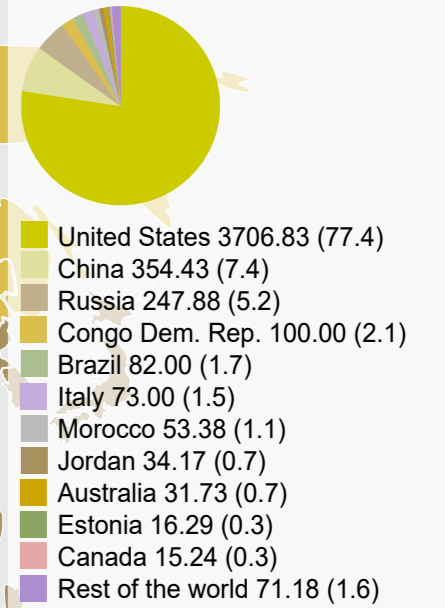


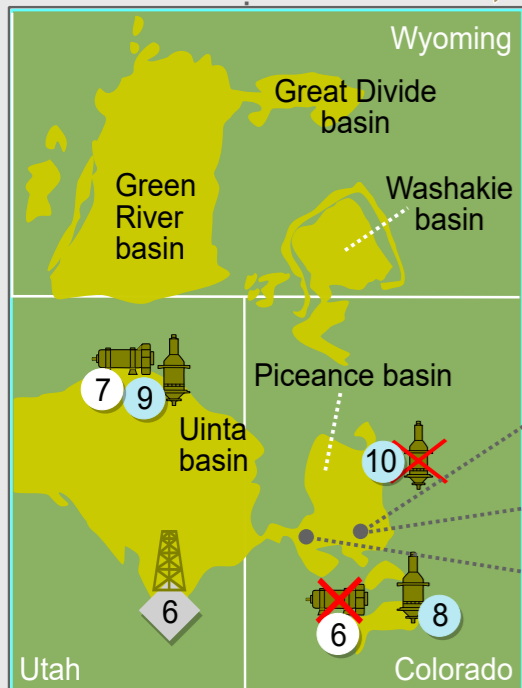
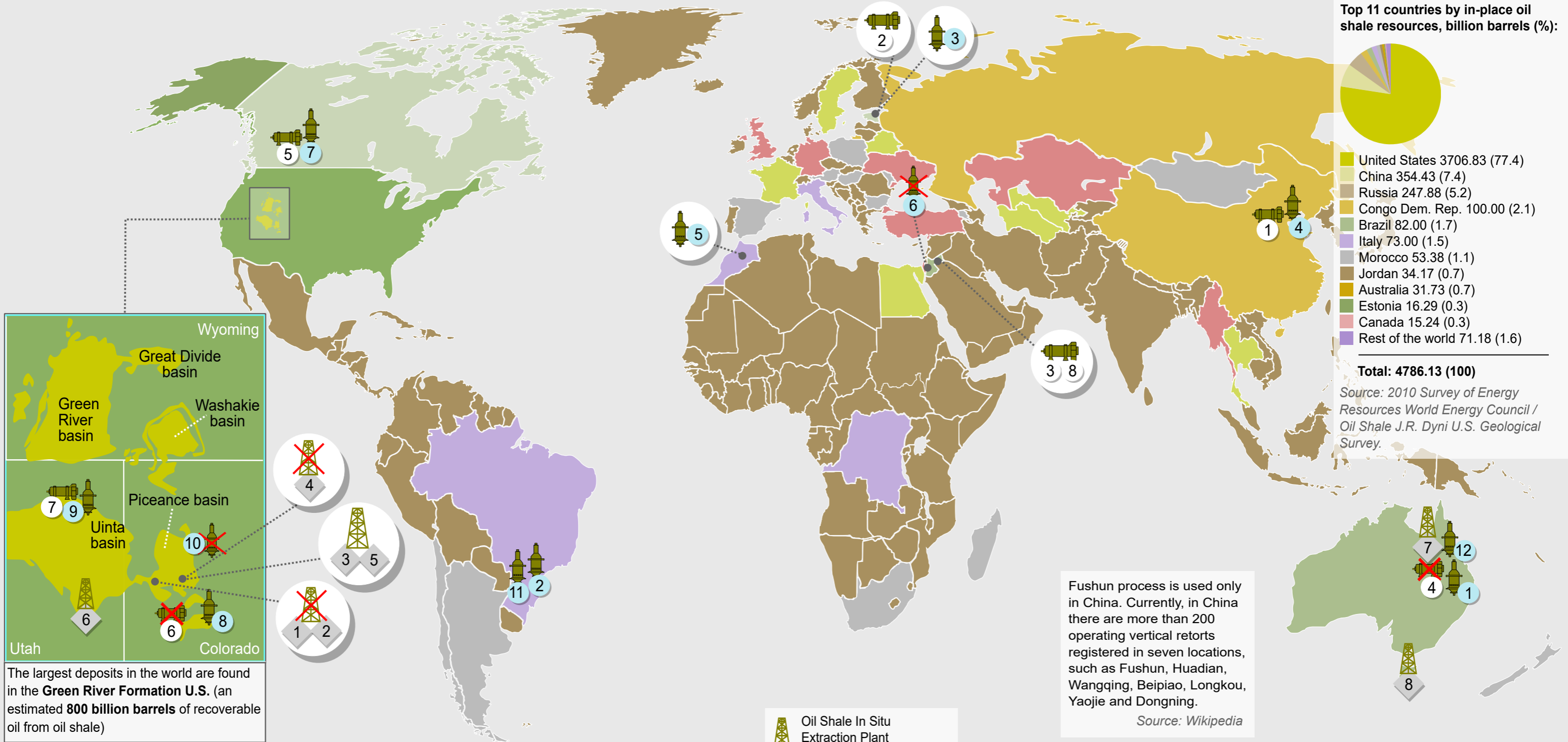
Oil Shale (Kerogen) Resources and Some Projects in the World, 2018

Top 11 countries by in-place oil shale resources, billion barrels (%):



Total: 4786.13 (100)

Source: 2010 Survey of Energy Resources World Energy Council / Oil Shale J.R. Dyni U.S. Geological Survey.



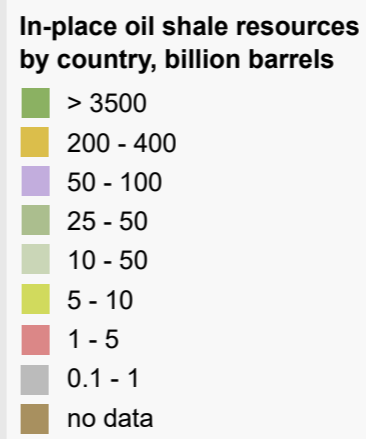
The largest deposits in the world are found in the **Green River Formation U.S.** (an estimated **800 billion barrels** of recoverable oil from oil shale)

Fushun process is used only in China. Currently, in China there are more than 200 operating vertical retorts registered in seven locations, such as Fushun, Huadian, Wangqing, Beipiao, Longkou, Yaojie and Dongning.
Source: Wikipedia

- Some Major Horizontal Oil Shale Retorting Plants (Process):**
- 1 Fushun MG, China (Alberta Taciuk Process - ATP)
 - 2 Eesti Energia Narva Oil Plant, Estonia (Galoter)
 - 3 KIO Al Lajjun Pilot Project, Jordan (ATP)
 - 4 OSEC Stuart Oil Shale Project, Qld, Australia (ATP)*
 - 5 UMATAC Alberta Pilot Plant, Canada (ATP)
 - 6 Colony Oil Shale Project, Colorado, USA (TOSCO II)*
 - 7 Enefit's South Project, Utah, USA (Enefit-280)
 - 8 JOSE Project, Jordan (Enefit-280)

- Some Major Vertical Oil Shale Retorting Plants (Process):**
- 1 Stuart Oil Shale Project, Qld, Australia (Paraho II)
 - 2 Petrobras Sao Mateus do Sul, Brazil (PetroSIX)
 - 3 Kivioli & Kohtla-Jarve Oil Shale Plants, Estonia (Kiviter)
 - 4 Fushun MG, Liaoning, China (Fushun)
 - 5 ONHYM Timahdit Pilot Plant, Morocco (ONHYM)
 - 6 PAMA Mishor Rotem Oil Shale Plant, Israel (PAMA)*
 - 7 NCUT Devon, Alberta Pilot Plant, Canada (Chattanooga)
 - 8 Rifle Oil Shale Project, Colorado, USA (Paraho II)
 - 9 Ambre Energy NA Vernal Pilot Plant, Utah, USA (Oil-Tech)
 - 10 Unocal Oil Shale Demo Plant, Colorado, USA (Union)*
 - 11 Irati Energy Papanduva Oil Shale Plant, Brazil (PRIX)
 - 12 Blue Ensign Townsville Pilot & Julia Creek Plants, Qld, Australia (Rendall)

- Oil Shale In Situ Extraction Plant (operational or planned)
- Oil Shale In Situ Extraction Plant (stopped or closed)*
- Horizontal Oil Shale Retorting Plant (operational or planned)
- Horizontal Oil Shale Retorting Plant (stopped or closed)*
- Vertical Oil Shale Retorting Plant (operational or planned)
- Vertical Oil Shale Retorting Plant (stopped or closed)*



Sources: 2010 Survey of Energy Resources World Energy Council / Oil Shale J.R. Dyni U.S. Geological Survey; Wikipedia.

- Some Major Oil Shale (Kerogen) In Situ Extraction Projects:**
- 1 Shell Mahogany Research Oil Shale Project, Colorado, USA*
 - 2 Chevron Rio Blanco, Colorado, USA*
 - 3 ExxonMobil Rio Blanco, Colorado, USA
 - 4 AMSO Rio Blanco, Colorado, USA*
 - 5 IEP Geothermic Fuel Cell Rio Blanco, Colorado, USA
 - 6 Red Leaf Resources Seep Ridge, Utah, USA (EcoShale In-Capsule Process)
 - 7 Alpha Project (MDL330), Greenvale Energy, Qld, Australia
 - 8 Tasmania Project (EL 20/2004), Boos Energy, Australia

Sources: 2010 Survey of Energy Resources World Energy Council / Oil Shale J.R. Dyni U.S. Geological Survey; John R. Dyni. Geology and Resources of Some World Oil-Shale Deposits/Scientific Investigations Report 2005-5294; Wikipedia et al.

1 FMG Fushun Processing Plant Country/Location: Fushun, Liaoning, China Company: Fushun Mining Group Start-up: 2008 Status: Operational Facility type: Commercial Production capacity: 250 t/h Extraction technology: Surface mining Retorting process: Alberta Taciuk (ATP) Heating method: Direct Heat carrier: Hot recycled solids (inert or burned shale) Retort type: Horizontal	2 Eesti Energia Narva Oil Shale Plant Country/Location: Narva, Estonia Company: Eesti Energia Oil Industry Start-up: 1980, 2012 Status: Operational Facility type: Commercial Production capacity: 280 t/h Extraction technology: Surface & underground mining Retorting process: Galoter (Enefit140 and Enefit280) Heating method: Direct Heat carrier: Hot recycled solids (inert or burned shale) Retort type: Horizontal	3 KIO Al Lajjun Oil Shale Project Country/Location: Al Lajjun, Jordan Company: Karak International Oil Start-up: 2009, 2015 (?) Status: Testing Facility type: Pilot or Commercial (planned) Production capacity: 15 000 bpd (planned) Extraction technology: Surface mining Retorting process: Alberta Taciuk (ATP) Heating method: Direct Heat carrier: Hot recycled solids (inert or burned shale) Retort type: Horizontal	4 OSEC Stuart Oil Shale Project Country/Location: Gladstone, Queensland, Australia Company: Enefit American Oil (formerly OSEC, LLC) Start-up: 1999-2004 Status: Closed Facility type: Demonstration Production capacity: 6000 t/day Extraction technology: Surface mining Retorting process: Alberta Taciuk (ATP) Heating method: Direct Heat carrier: Hot recycled solids (inert or burned shale) Retort type: Horizontal	5 UMATAC Alberta Pilot Plant Country/Location: Calgary, Alberta, Canada Company: UMATAC Industrial Processes Start-up: 1978 Status: Operational Facility type: Pilot Production capacity: 5 t/h Extraction technology: Surface mining Retorting process: Alberta Taciuk (ATP) Heating method: Direct Heat carrier: Hot recycled solids (inert or burned shale) Retort type: Horizontal
6 TOSCO Colony Oil Shale Project Country/Location: Parachute, Colorado, United States Company: Tosco Corporation Start-up: 1964-1972 Status: Closed Facility type: Pilot Production capacity: 40 t/h Extraction technology: Surface mining Retorting process: TOSCO II Heating method: Indirect Heat carrier: Hot recycled solids (inert or burned shale) Retort type: Horizontal	7 Enefit South Project (Utah) Country/Location: Vernal, Uintah, Utah, United States Company: Enefit American Oil Start-up: 2020/2024 Status: Planned Facility type: - Production capacity: 25 000 bpd (2020) Extraction technology: Surface mining Retorting process: Galoter (Enefit140 or Enefit280) Heating method: Direct Heat carrier: Hot recycled solids (inert or burned shale) Retort type: Horizontal	8 JOSE Project Country/Location: Al Qatrania, Jordan Company: Enefit (65%), YTL (30%), Near East Group (5%) Start-up: 2020/2024 Status: Planned Facility type: - Production capacity: 19 000 bpd (2020) Extraction technology: Surface mining Retorting process: Galoter (Enefit140 or Enefit280) Heating method: Direct Heat carrier: Hot recycled solids (inert or burned shale) Retort type: Horizontal	1 QER Stuart Oil Shale Project Country/Location: Gladstone, Queensland, Australia Company: Queensland Energy Resources (QER) Start-up: 2011 Status: Operational Facility type: Demonstration Production capacity: 60 t/day or 37-40 bpd Extraction technology: Surface mining Retorting process: Paraho II Heating method: Combined Heat carrier: Internal combustion or Externally generated hot gas Retort type: Vertical	2 Petrobras Sao Mateus do Sul Plant Country/Location: Sao Mateus do Sul, Parana, Brazil Company: Petroleo Brasileiro, S.A. (Petrobras) Start-up: 1992 Status: Operational Facility type: Commercial Production capacity: 5880 t/day Extraction technology: Surface mining Retorting process: PetroSIX Heating method: Direct Heat carrier: Externally generated hot gas Retort type: Vertical
3 KKT Kiviõli Oil Shale Plant Country/Location: Kiviõli, Estonia Company: Kiviõli Chemical Plant (Kiviõli Keemiatööstus) Start-up: 1922, 1928 Status: Operational Facility type: Commercial Production capacity: up to 65 000 t/y Extraction technology: Surface mining Retorting process: Kiviter Heating method: Direct Heat carrier: Internal combustion Retort type: Vertical	3 VKG Kohtla-Jarve Oil Shale Plant Country/Location: Kohtla-Jarve, Estonia Company: Viru Keemia Grupp Oil AS Start-up: 1921, 1924-1942, 1945 Status: Operational Facility type: Commercial Production capacity: up to 250 000 t/y Extraction technology: Surface mining Retorting process: Kiviter Heating method: Direct Heat carrier: Internal combustion Retort type: Vertical	4 FMG Fushun Processing Plant Country/Location: Fushun, Liaoning, China Company: Fushun Mining Group Start-up: 1992 Status: Operational Facility type: Commercial Production capacity: 200 t/day Extraction technology: Surface mining Retorting process: Fushun Heating method: Direct Heat carrier: Internal combustion Retort type: Vertical	5 ONHYM Timahdit Oil Shale Pilot Plant Country/Location: Timahdit, Morocco Company: Office National des Hydrocarbures et des Mines Start-up: 1985 Status: Operational Facility type: Pilot Production capacity: 80 t/day Extraction technology: Surface mining Retorting process: ONHYM T3 Heating method: - Heat carrier: - Retort type: Vertical	6 PAMA Mishor Rotem Oil Shale Plant Country/Location: Mishor Rotem, Dimona, Israel Company: PAMA Ltd., Israel Electric Corporation, Veolia Environnement S.A. Start-up: 1978, 1989-2011 Status: Closed Facility type: Demonstration Production capacity: 31 000 t/y (2004) or 13 MWe Extraction technology: Surface mining Retorting process: PAMA Heating method: Direct Heat carrier: Internal combustion Retort type: Vertical
7 NCUT Devon, Alberta Oil Shale Pilot Plant Country/Location: Devon, Alberta, Canada Company: Chattanooga Corporation Start-up: 2000, 2004 Status: Operational Facility type: Pilot Production capacity: 330 t/h Extraction technology: Surface mining Retorting process: Chattanooga Heating method: Direct Heat carrier: Reactive fluids Retort type: Vertical	8 STIS Rifle, Colorado Oil Shale Project Country/Location: Rifle, Colorado, United States Company: Shale Tech International Services LLC Start-up: 1974 Status: Operational Facility type: Pilot Production capacity: 1 t/h (2250 lb/h) Extraction technology: Surface mining Retorting process: Paraho II Heating method: Combined Heat carrier: Internal combustion or Externally generated hot gas Retort type: Vertical	9 Ambre Energy NA Vernal, Utah Pilot Plant Country/Location: Vernal, Utah, United States Company: Lighthouse Resources Inc. (formerly Ambre Energy North America, Inc.) Start-up: 2007 Status: Operational Facility type: Pilot Production capacity: 350 t/h (2008) Extraction technology: Surface mining Retorting process: Millenium (Oil-Tech) Heating method: - Heat carrier: Conduction through a wall (various fuels) Retort type: Vertical	10 Unocal Oil Shale Demo Plant Country/Location: Parachute, Colorado, United States Company: Unocal Corporation Start-up: 1985-1991 Status: Closed Facility type: Demonstration Production capacity: 875 t/d or up to 5900 bpd Extraction technology: Surface mining Retorting process: Union Heating method: Combined Heat carrier: Internal combustion or Externally generated hot gas Retort type: Vertical	11 Irati Energy Papanuva Oil Shale Plant Country/Location: Papanuva, Santa Catarina, Brazil Company: Irati Energy (Irati Energia) Start-up: - Status: Planned Facility type: Pilot Production capacity: 8000 bpd (pilot) Extraction technology: Surface mining Retorting process: PRIX Technology Heating method: Direct Heat carrier: - Retort type: Vertical
12 Blue Ensign Townsville Pilot Plant Country/Location: Townsville, Queensland, Australia Company: Blue Ensign Technologies Limited Start-up: - Status: Planned Facility type: Pilot Production capacity: 1 t/h Extraction technology: Surface mining Retorting process: Rendall Technology Heating method: Direct Heat carrier: Reactive fluids Retort type: Vertical	12 Blue Ensign Julia Creek Pilot Plant Country/Location: Julia Creek, Queensland, Australia Company: Blue Ensign Technologies Limited Start-up: - Status: Planned Facility type: Commercial Production capacity: 600 t/h Extraction technology: Surface mining Retorting process: Rendall Technology Heating method: Direct Heat carrier: Reactive fluids Retort type: Vertical	1 Shell Mahogany Research Oil Shale Project Country/Location: Denver, Colorado, United States Company: Shell Oil Company Start-up: 2004-2013 Status: Stopped/Cancelled Facility type: Test Production capacity: 1700 bbl (2004) Extraction technology: In situ Retorting process: Shell In Situ Conversion Process (Shell ICP)	2 Chevron Rio Blanco Oil Shale Project Country/Location: Rio Blanco, Colorado, United States Company: Chevron U.S.A., Inc. Start-up: - Status: Stopped/Cancelled Facility type: Pilot Production capacity: - Extraction technology: In situ Retorting process: Chevron In Situ Conversion Process (Chevron ICP)	3 ExxonMobil Rio Blanco Oil Shale Project Country/Location: Rio Blanco, Colorado, United States Company: ExxonMobil Corporation Start-up: 2010 Status: Testing, Research & Developing Facility type: - Production capacity: - Extraction technology: In situ Retorting process: ExxonMobil Electrofrac Process
4 AMSO (EGL) Rio Blanco Oil Shale Project Country/Location: Rio Blanco, Colorado, United States Company: American Shale Oil, LLC (AMSO) (formerly EGL Oil Shale, LLC) Start-up: 2012-2016 Status: Closed Facility type: Pilot Production capacity: - Extraction technology: In situ Retorting process: AMSO EGL Technology Process	5 IEP Geothermic Fuel Cell Rio Blanco Oil Shale Project Country/Location: Rio Blanco, Colorado, United States Company: Independent Energy Partners, Inc. Start-up: 2013 Status: Testing Facility type: Pilot Production capacity: - Extraction technology: In situ Retorting process: IEP Geothermic Fuel Cell Tech. Process	6 Red Leaf Resources Seep Ridge Oil Shale Project Country/Location: Seep Ridge, Utah, United States Company: Red Leaf Resources, Inc. Start-up: 2021/2023 Status: Planned Facility type: Commercial Production capacity: 10 000-12 000 bpd Extraction technology: Surface mining Retorting process: EcoShale In-Capsule Technology Heating method: Direct Heat carrier: Conduction through a wall (various fuels) Retort type: -	7 Alpha Oil Shale Project (MDL330) Country/Location: Alpha, Rockhampton, QLD, Australia Company: Greenvale Energy Ltd. Start-up: - Status: Planned Facility type: - Production capacity: - Extraction technology: In situ Retorting process: Radio Frequency Heating and Solvent Injection Technology	8 Tasmania Oil Shale Project (EL 20/2004) Country/Location: Latrobe, Tasmania, Australia Company: Boos Resources Ltd. Start-up: - Status: Operational Facility type: - Production capacity: - Extraction technology: In situ or surface mining Retorting process: -

