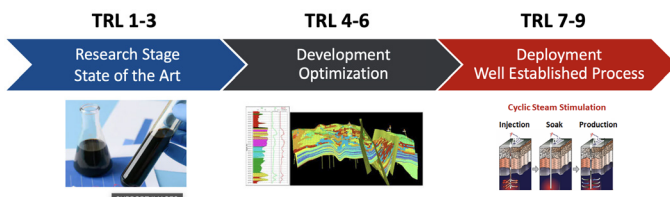


# > EOR TECHNOLOGY MATURITY TRL APPROACH



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The concept of Technology Readiness Levels (TRL) was first developed in the USA by NASA. The classification reflects the state of development results for wide production and/or application. Assessment of TRL and current TRL assignment indicates to the markets and consumer readiness of the process/technology for wide market implementation. Knowledge of TRL makes it easier for developers and customers to monitor the progress of research and the choice of technologies that are most ready for full scale application. For the petroleum industry in terms of EOR projects there are nine levels of technology availability. Therefore, Levels 1-3 represent the “Research” stage (Research: Basic principles, Concept and application formulation, Concept validation), 4-6 represent “Development” (Development: Experimental pilot, Demonstration pilot, Industrial pilot), and grades 7-9 “Deployment” (Deployment: First implementation, A few records of implementation, Extensive implementation). Many oil companies use this TRL methodology to assess the maturity of oil and gas production technologies.”



The EOR technology evaluation must consider several technical - economical aspects such as: Laboratory Experiments, Reservoir Modeling, Advanced Screening Processes, Sensitivities and Production Forecasts,

consequently the optimization and hierarchy of the scenarios in order to select the most feasible prior to the implementation phase. One strong and key variable in this phase in order to reduce risks and project failures, it is based on the maturity degree of the EOR technology. Understanding and incorporating the TRL approach in the workflow for EOR technologies selection might lead the operator to increase the probability of success in the pilot as well as in the full scale project. Following up the TRL concepts, inside the category N°9 the well established EOR process, it can be found Polymer Flooding, Miscible Gas Process, Steam Flooding and Cyclic Steam Stimulation (CSS) as the well established EOR processes worldwide. These EOR technologies are technical - economical proven in hundreds of projects worldwide. Based on that, steam flooding remains as the most suitable technique to maximize hydrocarbons recovery in heavy oil reservoirs, however according to the operator experience this referential matrix can be updated. Lastly, the consideration of this approach is necessary against the avalanche of emergent technologies which come across the petroleum industry in order increase oil production.

PHASE	TRL	EOR TECHNOLOGY
<b>Research Stage</b>	<b>1 - 3</b>	<ul style="list-style-type: none"> <li>• Colloidal Dispersion Gels (CDG) Injection</li> <li>• Performed Particle Gels (PPG)</li> <li>• In situ upgrading</li> <li>• Delayed Action Polymer (DAP) Injection</li> <li>• Hybrid Process</li> </ul>
<b>Development - Optimization</b>	<b>4 - 6</b>	<ul style="list-style-type: none"> <li>• High Pressure Air Injection (HPAI)</li> <li>• Low Salinity Waterflooding</li> <li>• Water Alternate Gas injection</li> <li>• Microbial</li> <li>• Polymer Disperse Systems (PDS)</li> <li>• Alkaline - Surfactant - Polymer (ASP)</li> <li>• SAGD</li> </ul>
<b>Well Established EOR Processes</b>	<b>7 - 9</b>	<ul style="list-style-type: none"> <li>• Polymer Flooding</li> <li>• Cyclic Steam Stimulation (CSS)</li> <li>• Miscible Gas Processes (CO2)</li> <li>• Steam Flooding</li> </ul>