

Summary of Costs Associated with Seismic Data Acquisition and Processing

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Test Method	Test Condition or Test Type	Typical Cost Range <sup>(1, 2, 3)</sup> (unless otherwise indicated)		Comments
		Low/Conventional Resolution	High Resolution	
2-D Seismic	Flat Terrain	\$9,300 / km \$15,000 / mile (not recommended)	15,500 / km \$25,000 / mile	A minimum of 5 miles is needed for coverage. Low resolution is not recommended because 2D is less likely to identify important features.
	Rough Terrain	\$12,400- 15,500 / km \$20,000 - \$25,000 / mile (not recommended)	\$19,900 - \$23,600 / km \$32,000 - \$38,000 / mile	This is an approximately 25%-50% markup over flat terrain due to dynamic energy source, cut line, clearing bushes, and other variables. Low resolution is not recommended because 2D is less likely to identify important features.
3-D and 4-D Seismic <sup>(4, 5, 8)</sup>	Flat Terrain	1-component: \$40,000 / km <sup>2</sup> \$104,000 / mi <sup>2</sup>	1-component: \$50,000 / km <sup>2</sup> \$129,000 / mi <sup>2</sup>	3-D and 4-D acquisition costs should be roughly the same. See general note "B" below for comment on processing costs <sup>(5, 8)</sup> . Prices tend to go down per square mile or kilometer for larger surveys as the fixed costs are spread over a larger area.
		3-component: \$80,000 / km <sup>2</sup> \$207,000 / mi <sup>2</sup>	3-component: \$100,000 / km <sup>2</sup> \$259,000 / mi <sup>2</sup>	
		9-component: \$160,000 / km <sup>2</sup> \$414,000 / mi <sup>2</sup>	9-component: \$200,000 / km <sup>2</sup> \$518,000 / mi <sup>2</sup>	
	Rough Terrain	1-component: \$50,000 - \$60,000 / km <sup>2</sup> \$129,000 - \$155,000 / mi <sup>2</sup>	1-component: \$60,000 - \$75,000 / km <sup>2</sup> \$155,000 - \$194,000 / mi <sup>2</sup>	
		3-component: \$100,000 - \$180,000 / km <sup>2</sup> \$259,000 - \$466,000 / mi <sup>2</sup>	3-component: \$120,000 - \$225,000 / km <sup>2</sup> \$311,000 - \$583,000 / mi <sup>2</sup>	
		9-component: \$200,000 - \$360,000 / km <sup>2</sup> \$518,000 - \$932,000 / mi <sup>2</sup>	9-component: \$240,000 - \$450,000 / km <sup>2</sup> \$622,000 - \$1,165,000 / mi <sup>2</sup>	
VSP	Zero Offset VSP	\$100,000 / test		Typically, Zero offset and Walkaway are paired together. The typical walkaway line is 3,000 – 5,000 ft. If walkaway has more than 3 walkaway lines, 3D VSP becomes cost-comparable.
	Walkaway VSP	\$400,000 / 3-line test		
	3-D VSP	\$500,000 / test		
	Crosswell VSP	See below for separate entry		
Crosswell		\$200,000 / test (minimum) (Cost typically includes processing cost) <sup>(5)</sup>		Crosswell involves two wells less than 1,000 meters apart. The depth of the monitoring wells are as deep as the injection well. One of the monitoring wells could be the injection well, however, extra work has to be done to use the injection well. Example for a project in Canada: Cost was \$250,000 for a 200-meter interval. However, there are other variables for different intervals.
Microseismic	Acquisition Hardware	\$500,000 - \$2,000,000 (typically over \$1,000,000)		In the current regulatory environment in US, for Carbon storage project, microseismic method is most likely required. Prior to CO2 injection, microseismic method is used to establish baseline. During the injection process, continuing monitoring is required. The cost for acquisition hardware system includes equipment in the well, data storage, backup system, etc. Hardware can be rented or purchased; however, due to the long-term nature of CCS projects, equipment purchasing is usually more cost efficient. The indicated costs are purchase costs. Microseismic data should be recorded 24 hours/day for the life of the project and thus budgeting for data processing should be on a per month basis. <sup>(5)</sup>
	Data Processing	\$25,000/month		

Supplemental General Information provided by Vendor A <sup>(5)</sup>:

- (A) Seismic data from seismic libraries: There are a number of data brokers that are active in various regions of the United States that will license existing 2D and 3D seismic data. It is not an outright purchase, as there are usually a number of conditions applied to the licensing. The costs are very much dependent on the vintage, quality, and acquisition parameters used in collecting the data. Usually there is a minimum number of miles or square miles you have to license
- (B) Processing Costs: All of the various seismic methods will have additionally costs associated with processing and is highly dependent on that firm's pricing. Per Vendor A's experience, Crosswell seismic data is the only one that consistently includes the cost of processing into the cost of the acquisition and that is because only one company acquires crosswell seismic data commercially. 4D processing usually involves processing at least 2 vintages of data at the same time and involves a certain amount of time-lapse analysis as opposed to processing alone. Thus 4D processing would be 2 to 3 times the cost of the baseline processing for 3D.

Additional Notes:

- (1) Costs indicated are a compilation of costs supplied by Vendor A and Vendor B in March 2013.
- (2) The indicated costs do not include the cost for the wells required for VSP, microseismic, and crosswell methods.
- (3) Typical range of costs is for acquisition unless other indicated for processing.
- (4) Information updated on March 20, 2013. 3-component costs are 2 to 3 times that of 1-component costs. 9-component costs will be higher than 3-component costs and are assumed to be 2 times that of 3-component costs. Contact is not aware of 6-component testing.
- (5) Information updated on April 5, 2013.

How costs were developed:

WorleyParsons reached out to existing contacts from both Vendor A and Vendor B to obtain high-level costs for acquisition and processing of seismic data to support the proposed CO2 transport and storage project. Vendor B was willing to provide some baseline costs for testing, but was resistant to provide refined numbers representing variable conditions due to the possibility of too many different variabilities. Vendor A was more forthcoming with variable cost ranges for the different tests. Vendors A and B were relatively comparable between their baseline costs. Both companies indicated that the costs indicated above are typical ranges and should only be used for high-level studies. More refined pricing should be obtained once further details are developed and site conditions are known.

WorleyParsons also attempted to contact another vendor for comparative pricing. Since WorleyParsons does not have a pre-existing relationship with this vendor, we were unable to find the right contact with whom to discuss their Seismic Data Acquisition services and costs.