

## Case Studies – Texas, Wyoming, California, Michigan

TEXAS	WYOMING	CALIFORNIA	MICHIGAN
<b>REGULATORY AUTHORITY – WHO REGULATES WHAT</b>			
OIL AND GAS			
<p>Texas Railroad Commission (TRRC)</p> <ul style="list-style-type: none"> <li>▪ oil and gas, pipelines, UIC (class II).</li> </ul> <p>The Texas Administrative Code provides a comprehensive regulatory scheme for the underground storage of any gas.<sup>1</sup></p>	<p>Wyoming Oil and Gas Conservation Commission</p> <ul style="list-style-type: none"> <li>▪ regulates class II wells under the Underground Injection Control (UIC) Program.<sup>2</sup></li> </ul>	<p>Department of Conservation, Division of Oil, Gas and Geothermal Resources (DOGGR)</p> <ul style="list-style-type: none"> <li>▪ Regulates Oil, gas, EOR, EGR, and the UIC Program.</li> </ul>	<p>MI Department of Environmental Quality (DEQ), Oil &amp; Gas Division</p> <ul style="list-style-type: none"> <li>▪ regulates drilling activities and everything related to minerals (coal, oil and gas classified as minerals),</li> <li>▪ policy is to limit waste and achieve maximum recovery<sup>3</sup></li> </ul> <p>Michigan's Oil and Gas Regulations includes the following:<sup>4</sup></p> <ul style="list-style-type: none"> <li>Part 615 - Supervisor of Wells</li> <li>Part 616 - Orphan Well Fund</li> <li>Part 617 – Unitization</li> </ul>
WATER			
<p>Local Groundwater Conservation Districts (GCDs)<sup>5</sup></p> <ul style="list-style-type: none"> <li>▪ purpose is to preserve, protect, and prevent the waste of groundwater</li> <li>▪ is the preferred method of groundwater regulation by the Legislature.<sup>6</sup></li> </ul> <p>Texas Groundwater Protection Committee</p> <ul style="list-style-type: none"> <li>▪ interagency committee designed to coordinate the regulations of groundwater by multiple state agencies.<sup>7</sup></li> <li>▪ State agencies delegated the responsibility of protecting groundwater are the Department of Agriculture, the Railroad Commission of Texas, and the State Soil and Water Conservation Board.<sup>8</sup></li> </ul>	<p>Wyoming Department of Environmental Quality, Water Quality Division<sup>9</sup></p> <ul style="list-style-type: none"> <li>▪ Regulates class I, IV and V wells under the UIC Program.</li> <li>▪ Regulates groundwater pollution control, operates the water and wastewater program, and maintains surface water quality standards.</li> </ul>	<p>The State Water Resources Control Board / Regional Water Quality Control Boards</p> <ul style="list-style-type: none"> <li>▪ responsible for the management of water resources.<sup>10</sup></li> </ul>	<p>MI Department of Environmental Quality (DEQ)<sup>11</sup></p> <ul style="list-style-type: none"> <li>▪ regulates activities that may impair or destroy the state's waters including inland lakes and streams, the Great Lakes, wetlands and groundwater.</li> </ul>

ENVIRONMENTAL			
<p>Texas Council on Environmental Quality (TCEQ) – UIC (classes I, IV, V).</p> <p>Note: Under specific FutureGen legislation, the TCEQ regulates CO<sub>2</sub> injection into deep saline aquifers.<sup>12</sup></p>	<p>Wyoming Department of Environmental Quality, Land Quality Division:</p> <ul style="list-style-type: none"> <li>▪ Regulates class III wells under the UIC Program.<sup>13</sup></li> <li>▪ Administers and enforces regulations regarding land disturbances resulting from mining and reclamation.<sup>14</sup></li> </ul>	<p>California Air Resources Board/CalEPA – air pollutants (CO<sub>2</sub> emissions from vehicles).</p>	<p>MI Department of Environmental Quality (DEQ)</p>
POWER			
<p>The Public Utilities Commission of Texas</p> <ul style="list-style-type: none"> <li>▪ responsible for the regulation of electric utilities.</li> </ul> <p>The Railroad Commission of Texas</p> <ul style="list-style-type: none"> <li>▪ regulates natural gas.</li> </ul>	<p>Wyoming Public Service Commission</p> <ul style="list-style-type: none"> <li>▪ regulates electric industry, including pipeline siting and construction.<sup>15</sup></li> </ul>	<p>California Energy Commission</p> <ul style="list-style-type: none"> <li>▪ responsible for power plant licensing &amp; permitting.</li> </ul>	<p>The Michigan Public Service Commission (Department of Labor and Economic Growth)</p> <ul style="list-style-type: none"> <li>▪ responsible for regulating electric utilities (with the exception of municipal utilities) and for regulating natural gas utilities, production, distribution, and storage.<sup>16</sup></li> </ul>

**EXPERIENCE WITH CO<sub>2</sub> INJECTION - EXISTING PROJECTS, INSTITUTIONAL CAPACITY/RESOURCES TO REGULATE**

**HISTORICAL PROJECTS**

Texas has substantial capacity for CO<sub>2</sub> injection and State resources to regulate the same. Texas generally, and the Permian Basin specifically, leads the United States in experience with CO<sub>2</sub> injections. In Texas alone, for example, there are 10,000 permitted carbon dioxide injection wells, 8,000 of which inject carbon dioxide exclusively. Those wells inject over 1 billion cubic feet of CO<sub>2</sub> daily. In 2005, the Permian Basin produced its billionth barrel of oil from injected carbon dioxide.

<i>Lost Soldier</i>	
Timeframe	1989 – 2006
Production (b/d)	3,000
Production to 2000(MMbbl)	44

<i>Wertz</i>	
Timeframe	1986 – 2006
Production (b/d)	1,300
Production to 2000(MMbbl)	17

<i>Salt Creek</i>	
Timeframe	2004 – 2006
Production (b/d)	25,000

<i>Teapot Dome</i>	
Timeframe	2005 – 2015

<i>Coyote East, Hualde Dome Unit</i>	
Project Type	WAG
Timeframe	1982-1984
Cumulative Net CO <sub>2</sub> Injected (Mcf)	143,080

<i>Huntington Beach, Onshore Area A-37</i>	
Project Type	Cyclic
Timeframe	1981-1982
Cumulative Net CO <sub>2</sub> Injected (Mcf)	1,893,892

<i>Wilmington, Fault Block I</i>	
Project Type	WAG
Timeframe	1983-1986
Cumulative Net CO <sub>2</sub> Injected (Mcf)	2,329,900

<i>Wilmington, Fault Block III</i>	
Project Type	WAG
Timeframe	1981-1996
Cumulative Net CO <sub>2</sub> Injected (Mcf)	3,490,301

<i>Wilmington, Fault Block V</i>	
Project Type	WAG
Timeframe	1982-1989
Cumulative Net CO <sub>2</sub> Injected (Mcf)	8,463,295

<i>Venture D-6</i>	
Project Type	Pilot flood
Timeframe	1988-1988
Cumulative Net CO <sub>2</sub> Injected (Mcf)	216,159

Production in 1984:<sup>17</sup>

- Gas injection: 6,439,797 MCF – 181 injection wells
- Water injection: 6,603,000 BBL – 502 injection wells
- Total primary oil production in 1984 – 2,074,576 BBL
- Total secondary oil production in 1984 – 5,314,832 BBL November 2005-May 2006 – CO<sub>2</sub> injection reporting at 4 facilities (it is not clear if this is all of the CO<sub>2</sub> injection activity in the state)

Other production information:<sup>18</sup>

- Oil production: 29,201 MSCF
- Gas production: 1,301,647 MSCF
- CO<sub>2</sub> injection: 2,011,089 MSCF
- CO<sub>2</sub> produced: 1,426,772 MSCF

		<table border="1"> <tr><td colspan="2"><i>Coles Levee, North Stevens</i></td></tr> <tr><td>Project Type</td><td>Flood</td></tr> <tr><td>Timeframe</td><td>1981-1984</td></tr> <tr><td>Cumulative Net CO<sub>2</sub> Injected (Mcf)</td><td>1,706,355</td></tr> </table> <table border="1"> <tr><td colspan="2"><i>Lost Hills, Etchegoin</i></td></tr> <tr><td>Project Type</td><td>Pilot/WAG</td></tr> <tr><td>Timeframe</td><td>2000-2002</td></tr> <tr><td>Cumulative Net CO<sub>2</sub> Injected (Mcf)</td><td>1,886,421</td></tr> </table> <p>Cumulative net CO<sub>2</sub> injected for the state of California is 18,419,403 Mcf.</p>	<i>Coles Levee, North Stevens</i>		Project Type	Flood	Timeframe	1981-1984	Cumulative Net CO <sub>2</sub> Injected (Mcf)	1,706,355	<i>Lost Hills, Etchegoin</i>		Project Type	Pilot/WAG	Timeframe	2000-2002	Cumulative Net CO <sub>2</sub> Injected (Mcf)	1,886,421	
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**BACKGROUND**

<p>Permian Basin</p> <ul style="list-style-type: none"> <li>OOIP: 95.4 billion barrels</li> <li>Recovered (or proved): 33.7 billion barrels</li> <li>Remaining OIP: 61.7 billion barrels</li> <li>Amenable to CO<sub>2</sub> EOR: 39.3 billion barrels.<sup>19</sup></li> </ul> <p>East and Central Texas</p> <ul style="list-style-type: none"> <li>OOIP: 108 billion barrels</li> <li>Recovered: 35.4 billion barrels</li> <li>Remaining OIP: 72.6 billion barrels</li> <li>Amenable to CO<sub>2</sub> EOR: 34.1 billion barrels<sup>20</sup></li> </ul>	<ul style="list-style-type: none"> <li>OOIP: 15.2 billion barrels</li> <li>Recovered: 4.8 billion barrels</li> <li>Remaining OIP: 10.4 billion barrels</li> <li>Amenable to CO<sub>2</sub> EOR: 7.6 billion barrels</li> </ul>	<ul style="list-style-type: none"> <li>OOIP: 83.3 billion barrels</li> <li>Recovered: 26.0 billion barrels</li> <li>Remaining OIP: 57.3 billion barrels</li> <li>Amenable to CO<sub>2</sub> EOR: 22.1 billion barrels<sup>21</sup></li> </ul>	<ul style="list-style-type: none"> <li>OOIP – 216.7 million barrels</li> <li>Recoverable OOIP – 19.5 million barrels.</li> <li>Total recovered oil to date - 29.8 million barrels.</li> <li>Total recovered to date from secondary recovery or pressure mgmt – 16.3 million barrels.</li> </ul>
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**OTHER INFO**

<p>Numerous companies in Texas are engaged in the CO<sub>2</sub> business, including: ExxonMobil, Occidental Petroleum, Anadarko Petroleum Corporation, PetroSource Energy Company, and Kinder Morgan CO<sub>2</sub> Company, LP.</p>	<p>A component of the state-mandated Enhanced and Improved Oil Recovery Commission research program is on CO<sub>2</sub> capture for enhanced recovery.<sup>22</sup> Highlights of the CO<sub>2</sub> capture research include:<sup>23</sup></p> <ul style="list-style-type: none"> <li>Development of synthetic compounds that have higher absorption than liquids.</li> <li>Development of concepts for appropriately modifying</li> </ul>		<p>Michigan wells initially used recycled gas injection for both pressure management and for secondary recovery. It appears that this practice was primarily replaced with water flooding starting around 1958, although one or two recycled gas injection wells were reported through 1984. CO<sub>2</sub> injection has just recently started and there seem to be very few wells using this approach. There are also about 55 natural gas storage wells. MDEQOG has a set of animated maps the</p>
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	<p>inorganic membranes.</p> <ul style="list-style-type: none"><li>▪ Development of a poly (ionic liquid) CO<sub>2</sub> sorbent.</li><li>▪ Development of two polymer membranes with high CO<sub>2</sub> selectivity and permeability.</li></ul>		<p>present the history of well development in the state going back to the 1940's at this location.<sup>24</sup></p>
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**SURFACE LIABILITY (DAMAGE TO AGRICULTURAL LANDS, RESIDENTIAL, PUBLIC SAFETY)**

**SURFACE WATER RIGHTS**

The state of Texas adopted and follows the traditional common law “rule of capture” to define groundwater rights.<sup>25</sup> The rule of capture provides that landowners have the right to the entire subsurface and can take and use any groundwater accessible from their land.<sup>26</sup> Additionally, a landowner can not be held liable for depriving other neighboring landowners of the water’s use. The only exceptions to landowner liability under the rule of capture are negligence in causing subsidence of land, willful waste, and malice.<sup>27</sup>

Water is the property of the state, with use rights attaching to the land for irrigation, or to a legally recognized beneficial application.<sup>28</sup> ‘Beneficial use’ is the measure and limit of the right to use water at all times, not exceeding the statutory limit.

In California, there is no private ownership of ground or flowing water and groundwater is wholly owned by the State.<sup>29</sup> The State has the power to supervise and regulate the use of water,<sup>30</sup> and the State is to regulate so as to protect the public interest in and beneficial use of all water in the State, and particularly to maximize the public benefit from use of groundwater.<sup>31</sup>

A private party can obtain the right to use of water by owning land appurtenant to the water source (overlying rights), by appropriating water (appropriative rights), by inheriting a pueblo right (pueblo rights), or by open and notorious prescription (prescriptive rights).<sup>32</sup> All uses of water, regardless of the right upon which the use is based, are subject to the Constitutional standard that the use must be reasonable and beneficial.<sup>33</sup>

Michigan applies the doctrine of reasonable use which allows a riparian owner to make any and all reasonable use of the water as long as such use does not unreasonably interfere with other riparian owners’ opportunity for reasonable use.<sup>34</sup> Reasonable use is determined by a weighing of factors of the user as compared to similar factors of other competing users.<sup>35</sup>

**LIABILITY ASSOCIATED WITH OIL AND GAS**

Texas law and regulations comprehensively require oil & gas operators to protect the environment – specifically including land and surface water – and makes them liable for clean-up costs and related harm in the event of a spill or other release of materials to the environment.<sup>36</sup> Any alteration of the physical, thermal, chemical, or biological quality of, or the contamination of, any surface or subsurface water in the state that renders the water harmful, detrimental, or injurious to humans, animal life, vegetation, or property, or to public health, safety, or welfare, or impairs the usefulness or the public

The operator must pay the surface owner compensation equal to the amount of damages sustained by the surface owner for loss of production and income, loss of land value and loss of value of improvements caused by oil and gas operations,<sup>40</sup> unless there is a written agreement between the parties for notice of and compensation for damages.<sup>41</sup> If no agreement is reached, the surface owner can bring an action for damages against the oil and gas operator.<sup>42</sup> There is a two-year statute of limitations on any such action for damages commencing after the damage was or should have been

Wells with known high pressure gas(es) or wells being drilled in areas where the pressure is unknown must be equipped with sufficiently strong casings and other safety devices so as to prevent blowouts, explosions, and fires.<sup>44</sup> The Department of Conservation is to investigate and report on options for guaranteeing blowout insurance for persons drilling or redrilling wells in high pressure areas.<sup>45</sup>

The Michigan rule prohibits a permittee from causing damage to the surface and subsurface, including the escape of a substance in a quantity sufficient “to pollute the air, soil, surface waters, or groundwaters, or to cause unnecessary endangerment of public health, safety, or welfare,”<sup>46</sup> the waste of injected fluids,<sup>47</sup> and waste from the disposal of brines produced.<sup>48</sup>

<p>enjoyment of the water for any lawful or reasonable purpose is prohibited.<sup>37</sup> The standard is “no pollution.”<sup>38</sup></p> <p>Specifically with respect to surface liability, TRRC regulations exempt from clean-up liability innocent parties who agree voluntarily to clean-up contaminated property.<sup>39</sup> Parties who are responsible for the damage remain liable. These provisions are part of the TRRC’s Voluntary Cleanup Program.</p>	<p>discovered.<sup>43</sup></p>		
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**SUBSURFACE LIABILITY (GEOPHYSICAL TRESPASS, HYDROCARBON DAMAGE, GROUNDWATER CONTAMINATION)**

**MINERAL RIGHTS**

<p>Under Texas mineral rights law, the owner of land owns the minerals, oil, and gas beneath it, unless those estates have been severed. The landowner also owns the reservoir storage land beneath the land. Oil and gas interests are also subject to the rule of capture, entitling the owner of land on which a well sits to all of the oil and gas that may be obtained through the well, regardless of the land on which the oil and gas “sits,” subject to due care and reasonableness considerations intended to protect other landowners. If oil or gas is re-injected into the ground for storage, it remains the property of the capturer, regardless of the ownership of the surface overriding the storage area.<sup>49</sup></p> <p>Although, if injected substances are abandoned, they are no longer considered ‘captured.’</p> <p>Furthermore, the negative rule of capture limits the recovery for trespass in the case of subsurface intrusions. No recovery exists when injected secondary recovery forces substances to move across property lines.<sup>50</sup> However, the Texas Court may recognize a cause of action for subsurface intrusion in situations where there is actual harm.<sup>51</sup></p>	<p>The Commission has the authority to require and regulate the noncommercial underground disposal into Class II injection wells of salt water, nonpotable water and oil field wastes related to oil and gas production in such a manner as to prevent contamination of the waters of the state.<sup>52</sup></p>	<p>The operator of an oil and gas lease must act as a prudent operator would using reasonable diligence, keeping in mind the interests of the lessor, lessee and the state, with common goal being to further eliminate waste by increasing recovery of hydrocarbons.<sup>53</sup></p>	<p>In general, mineral rights belong to the surface owner.<sup>54</sup> Under ownership in place theory the nature of the interest of the landowner in oil and gas contained in his land is the same as his interest in solid minerals; solid minerals are part of the land in or beneath which they are located, and as a consequence the owner of land is also the owner of the oil and gas in or beneath it.<sup>55</sup> Under the rule of capture, owner of tract of land acquires title to the oil and gas which he produces from wells drilled thereon, even if it may be proved that part of such oil or gas migrated from adjoining lands; under such rule, in absence of state regulation of drilling practices, landowner is not liable to adjacent landowners whose land is drained as result of such operations.<sup>56</sup> The fair share rule provides that each operator should have opportunity equal to that afforded other operators to recover the equivalent amount of recoverable oil and gas underlying his property does not do away with rule of capture, but rather acts to place limits on its proper application.<sup>57</sup> The damages and required remediation / remuneration for damage to the subsurface do not seem to be addressed explicitly in the regulations.</p> <p>The permit for an injection well specifies the strata to which the well must be confined.<sup>58</sup> Further, the requirements for constructing and gaining approval for constructed wells are quite detailed.</p>
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**GROUNDWATER RIGHTS**

<p>Under Texas law, the owner of the surface also owns all groundwater (the term “groundwater” is used in a general sense and refers to all water beneath the surface other than defined subterranean</p>	<p>All waters, including groundwaters are the property of the State and are subject to State control of their beneficial use. Rights to underground water are subject to the same</p>	<p>The regulatory structure for surface waters also applies to groundwater, except that groundwater is wholly owned by the State.</p>	<p>The doctrine of reasonable use also applies to groundwater rights.<sup>65</sup> However, the doctrine is slightly modified as compared with its application to surface water rights. It is applied in a more flexible manner to</p>
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<p>streams.) beneath his land, and has the right to use it for any purpose.<sup>59</sup> No liability attaches if the landowner's use of groundwater causes harm to an adjacent landowner.<sup>60</sup> It is unclear what, if any, limits on recovery for "invasion" into groundwater Texas courts might impose, although it follows that if no actual harm or impairment of use is caused by such an "invasion," courts may reject trespass claims for the same reason such claims are rejected for "invasion" into the subsurface generally.</p>	<p>preferences as for surface waters, and rights not preferred may be condemned and changed to a preferred use in the manner provided by law for surface waters.<sup>61</sup> Pollution or waste of the waters of the state, and altering of the physical, chemical, radiological, biological or bacteriological properties of any waters of the state are prohibited.<sup>62</sup> Release of hazardous substances is also prohibited, and any party that owns or controls a hazardous substance (or oil) must immediately contain the release (or threat thereof) and correct the cause of the release.<sup>63</sup> A hazardous substance is any substance or waste which, after release, constitutes a threat to public health or welfare, or other aquatic life or wildlife because of its quantity, concentration, chemical, corrosive, flammable, reactive, toxic, infectious, or radioactive characteristics.<sup>64</sup></p>		<p>ensure that no one user would be deprived of all beneficial use of its water resources.<sup>66</sup> It is applied such that an owner is only required not to interfere with an adequate supply of water for the plaintiff's reasonable use.<sup>67</sup> This is called the correlative rights rule, or reasonable use balancing test.<sup>68</sup> Landowners can use underground percolating water resources (distinguishable from those that flow in a well-defined channel) freely up to the point that such use unreasonably interferes with the correlative right of a neighbor.</p> <p>The Groundwater Discharge Program regulates discharge to groundwater under Part 31, Water Resources Protection, of the Natural Resources and Environmental Protection Act, 1994 PA 451 and Part 22 Rules, including the authorization of discharges of waste and wastewaters into the ground or groundwaters, groundwater monitoring, discharge facility inspection, and toxicological support for the Waste Management Division.<sup>69</sup></p>
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## Existing EOR / EGR

### PROJECTS

Texas oil producers are familiar with using technology for improving oil recovery. For example, operators can draw upon the experiences of a number of CO<sub>2</sub>-EOR floods in the Permian Basin as well as the secondary (waterflooding) efforts in Texas. In addition, a large N<sub>2</sub>-Immiscible flood has been conducted in the Hawkins field since 1987 that has allowed an additional 40 MMBbls of oil to be recovered.<sup>70</sup>

CO<sub>2</sub>-EOR projects in Colorado's Rangely Field and Wyoming's Lost Soldier and Wertz fields have been underway since the 1980's, and several new projects have been initiated in the past two years. The CO<sub>2</sub> floods in the Lost Soldier and Wertz fields were both successful. The Lost Soldier project, a flooding of three formations, produces at a rate of 3,000 barrels per day, with a total of 44 million barrels recovered through 2000. The Salt Creek Field CO<sub>2</sub> - EOR project began in 2004 and is expected to raise field production to 25,000 - 30,000 BPD, compared to 6,000 BPD in 2004. Approximately 130 MMcf/d of CO<sub>2</sub> is being injected into the formation, and early results are as expected.<sup>71</sup> The Wyoming Enhanced and Improved Oil and Recovery Commission is responsible for developing an oil and gas recovery technology research program to increase the recovery of oil and gas resources.<sup>72</sup> According to the Wyoming Geological Survey (WGS), approximately 8 billion barrels of oil remain in Wyoming fields and between 5% and 15% of this oil can be recovered with EOR technologies. Therefore, a broad application of EOR could increase the state's ultimate oil production by anywhere from 400 million to 1.2 billion barrels.<sup>73</sup>

Statistics on EOR projects in California are below.

<i>All Projects</i>	
Year	Total # Projects
2000	61
2001	57
2002	57
2003	57
2004	52

<i>Water Flooding</i>	
Year	Oil Recovered (bbl)
2000	43,752,000
2001	43,286,000
2002	46,660,000
2003	42,683,000
2004	42,658,900

<i>Thermal</i>	
Year	Oil Recovered (bbl)
2000	135,738,000
2001	135,814,000
2002	108,436,000
2003	87,850,700
2004	104,539,600

<i>Gas Injection</i>	
Year	Oil Recovered (bbl)
2000	1,992,000
2001	2,975,000
2002	4,264,000
2003	4,814,000
2004	6,652,000

Michigan has two small miscible CO<sub>2</sub>-EOR floods that have been ongoing for the past 10 years. Dover 33 and Dover 36, two Niagran pinnacle reef field reservoirs of 5200 feet in depth, were started in 1996 by Core Energy, LLC. Dover 36 is expected to produce an estimated 31% of its 3.7 MMBbls OOIP, which increased by 5% of the field OOIP after of 5.4 Bcf of CO<sub>2</sub> was injected. Dover 33 is supposed to produce an estimated 33% of its 4.1 MMBbls OOIP, and 21 Bcf CO<sub>2</sub> injected should produce an additional 18% OOIP. Michigan Technical University, Western Michigan University and Jordan Development Company, LLC are conducting a third CO<sub>2</sub> EOR project on the Dover 35 field (injection began in 2004), which is similar in size and reservoir characteristics to the Dover 33 and 36 fields. The operators expect an ultimate primary recovery of 44% OOIP with an additional recovery of 2.2 MMBbls of OOIP.<sup>74</sup>

		<i>Total Incremental Production</i>			
		Year	Oil Recovered (bbl)		
		2000	181,482,000		
		2001	182,075,000		
		2002	159,360,000		
		2003	135,357,700		
		2004	153,850,500		

## EXISTING WELL ABANDONMENT REGULATIONS

### REGULATIONS

<p>Well plugging is extensively regulated, with advance notice and technical performance criteria applying to the operations. The TRRC requires that the owner assume responsibility for plugging the well and that the owner or its successors fulfill the plugging process:<sup>75</sup></p>	<p>There are specific requirements for plugging of wells,<sup>76</sup> the casing of injection wells,<sup>77</sup> and abandonment of wells<sup>78</sup> to ensure that groundwater is protected from pollution.</p>	<p>Before a well can be abandoned, the operator must show that the necessary steps have been taken to isolate oil-bearing or gas-bearing strata and to protect all waters from pollution or damage.<sup>79</sup> If there is a subsequent risk of damage or pollution, the operator can be made responsible for reabandoning the well.<sup>80</sup></p>	<p>Michigan has detailed well-plugging requirements including instructions for plugging, methods and materials to be used, and confinement specifications.<sup>81</sup></p> <p>If a well is determined to be closed and not abandoned, the state (the Supervisor of Wells) is required to plug the well within 30 days, with the cost to be borne by the owner / operator or the surety for the well.<sup>82</sup> Abandoning of a well without proper plugging is a misdemeanor charged to the owner/operator, and is punishable by imprisonment for not more than 90 days, and/or a fine of not more than \$1,000 plus the costs of prosecution.<sup>83</sup></p>
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### EXISTENCE OF INSURANCE/INDEMNITY BONDS/FEEES FOR PLUGGING AND ABANDONMENT

<p>Operators must meet financial security and insurance requirements. Specifically, operators shall submit well-specific plugging insurance policies, bonds and letters of credit on forms prescribed by the TRRC.<sup>84</sup></p> <p>Texas operates an abandoned/orphaned well program.<sup>85</sup> Funding for the program comes from regulatory fees, permit fees and bond fees paid by the oil &amp; gas industry.</p>	<p>Wyoming requires the operator to put forth a surety bond or other form of guaranty as part of the permitting process; the bond or guaranty must be in amount not less than \$2,000 per well site on the land.<sup>86</sup> The Commission has the authority to plug wells, using permitting funds, if it is unable to require the owner to plug the well or the bond or other guaranty does not cover the cost of plugging. This does not, however, make the state liable for any failure to properly plug a well.</p> <p><i>Bonding Requirements:</i><sup>87</sup> A bond is required to ensure a well is operated so as not to cause waste or damage to the environment, and to ensure adequate plugging. The minimum amount is \$10,000 per well for wells less than 2,000 feet deep; \$20,000 per well for wells of 2,000</p>	<p>An individual oil and gas well indemnity or cash bond or Class II commercial waste water disposal well indemnity or cash bond must be filed by the operator. The bond shall secure the State against all losses, charges, and expenses incurred by the State to obtain compliance. An indemnity or cash bond can be terminated when the well is completed (when it has produced for a six-month period) or plugged and abandoned properly, another valid bond substituted for it, all required records are filed, and all operations are in compliance.</p> <p><i>Bond Amounts</i> Individual Oil and Gas Wells (onshore surface location)</p> <ul style="list-style-type: none"> <li>• \$15,000 - less than 5,000 feet deep</li> <li>• \$20,000 - at least 5,000 but less than 10,000 feet deep</li> <li>• \$30,000 - 10,000 or more feet deep</li> </ul> <p>Onshore Wells Covered by a Blanket</p>	<p>Rules governing bonds/ fees and insurance are contained in the general provisions for the Supervisor of Wells and in the administrative rules. Operators must first obtain a permit for a well, which includes securing a bond and paying the permit fee of \$300.<sup>91</sup></p> <p><i>Bond Amounts:</i> Single well conformance bonds shall be in the amount of:</p> <ul style="list-style-type: none"> <li>• \$10,000 for wells 2,000 feet deep (true vertical depth) or less;</li> <li>• \$20,000 for wells deeper than 2,000 feet but not deeper than 4,000 feet;</li> <li>• \$25,000 for wells deeper than 4,000 feet but not deeper than 7,500 feet; and</li> <li>• \$35,000 for wells deeper than 7,500 feet.</li> </ul> <p>A blanket conformance bond can be issued to cover a maximum of 100 wells, and must be in the amount of:</p> <ul style="list-style-type: none"> <li>• \$100,000 for wells 2,000 feet deep or less;</li> </ul>
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	<p>feet or more in depth; or alternatively, a blanket bond in the amount of \$75,000.00 covering all wells including wells less than 2,000 feet in depth.</p> <p>The bond(s) remain in effect until the well has been permanently plugged and abandoned, the well has been properly converted to a water well, the successive owner/operator or purchaser of the well(s) and/or the site(s) provided a bond or other surety; or the bond has been released by the Commission.</p> <p>Site reclamation must be initiated within a year of permanent abandonment, and must be completed in a timely manner.<sup>88</sup></p>	<p>Bond</p> <ul style="list-style-type: none"> <li>• \$100,000 (covers 50 or fewer total onshore wells owned by an operator)</li> <li>• \$250,000 (covers more than 50 total onshore wells owned by an operator)</li> <li>• \$1,000,000 (covers all wells owned by an operator, including idle wells)</li> </ul> <p>Individual Class II Commercial Waste-Water Disposal Wells - \$50,000.<sup>89</sup></p> <p>A Class II well may be covered by either an individual Class II commercial waste-water disposal well indemnity or cash bond or a blanket indemnity or cash bond. However, only one Class II commercial well may be covered by a \$250,000 or a \$1,000,000 blanket bond. Additional Class II commercial wells must be covered by individual bonds. Individual Five-Year Idle Wells - \$5,000 Operators may file a \$5,000 individual indemnity or cash bond to cover their idle wells under Section 3206 of the PRC.</p> <p>The Department of Conservation is required to report annually to the Governor and Legislature on options for ensuring that parties drilling oil and gas wells have blowout insurance.<sup>90</sup></p>	<ul style="list-style-type: none"> <li>• \$200,000 for wells deeper than 2,000 feet but not deeper than 4,000 feet; and</li> <li>• \$250,000 for wells deeper than 4,000 feet.<sup>92</sup></li> </ul>
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**ACCOUNTING LINKAGES (EXISTING CO<sub>2</sub> REGULATIONS THAT MAY ADDRESS LIABILITY DIRECTLY OR INDIRECTLY)**

<p>For purposes of the FutureGen project, Texas has enacted legislation that gives the State title to injected CO<sub>2</sub> (specifically, to the TRRC).</p>	<p>None.</p>	<p>CPUC Carbon Adder: In December 2004 the California PUC approved a requirement that a “carbon adder” be included in resource plans for three of California’s utilities, Pacific Gas and Electric Company, Southern California Edison, and San Diego Gas and Electric Company. A carbon adder is a means of accounting for possible future costs of mitigating GHG emissions. It is an expected future price for CO<sub>2</sub> that is assumed when comparing investment options. Carbon adders are used to compare the cost of fossil fuel and renewable generation, as well as demand-side management investments. The carbon adder is used for utility planning purposes only, and is not assessed to consumers. Taking the cost of carbon into account means that an investment is considered more cost-effective if it avoids a ton of CO<sub>2</sub> emissions at an incremental cost equal to the value of the carbon adder. The CPUC based the range of costs on a number of studies and in April 2005 assessed a carbon adder of \$8.00 per ton of CO<sub>2</sub>.</p>	<p>None.</p>
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## EXISTING MONITORING REGULATIONS

After a well is completed, the operator has to file a basic electric log with the TRRC.<sup>93</sup> Operators of disposal/injection wells must monitor the injection pressure and volume at least monthly and report the results annually to the TRRC. Operators of hydrocarbon storage wells in salt formations must monitor the injection pressure and net volume injected or withdrawn at least monthly and report the results annually to the TRRC.

The owner or operator of a well must perform a mechanical integrity test no less than every five years. The test is designed to determine if there is a significant leak in the well, and if there is significant fluid movement into an underground water source.<sup>94</sup>

An operator may be required to implement a monitoring program to detect releases into the soil and water.<sup>95</sup> Operators of idle wells (ones that have not produced or been used for injection for six consecutive months) are required to perform periodic tests to ensure no damage is occurring to oil and gas reservoirs or groundwater.

Operators of injection wells must collect data on all oil, gas and brine produced, the cumulative volume of fluid injected, injection pressures, and injection rate. Operators must report this data at regular intervals.<sup>96</sup> If for a brine disposal injection well, recordings must be made on a weekly basis and reports filed monthly; if for a secondary recovery injection well, recordings must be made monthly and reports filed annually.<sup>97</sup> Gas storage wells are exempt from the rule.

## NATURAL GAS STORAGE

<p>TX had 34 total underground natural gas storage sites with a working gas capacity of 440 Bcf as of 2005.<sup>98</sup></p> <p>Title 3 of the Texas Natural Resources Code regulates oil and gas generally. The code contains a section controlling underground natural gas storage and conservation, and the TRRC oversees its application. The code grants storers of natural gas the right of eminent domain for the acquisition of underground storage facilities where certain conditions are met, including a finding by the Commission that the storage is necessary for adequate service to the public and is in the public interest.<sup>99</sup> Storers may thus obtain ownership of underground storage space.</p>	<p>WY had 8 total underground natural gas storage sites with a working gas capacity of 46 Bcf as of 2005.<sup>100</sup></p>	<p>CA had 11 total underground natural gas storage sites with a working gas capacity of 266 billion cubic feet (Bcf) as of 2005.<sup>101</sup></p> <table border="1"> <thead> <tr> <th>Year</th> <th>Total Storage (Mcf)</th> </tr> </thead> <tbody> <tr> <td>2000</td> <td>365,502,883</td> </tr> <tr> <td>2001</td> <td>443,999,925</td> </tr> <tr> <td>2002</td> <td>415,578,273</td> </tr> <tr> <td>2003</td> <td>425,189,309</td> </tr> <tr> <td>2004</td> <td>442,057,808</td> </tr> </tbody> </table> <p>The State is required to maintain surveillance over natural gas storage facilities to insure that no damage occurs to the environment by reason of injection and withdrawal of gas.<sup>102</sup></p>	Year	Total Storage (Mcf)	2000	365,502,883	2001	443,999,925	2002	415,578,273	2003	425,189,309	2004	442,057,808	<p>MI had 45 total underground natural gas storage sites with a working gas capacity of 633 Bcf as of 2005.<sup>103</sup></p>
Year	Total Storage (Mcf)														
2000	365,502,883														
2001	443,999,925														
2002	415,578,273														
2003	425,189,309														
2004	442,057,808														

<sup>1</sup> 16 TEX. ADMIN. CODE § 3.97 (2006).

<sup>2</sup> <http://deq.state.wy.us/wqd/groundwater/uicprogram/index.asp>.

<sup>3</sup> MICH. COMP. LAW ANN. § 324.61502 (2006).

<sup>4</sup> Oil and Gas exploration, drilling, and operating is regulated under the Natural Resources and Environmental Protection Act, Act No. 451 of the Public Acts of 1994, as amended (last amended 9/10/2004).

<sup>5</sup> TEX. WATER CODE §36.0015 (2006).

<sup>6</sup> *Id.*

<sup>7</sup> *Id.* at §26.403(a).

<sup>8</sup> *Id.* at §26.406(b).

<sup>9</sup> <http://deq.state.wy.us/wqd/index.asp>.

<sup>10</sup> CAL. WATER CODE, §13100 (2006).

<sup>11</sup> <http://www.michigan.gov/deq/0,1607,7-135-3313---,00.html>

<sup>12</sup> 30 TEX. ADMIN. CODE § 331.11(a)(4)(d) (2006). *See also*, FutureGen Alliance, <http://www.futuregenalliance.org>.

<sup>13</sup> <http://deq.state.wy.us/wqd/groundwater/uicprogram/index.asp>.

<sup>14</sup> <http://deq.state.wy.us/lqd/index.asp>.

<sup>15</sup> *See* <http://psc.state.wy.us/default.htm>.

<sup>16</sup> *See* <http://www.michigan.gov/mpsc/>.

<sup>17</sup> Mich. Dept. of Env. Quality, Div. of Oil and Gas (“MDEQOG”) – Table 12b Pressure Maintenance and Secondary Recovery Operations (a discontinued Database).

<sup>18</sup> Obtained from MDEQOG based on information reported in monthly reports #7126A, 7126B, 7609, 7107 and Operating Report EQP form 7609.

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- <sup>19</sup> See Basin Oriented Strategies for CO<sub>2</sub> Enhanced Oil Recovery: Permian Basin (DOE, February 2006) for a full summary of this potential, including the identities of specific reservoirs,
- <sup>20</sup> U.S. Dept. of Energy, Off. of Fossil Energy – Off. of Oil and Natural Gas, Basin Oriented Strategies for CO<sub>2</sub> Enhanced Oil Recovery: East and Central Texas (DOE, February 2006).
- <sup>21</sup> U.S. Dept. of Energy, Off. of Fossil Energy – Off. of Oil and Natural Gas, Basin Oriented Strategies for CO<sub>2</sub> Enhanced Oil Recovery: California (DOE, February 2006).
- <sup>22</sup> Enhanced Oil Recovery Commission, A Progress Report to the Joint Minerals, Business, and Economic Development Committee 2 (Nov. 1, 2005), *available at* <http://eori.gg.uwyo.edu/downloads/report11105.pdf>.
- <sup>23</sup> *Id.* at 6.
- <sup>24</sup> [http://www.michigan.gov/deq/0,1607,7-135-3311\\_4111\\_4231-146189--,00.html](http://www.michigan.gov/deq/0,1607,7-135-3311_4111_4231-146189--,00.html).
- <sup>25</sup> See *Houston & Texas Central Railway Co. v. East*, 98 Tex. 146, 81 S.W. 279 (1904); *Sipriano v. Great Spring Waters of America, Inc*, 1 S.W.3d 75, 75 (Tex. 1999).
- <sup>26</sup> *Sipriano v. Great Spring Waters of America* 1 S.W. 3d at 76.
- <sup>27</sup> *Fain v Great Spring Waters of America, Inc.*, 973 S.W.2d 327 (Tex.App. 1998).
- <sup>28</sup> WYO STAT. ANN. § 41-3-101 (2005).
- <sup>29</sup> *State v. Superior Court of Riverside County*, 78 Cal. App. 4th 1019, 1022-1023 (4th Dist. 2000).
- <sup>30</sup> *Central and West Basin Water Replenishment District v. Southern California Water Co.*, 109 Cal. App. 4th 891, 904 (2d Dist. 2003).
- <sup>31</sup> CAL. WATER CODE §105 (2006).
- <sup>32</sup> *Central and West Basin Water Replenishment District v. Southern California Water Co.*, 109 Cal. App. 4th at 906.
- <sup>33</sup> CAL. CONST., ART. X, §2.
- <sup>34</sup> *Dumont v. Kellogg*, 29 Mich. 420 (1874); *Schenk v. City of Ann Arbor*, 196 Mich. 75, 163 N.W. 109 (1917).
- <sup>35</sup> *Dumont v. Kellogg*, 29 Mich. 420 (1874).
- <sup>36</sup> See, e.g., 16 TEX. ADMIN. CODE §3.91 (cleanup of soil contaminated by a crude oil spill).
- <sup>37</sup> *Id.* at §3.8(a)(28).
- <sup>38</sup> *Id.* at §3.8(b).
- <sup>39</sup> *Id.* at §4.445.
- <sup>40</sup> WYO STAT. ANN. at §30-5-405.
- <sup>41</sup> *Id.* at §30-5-406.
- <sup>42</sup> *Id.*
- <sup>43</sup> *Id.* at §30-5-409.
- <sup>44</sup> CAL. PUB. RES. CODE §3219 (2006).
- <sup>45</sup> *Id.* at §3219.5.
- <sup>46</sup> MICH. COMP. LAWS ANN. r. 324.504 (2006)
- <sup>47</sup> *Id.* at r. 324.703.
- <sup>48</sup> *Id.*
- <sup>49</sup> See *Lone Star Gas Co. v. Murchison*, 353 S.W.2d 870 (Tex. Civ. App. 1962).
- <sup>50</sup> See, e.g., *Railroad Commission of Texas v. Manziel*, 361 S.W.2d 560 (Tex. 1962).
- <sup>51</sup> *FPL Farming, Ltd. v. Texas Natural Resource Conservation Commission*, 2003 WL 247183 (Tex. Civ. App. 2003).
- <sup>52</sup> WYOM STAT. ANN. §30-5-104.
- <sup>53</sup> CAL. PUB. RES. CODE at §3106(c).
- <sup>54</sup> Mich Comp. Laws §§554.291-554.293 (1963).
- <sup>55</sup> *Wronski v. Sun Oil Co.*, 89 Mich.App. 11, 21, 279 N.W.2d 564, 569 (1979).
- <sup>56</sup> *Id.*
- <sup>57</sup> *Id.*
- <sup>58</sup> MICH. COMP. LAWS ANN. at r. 324.802.
- <sup>59</sup> See, e.g., *Bartley v. Sone*, 527 S.W.2d 754 (Tex. Civ. App. 1975); *Glasscock Underground Water Conservation District v. Pruit*, 915 S.W.2d 577 (Tex. Civ. App. 1996).

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- <sup>60</sup> See generally Behrens, Eric and Matthew G. Dore, Rights of Landowners to Percolating Groundwater in Texas, 32 S. TEX. L. REV. 185 (1991).
- <sup>61</sup> WYO STAT. ANN. § 41-3-906 (2005).
- <sup>62</sup> WYO STAT. ANN. at § 35-11-301.
- <sup>63</sup> *Id.*
- <sup>64</sup> *Id.*
- <sup>65</sup> *Schenk v. City of Ann Arbor*, 196 Mich. 75, 163 N.W. 109 (1917).
- <sup>66</sup> *Bernard v. City of St. Louis*, 220 Mich. 159, 189 N.W. 891 (1922).
- <sup>67</sup> *Id.* at 165, 189 N.W. 891.
- <sup>68</sup> *Maerz v. United States Steel Corp.*, 116 Mich.App. 710, 323 N.W.2d 524 (1982).
- <sup>69</sup> [http://www.michigan.gov/deq/0,1607,7-135-3313\\_4117-9706--,00.html](http://www.michigan.gov/deq/0,1607,7-135-3313_4117-9706--,00.html)
- <sup>70</sup> U.S. Dept. of Energy, Off. of Fossil Energy – Off. of Oil and Natural Gas, Basin Oriented Strategies for CO<sub>2</sub> Enhanced Oil Recovery: East and Central Texas 3-3 (Feb. 2006).
- <sup>71</sup> U.S. Dept. of Energy, Off. of Fossil Energy – Off. of Oil and Natural Gas, Basin Oriented Strategies for CO<sub>2</sub> Enhanced Oil Recovery: Rocky Mountain Basin 6-11 - 6-12 (Feb. 2006).
- <sup>72</sup> WYO STAT. ANN. at § 30-8-101.
- <sup>73</sup> Enhanced Oil Recovery Commission, A Progress Report to the Joint Minerals, Business, and Economic Development Committee 2 (Nov. 1, 2005), available at <http://eori.gg.uwyo.edu/downloads/report11105.pdf>.
- <sup>74</sup> U.S. Dept. of Energy, Off. of Fossil Energy – Off. of Oil and Natural Gas, Basin Oriented Strategies for CO<sub>2</sub> Enhanced Oil Recovery: Illinois and Michigan Basins 6-12 (Feb. 2006).
- <sup>75</sup> 16 TEX. ADMIN. CODE § 3.14 (2006).
- <sup>76</sup> Wyom. Oil and Gas Conserv. Comm. Rules, Chpt. 3, §§ 14, 18.
- <sup>77</sup> Wyom. Oil and Gas Conserv. Comm. Rules, Chpt. § 8.
- <sup>78</sup> Wyom. Dept. of Env. Quality, Water Quality Rules and Regulations, Chpt. 11, § 70.
- <sup>79</sup> CAL. PUB. RES. CODE at §3208.
- <sup>80</sup> *Id.* at §3208.1(a).
- <sup>81</sup> MICH. COMP. LAWS ANN. at r. 324.902.
- <sup>82</sup> *Id.* at r. 324.61519.
- <sup>83</sup> *Id.* at r. 324.61520.
- <sup>84</sup> 16 TEX. ADMIN. CODE § 3.78(e) (2006).
- <sup>85</sup> [http://www.rrc.state.tx.us/divisions/og/site\\_rem/StatefundedCleanupProgram.html](http://www.rrc.state.tx.us/divisions/og/site_rem/StatefundedCleanupProgram.html).
- <sup>86</sup> WYO STAT. ANN. at §30-5-404.
- <sup>87</sup> Wyom. Oil and Gas Conserv. Comm. Rules, Chpt. 3, § 4.
- <sup>88</sup> Section 7. Forfeiture, Release, or Return of Surety Bond or Other Guaranty.
- <sup>89</sup> CAL. PUB. RES. CODE at §3205.2.
- <sup>90</sup> CAL. PUB. RES. CODE at §3219.5(a).
- <sup>91</sup> MICH. COMP. LAWS ANN. at r. 324.61525.
- <sup>92</sup> *Id.* at r. 324.212.
- <sup>93</sup> 16 TEX. ADMIN. CODE § 3.16(c) (2006).
- <sup>94</sup> Wyom. Oil and Gas Conserv. Comm. Rules, Chpt. 4, §7.
- <sup>95</sup> CAL. PUB. RES. CODE at §3106(c).
- <sup>96</sup> MICH. COMP. LAWS ANN. at r. 324.612. See also *Id.* at r. 324.806.
- <sup>97</sup> *Id.* at r. 324.806.
- <sup>98</sup> Energy Information Administration, Office of Oil and Gas, U.S. Underground Natural Gas Storage Developments:1988-2005 3 Tbl.1 (October 2006), available at [http://www.eia.doe.gov/pub/oil\\_gas/natural\\_gas/feature\\_articles/2006/ngstorage/ngstorage.pdf](http://www.eia.doe.gov/pub/oil_gas/natural_gas/feature_articles/2006/ngstorage/ngstorage.pdf).
- <sup>99</sup> TEX. CODE ANN. § 91.174 (2006).

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<sup>100</sup> *Id.*

<sup>101</sup> *Id.*

<sup>102</sup> CAL. PUB. RES. CODE at §3403.5.

<sup>103</sup> *Id.*