler feed water quality and concentrate stream compatible with evaporator treatment @ 90^0C and pH >10
- design and build robust, high temp/high pH tolerant RO membrane
- establish optimum system design, recovery rate and operating conditions for pre-concentration system
- determine options available for control and monitoring the pre-concentration process
- validate total lifecycle cost model and value proposition for combined deoiling & pre-concentration system
- Identify most promising pathways for future technology development

3 Demonstration plant with best technology - 6 months @ 100 gpm

- Demonstrate the achievement of the above criteria at a scale sufficient to support commercialization
- Validate total lifecycle cost model and value proposition for best combined deoiling & preconcentration system

Field testing – "erector set" approach



Operation	Chemical Pre-treatment	Physical Separation	Sorbent	Ceramic/Spiral Membrane	Silica Removal	TDS Removal
Goal	Break oil for subsequent removal in a physical separator	Remove oil/solids from process fluids	Remove dissolved and other organic components	Provide absolute barrier to emulsified oils	Remove silica at pH <10, 90^{0}C	Provide high purity boiler feed water

Phase 3 – Scale up best performing technologies to 100 gpm demo plant

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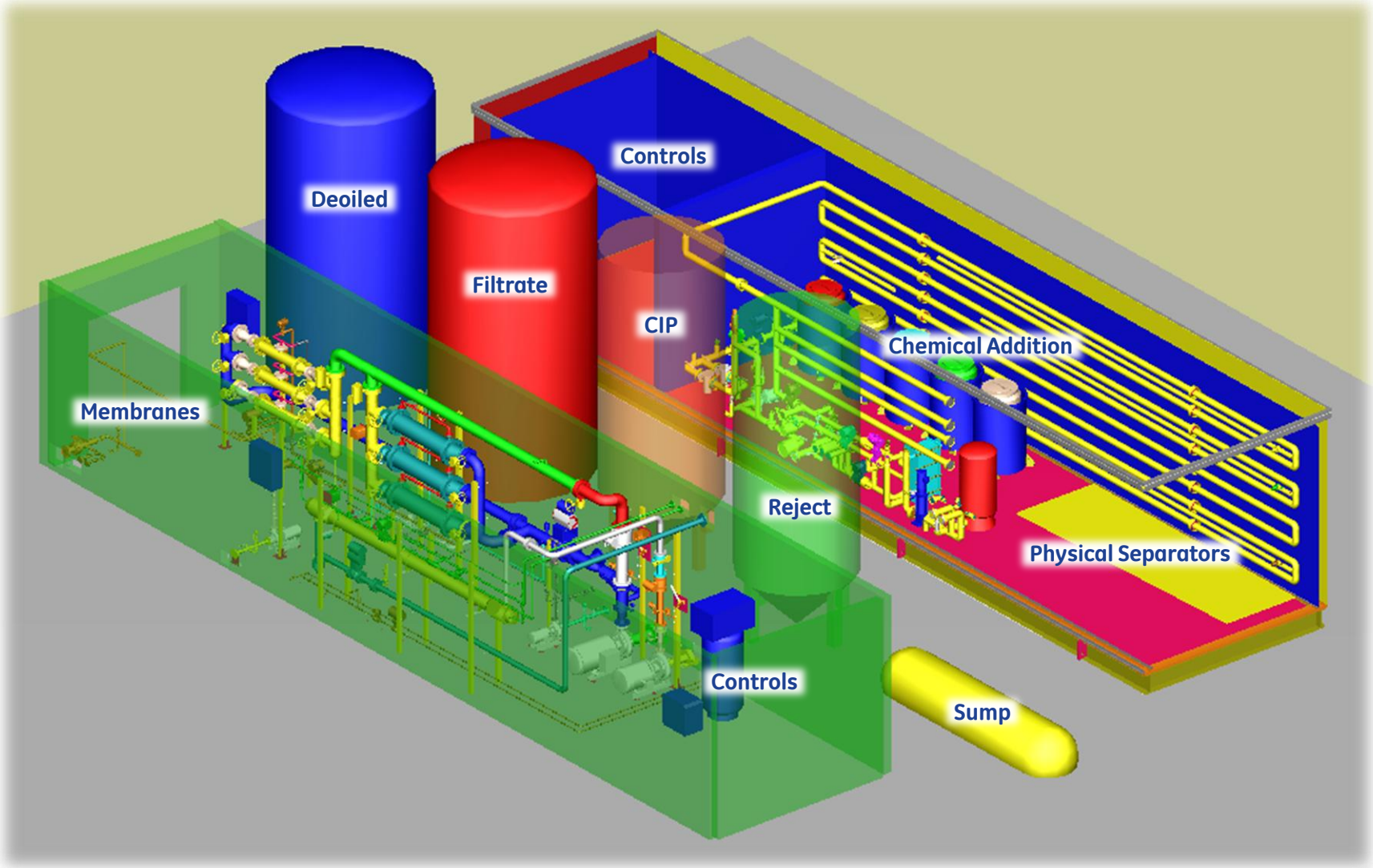
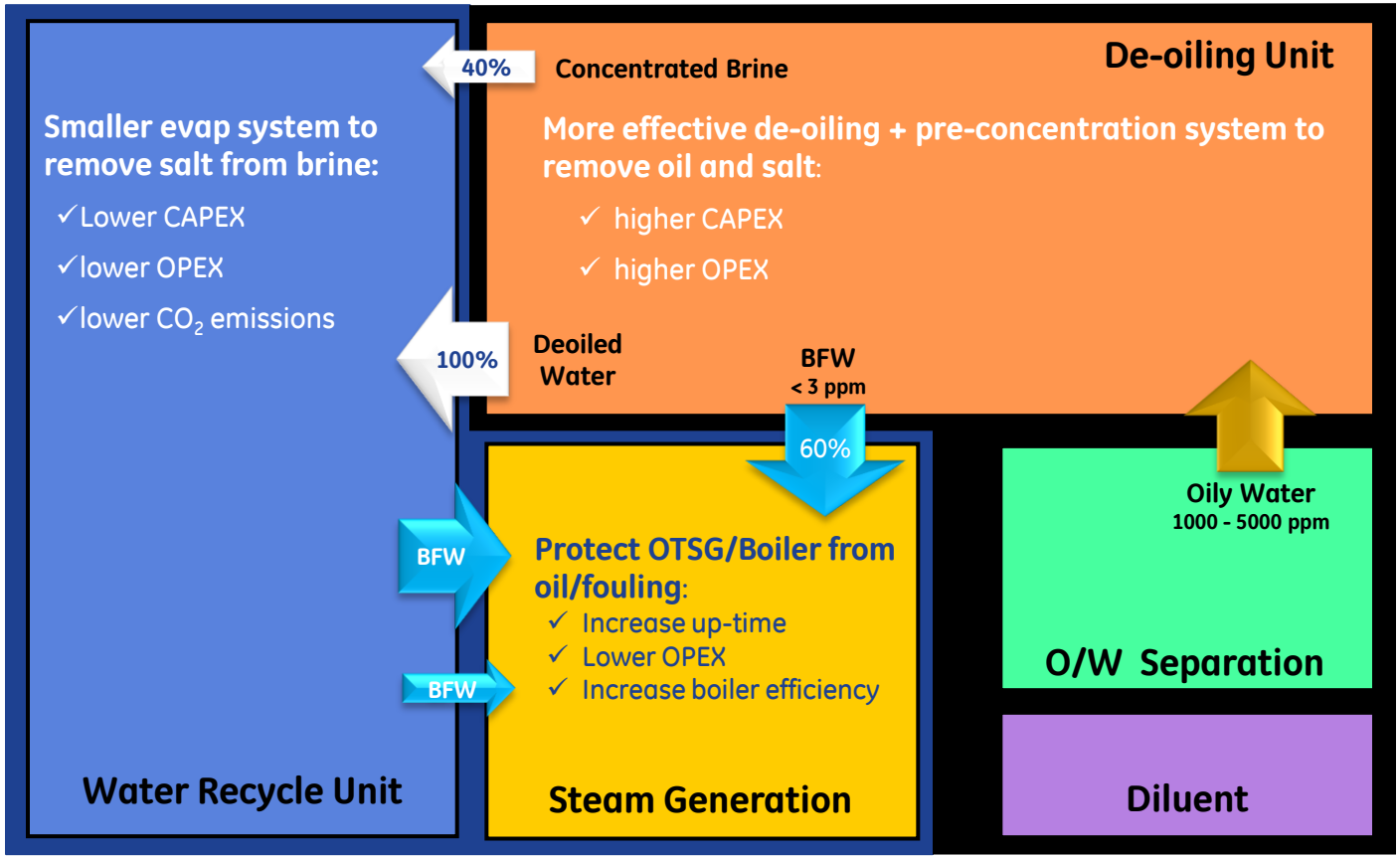
Deoiling pilot layout



Value proposition



Increase plant availability and decrease overall CAPEX/OPEX

Value proposition

Establishment of an efficient deoiling process offers the potential for RO systems to be used in conjunction w/ thermal evaporators to reducetotal energy and cost required for SAGD produced water recycling

Direct Benefits:

- 40% smaller evaporator required
- 26% lower capital cost
- 29% lower annual operating cost
- 30% lower CO_2 emissions

Indirect Benefits:

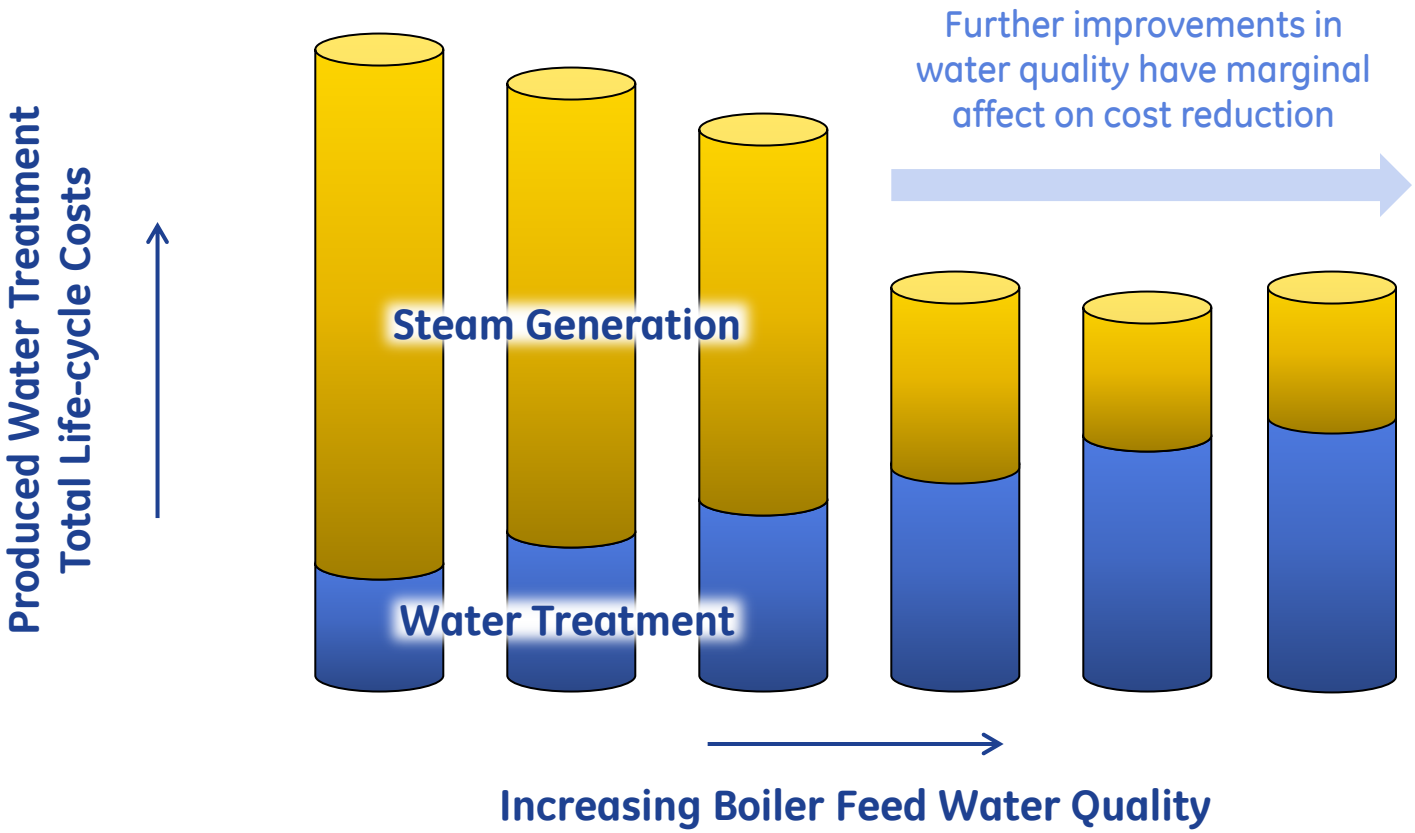
- Reduced risk of boiler issues/tube failures – barrier to oil
- Smaller areal footprint
- Improved plant availability - down time costs ~ $2.4M/day

Conventional Deoiling ($M)		
Equip.	CAPEX	OPEX/yr
Skim tank	No change	
IGF	6.8	2.0
WSF	4.5	0.6
Evaporator	76.0	6.7
Boiler	No change	
Total	**87.4**	**9.4**

NextGen Deoiling ($M)		
Equip.	CAPEX	OPEX/yr
Skim tank	No change	
Deoiling	15.4	2.1
HT RO	11.0	1.8
Evaporator	38.0	2.7
Boiler	No change	
Total	**64.4**	**6.6**

* Estimates based on 30,000 BOPD SAGD facility

Finding the saddle point



What is the optimum combination for lowest overall life-cycle cost?

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