THE MERITS OF HEAVY RESIDUE GASIFICATION IN TODAY'S WORLD

IChemE Conference 2010

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PRESENTATION OVERVIEW

- The Global Energy Challenge
- Gasification Technology
- Gasification in Refining
- Gasification in Oil Sands
- Gasification in Gas-to-Liquids
- Gasification for Power and EOR
- Conclusion

THE NEW ENERGY FUTURE

9 billion people

2.5 billion more than today

4-5 times richer

with most extra wealth coming from developing countries

Double the energy

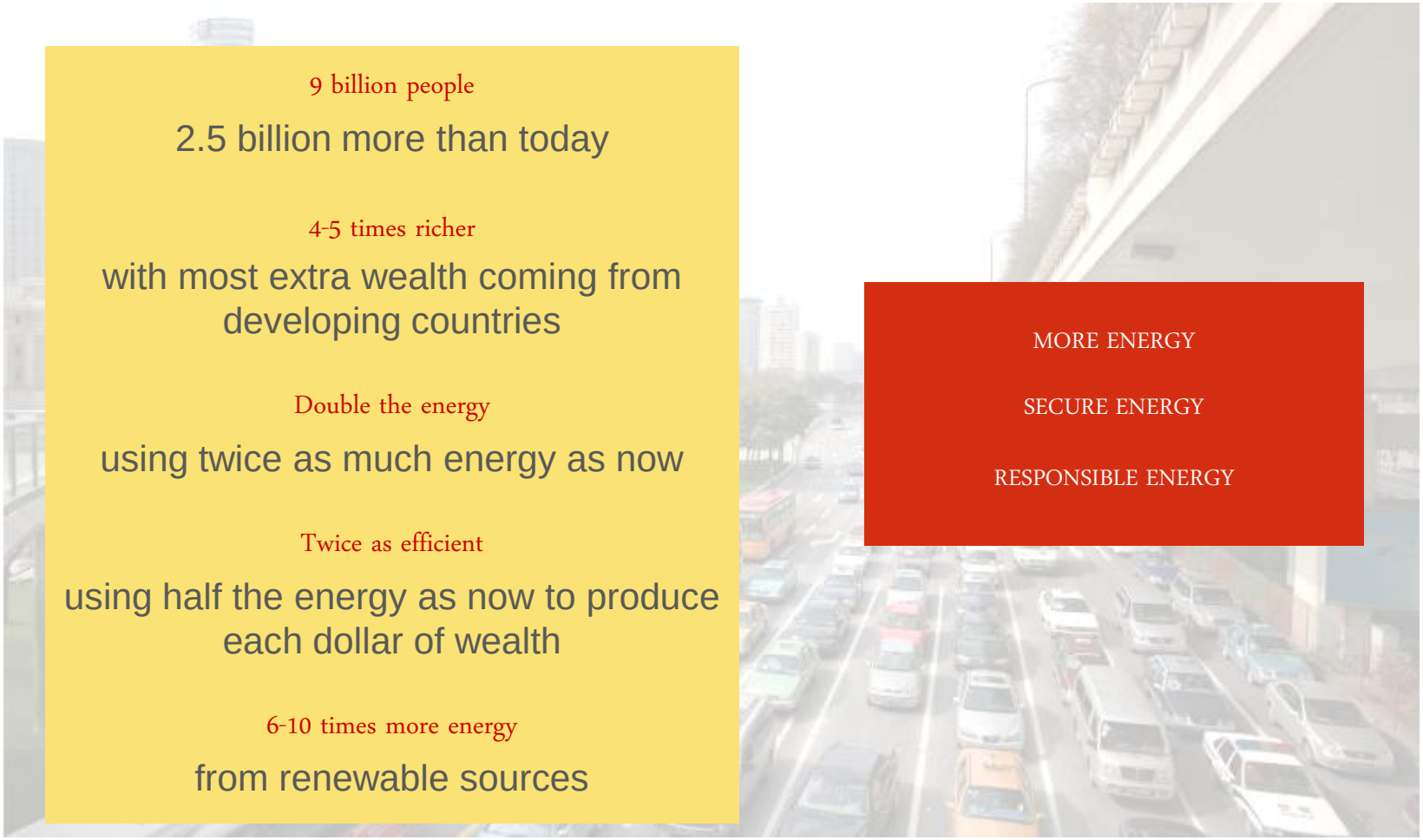
using twice as much energy as now

Twice as efficient

using half the energy as now to produce each dollar of wealth

6-10 times more energy

from renewable sources



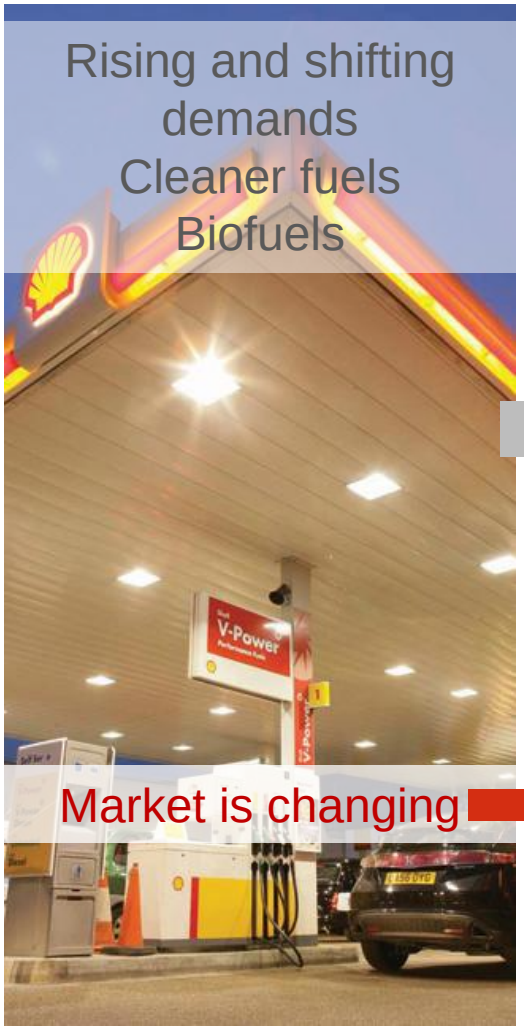
MORE ENERGY

SECURE ENERGY

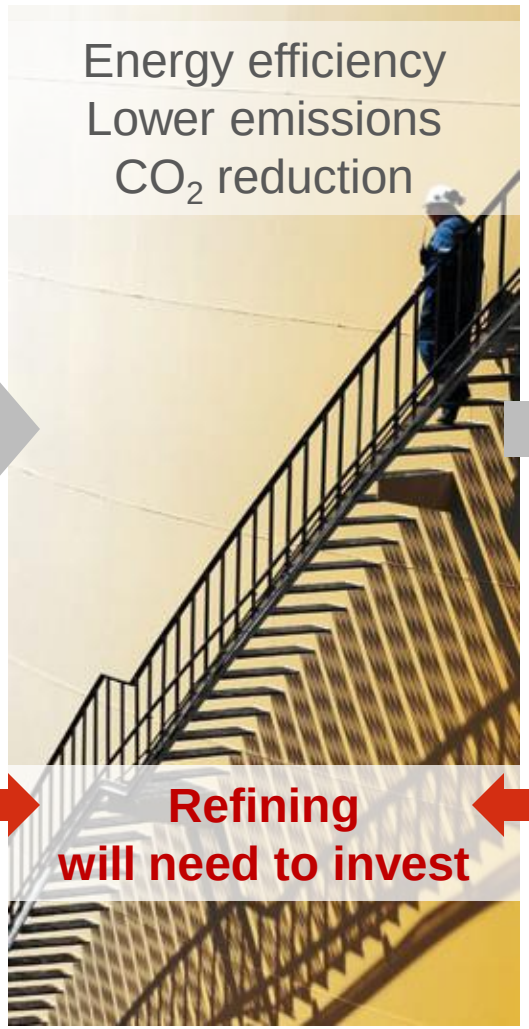
RESPONSIBLE ENERGY

THE GLOBAL ENERGY CHALLENGE

Rising and shifting demands
Cleaner fuels
Biofuels



Energy efficiency
Lower emissions
CO_2 reduction



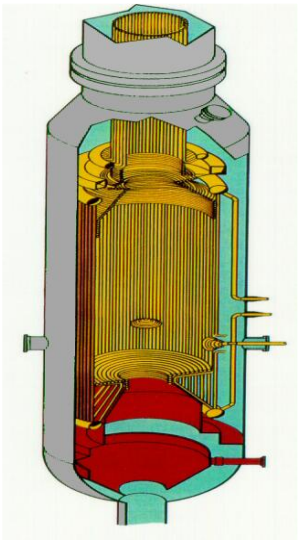
More unconventional crude/feedstocks

Market is changing

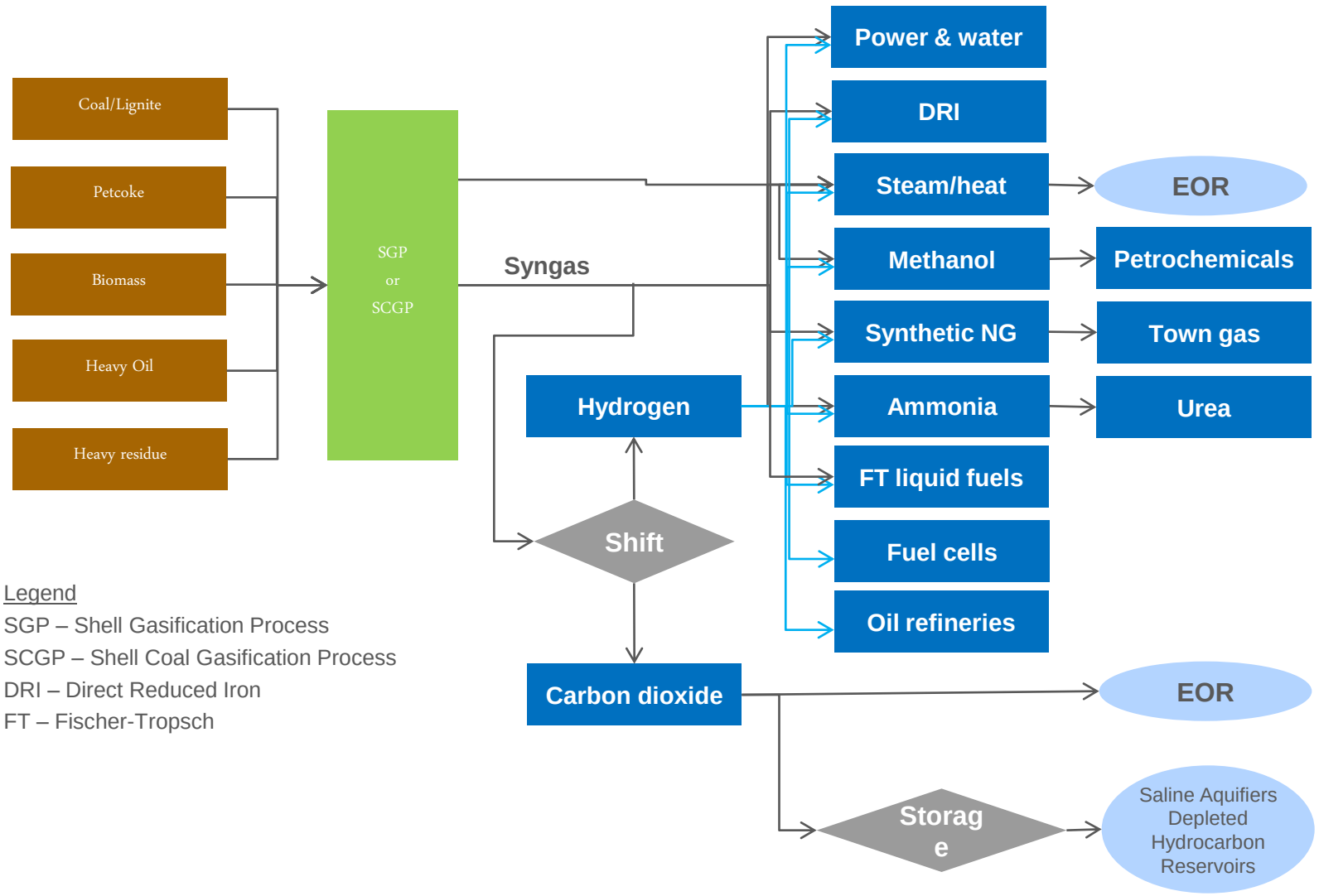
Refining will need to invest

Upstream is changing

SHELL GASIFICATION TECHNOLOGIES

SGP	SCGP
 Liquid refinery residues	Coal and coke 
Non-slagging condition	Slagging condition
Refractory lined gasifier	Membrane wall gasifier
Liquid feed system	Dry feed system
Fire tube boiler	Water tube boiler
Soot water handling	Solid slag handling

VERSATILITY OF SHELL GASIFICATION TECHNOLOGIES



Legend

SGP – Shell Gasification Process

SCGP – Shell Coal Gasification Process

DRI – Direct Reduced Iron

FT – Fischer-Tropsch

CONVERTING "BOTTOM OF THE BARREL" INTO VALUABLE PRODUCTS

- Proven track record in gasification since 1950's
  - Residue/gas: >150 reactors built, >80 reactors in operation
  - Gas: major equity investment in GTL Qatar (18 reactors)
  - Coal: 24 units sold globally, 13 plants currently in operations
- Proven track record on heavy, high sulphur, viscous residues, s/a Thermal Cracker residue, Solvent Deasphalter residue
- High syngas yield (typically >2,600 Nm3 CO+H2 per ton feed), low oxygen consumption and low soot formation, and high thermal efficiency through syngas cooler

CONVERTING "BOTTOM OF THE BARREL" INTO VALUABLE PRODUCTS

- Safe and Reliable operation: automated and fully safeguarded heat-up, start-up, shutdown sequences
- Long burner run length and long refractory lifetime
- Extensive experience in start-up, operation and maintenance of own units and licensed units.

Shell Pernis
1997
Cracked Residue
3x550 t/d

ENI
Sannazzaro
2006
Residue/Asphalt
2x600 t/d

Nexen (Opti)
2008
Asphalt
4x1033 t/d

Fujian
2009
Asphalt
3x1200 t/d

GASIFICATION IN REFINING
SHELL PERNIS REFINERY, NETHERLANDS

GASIFICATION IN OIL SANDS

- JV between Nexen and OPTI Canada, operated by Nexen
- Produces 72,000 bbl/day of bitumen
- Heavy asphaltene by-product is gasified in a SGP unit, which generates all hydrogen for the hydrocracking unit and high-quality steam for use throughout the plant.
- Excess syngas is used for power and steam generation.
- Therefore unlocking the value of oil sands, without using natural gas
- Shell delivered four oil gasification installations to Nexen, with a total capacity of 3,600 t/d, the largest in the world.
- The start-up of the units progressed well and the gasification units have successfully demonstrated their intended performance.
- TSA signed in 2010

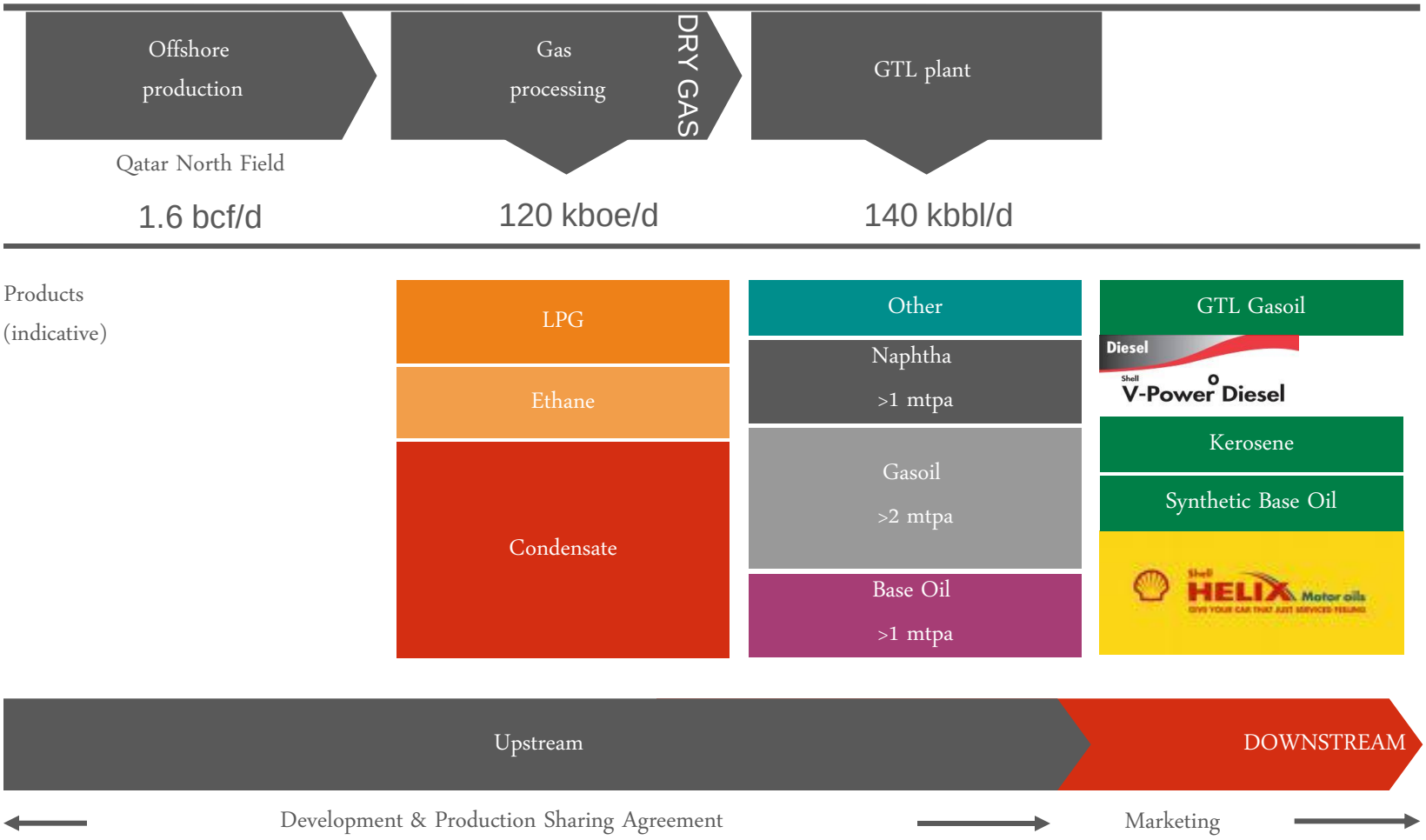
GASIFICATION IN OIL SANDS
LONG LAKE PROJECT, CANADA

GASIFICATION IN GAS-TO-LIQUIDS
PEARL GTL PROJECT, QATAR

- World's largest GTL plant
- 120,000 boe/d of natural gas liquids and ethane and 140,000 b/d of liquid hydrocarbon products
- Major construction completed end 2010, production ramp up in 2011
- Entered the testing phase

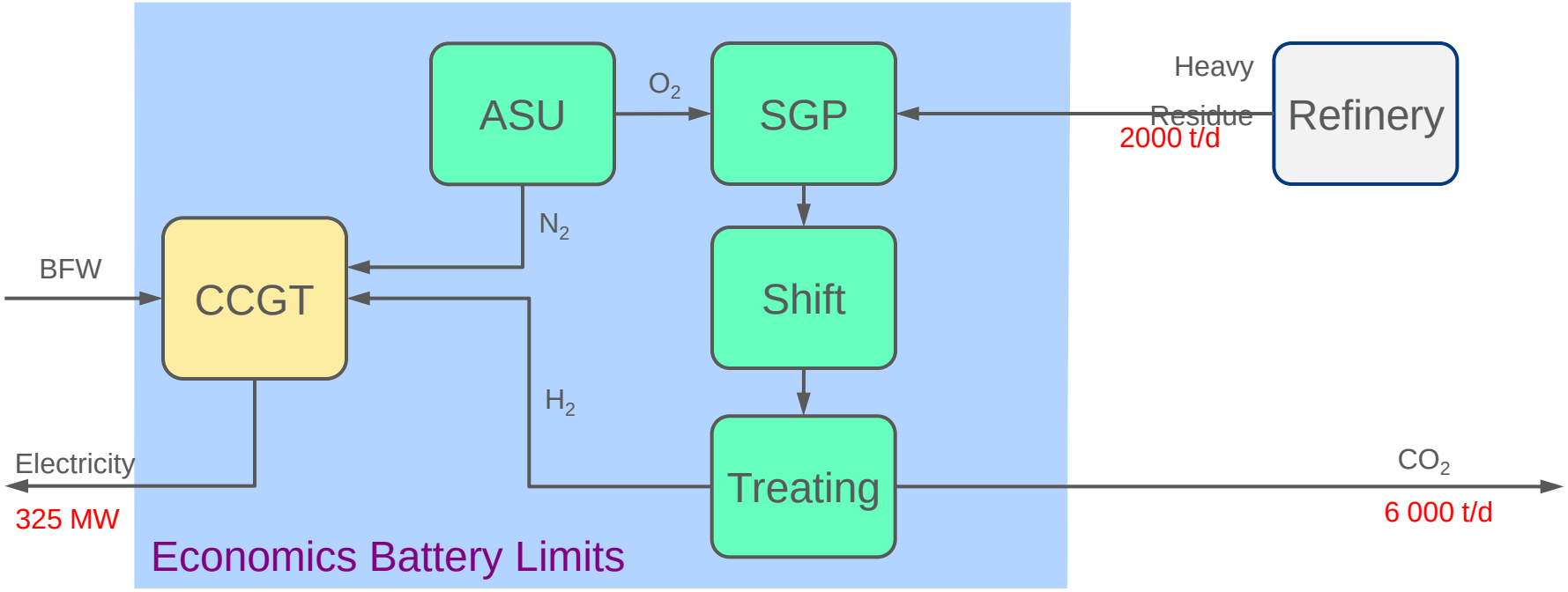
Pearl GTL Project, Qatar

PEARL – A WORLD CLASS INTEGRATED GTL PROJECT

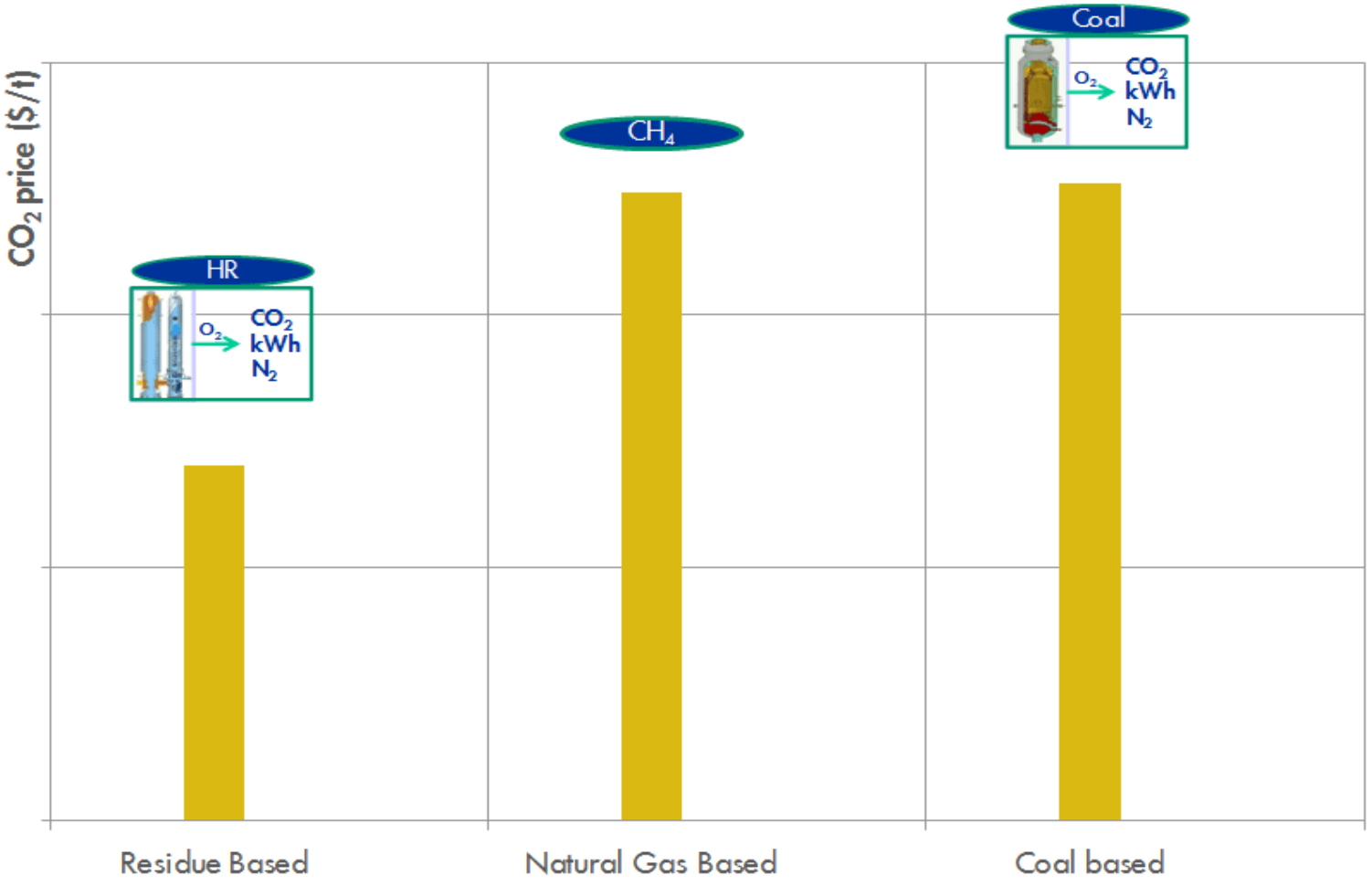


GASIFICATION FOR POWER AND EOR

- Shift of syngas with steam leads to pure streams of CO2 and H2.
- N2 is used to dilute H2 before its combustion in gas turbines.
- Power price is competitive when CO2 is sold as a valuable product.



RELATIVE COSTS OF CO_2 AS A BY-PRODUCT OF POWER PRODUCTION



Based on an internal Shell study

CONCLUSION

- Global demand for energy will continue to increase, while CO_2 emissions will have to be reduced
- More stringent industrial and environmental requirements in the oil and gas business are imminent
- Gasification technology applications can provide solutions
- Upstream operations will present new areas of application – in regions with EOR potential residue gasification-to-power could well be a key enabler
- Shell is strongly positioned to meet the energy challenge

RECENT SGP PROJECTS

Owner	Location	Feedstock	Input, t/d	Syngas, $10^6 Nm^3/d$	End product	Startup date
Shell Nederland Raffinaderij	Rotterdam, Netherlands	Cracked residue	1650	4.7	Hydrogen/ power/steam	1997
Lanzhou Chemical	Lanzhou, China	Vacuum reside	700	2.1	Chemicals	1998
Chemopetrol revamp	Litvinov, Czech Republic	Cracked residue	1250	3.6	Chemicals/ hydrogen	2001
Lucky Goldstar	Naju, Korea	Vacuum residue	225	0.7	Chemicals	2001
Eni SpA	Sannazzaro, Italy	Cracked residue	1200	3.4	Hydrogen/ power	2006
Opti/Nexen	Alberta, Canada	Asphalt	3790	9.7	Steam/ hydrogen	2008
Fujian ethylene project	Fujian, China	Asphalt	2180	5.7	Hydrogen/ power	2009