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TITLE: Water to Value ? Produced Water Management for Sustainable Field Development of Mature and Green Fields

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ABSTRACT:

Abstract Produced water is an inextricable part of the hydrocarbon recovery process. As fields mature, they tend to produce increasing amounts of water. Worldwide, daily water production in 1999* was quoted to be over 33.4 m³/d (210 million barrels) some 3 times the world oil production. Water production within several operating units in the Shell group has increased steadily from roughly 350,000 m³/ d in 1990 to over 1,000,000 m³ /d today. Figure 1 shows the historic picture of water produced by Shell's operating units. Doubling the quantity of water in next decade will lead to the increase in unit technical cost due to increased operating costs and costs for replacement and expansion of existing water handling facilities. Excessive production of water is the main criterion to abandon oil and gas wells, leaving large volumes of hydrocarbons behind. Field development scenarios using optimised water management have unlocked and will unlock additional recoverable reserves. Although in water flooding projects, produced water is an enabler for improved hydrocarbon recovery, produced water becomes a major issue due to its sheer volume, its high handling cost and its environmental impact. Across the Shell operating units, some 55% of the water is reinjected whilst the rest is discharged to open surface waters particularly in offshore operations. Most of discharged water requires treatment because of contamination with traces of oil, heavy metals, boron, and corrosive fluids like H₂S, CO₂ , salt and solids. Treatment and disposal of the current water volume costs the Shell OU's over US \$400 Million per annum (\$0.15/ m³ to as much as \$15/ m³ depending on volumes and location). This cost is inline with an average cost of US \$0.578/bbl for handling water production ranging from 3181 to 31,810 m³/d. Figure 2 shows typical process cost distributions of the water lifecycle cost*. This water handling cost includes capital and operating expenses, utilities and chemicals for lifting, separation, de-oiling, filtering, pumping and injection. These costs are expected to further increase when traditional discharge routes, such as dumping overboard and shallow re-injection are phased out.

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