HOLLIDAY ENVIRONMENTAL SERVICES, INC.

ENVIRONMENTAL ENGINEERS & REGULATORY CONSULTANTS

P.O. BOX 2508 BELLAIRE, TEXAS 77402-2508 (713) 668-7640 FAX (713) 668-5184
E-MAIL ghh@att.net

7 September 2008

Environmental Protection Agency
1200 Pennsylvania Ave. N.W.
Washington, D.C. 20460

RE: DOCKET 1D NO. EPA-HQ-OW-2008-0390 - COMMENTS

Gentlemen:
These comments respond to the EPA request regarding the revisions to the Underground Injection Control (UIC) Class VI well rule proposed 25 July 2008 at 73 FR 43492-43541. We agree EPA has the authority under the Safe Drinking Water Act (SDWA) to propose regulations governing Carbon Dioxide Sequestration Wells to protect Underground Sources of Drinking Water, but we believe such wells are: 1) dangerous and 2) unnecessary. Also, we believe the Safe Drinking Water Act is not suited to provide necessary safety to the citizenry, because EPA by promulgating Class VI wells is authorizing construction of a CERCLA eminent hazard substance storage site and a RCRA hazardous substance (corrosively) storage site. Each of these concerns and many more are discussed below. We request these comment be made a part of the record EPA-HQ-OW-2008-0390.

SUMMARY

The Environmental Protection Agency at 73 FR 43492-43541 requests comments regarding the proposal to prepare regulations for an unknown number of Class VI wells, which are in reality, manmade explosive devices storing buoyant carbon dioxide sequestered deep in the earth under supercritical pressure conditions by persons of unknown technical ability seeking monetary rewards and approved by Agency technically untrained employees, who are not Professional Engineers and supervised by a Regional Director who is neither an engineer nor a Professional Engineer. The Agency proposes using untrained EPA employees who are not required to demonstrate their CO_2 sequestration technical knowledge by completing and passing a written examination. Further, the Agency proposes to sequester buoyant CO_2 until the end-of-time by only requiring 50 years of monitoring (40 CFR 146.93(b)(1)). In addition, EPA proposes using well completion materials not currently developed and proven corrosion-resistant under carbonic acid corrosive conditions.
The proposed regulations are a formula for future disaster: 1) Dangerous to sequester CO_2, a supercritical fluid stored at high pressure: 2) The scientific basis for sequestering Carbon Dioxide (CO_2) as a means of slowing or eliminating climate change is not scientifically established. In fact, EPA does not claim anthropogenic CO_2 is the cause of climate temperature increase. EPA simply infers sequestration is necessary. Refer to the Comment Section entitled "Sequestration is not necessary" and Attachment 2 for details on the lack of supporting data for this argument.

The sequestration of CO_2 represents a money-making scheme of a political pollutant, which will encourage unqualified organizations and speculators to seek Class VI injection permits. These unqualified organizations will find unqualified consultants to prepare documents supporting the permit applications. EPA, in the instant proposed rule, suggests several financial responsibility schemes to avoid this problem, but EPA and states do not know how to assure financial responsibility. Proposed regulations, with this lack of specificity, typically results in EPA select conditions, which received no comments during the proposal stage. This gives EPA free rein to select regulation wording not reviewed by the commenting public, and not alluded to during the proposal.

One of the most frightening aspects of the proposed rule is EPA imposes no qualification requirements on EPA review personnel. Thus, a well written, but false document, can easily be accepted by EPA, when technically unqualified reviewers are used. If qualified reviewers were used, the application would be rejected.

A review of the existing technical literature suggests no author has considered how long sequestration is expected to last. Schlumberger says in their advertising, sequestration is "permanent" separation of CO_2 from the near surface waters. Webster Unabridged Dictionary defines "permanent" as meaning unchanging, a very long time, to last indefinitely. Indefinitely is for ever without end. This appears to be an impossible assignment. Governments come and go, people come and to, and most importantly companies (permittees) come and go. The cost of carbon dioxide sequestrations monitoring until the end of time is a monumental expenditure. To circumvent this problem EPA states 50 years should be long enough, even though EPA offers no technical support for this assumption, but then they say "not to worry," EPA will allow the non-technically trained Regional Director to lengthen or shorten the sequestration reservoir monitoring time based on his vast inexperience. EPA offers no guidance to assist the untrained, non-engineer Regional Director in making that determination. EPA discusses what happens, if, the sequestration operator goes bankrupt or decides "enough is enough" and cannot or will not continue monitoring the highly pressure CO_2 containing formulation. But EPA offers no useable answer. EPA suggests in the instant preamble that, commenters waiting until EPA finds an answer.

The Federal Government can establish a trust fund? If one observes the Social Security Trust Fund, we can expect the sequestration fund to be combined with the General Fund for Government maintenance and then the money is not available when need! Who will prevent Congress from using the when times lean. The Safe Drinking Water Act makes no provision for this alternative!

EPA believes Class VI wells and associated reservoirs will be safe, even though corrosion resistant materials are not available. Again EPA says "not to worry" EPA "knows" the Oil and Gas Industry will develop corrosion resistant pipe and cement. Our investigation shows no pipe, packer, rubber seal or cement are resistant to carbonic acid attack for 50 years (maximum test length to date is 12 months!). Thus, when the well or formation fails (leaks), the CO_2 phase change will result in a massive increase in volume as the CO_2 approaches the earth's surface causing vast destruction. EPA is not authorized by the Safe Drinking Water Act to consider protection of human life from such a disaster. Since the disaster may occur where there is no USDW the Statue provides no protection for the general public in that area. Thus, at some future time the sequestration system operating at 2215± psia (Moore, et al) can fail due to corrosion (Meyer, 2007) or the carbon dioxide finds its way to the earth's surface.

Meyer (2007) reports severe corrosion of stainless steel 404 components during injection at an enhanced oil recovery (EOR) using carbon dioxide. Also, Newton and McClay, say "[p]redict[ing] ··· corrosivity based on CO_2 and water cuts have not always proved accurate." The presence of water insitu to storage reservoirs increases the corrosive nature of this CO_2. The injected CO_2 is buoyant and rises to the bottom of the top confining zone. The confining zone is penetrated by at least one injection well and probably more. These wells must have casing, which will be corroded quickly unless there is a constant injection of corrosion inhibitor.

A review of the Department of Energy, State of Washington and State of New Mexico reports and rules shows none of these Agencies are willing to discuss the types of material appropriate for well completion components. This is true, also, of the IOGCC (2007) report. On the other hand, EPA at 73 FR 43510 suggests using stainless steel 316 fittings, and forgings on the basis of recommendation of Meyer (2007) for surface connections associated with EOR wells. We ask for clarification from Dr. Meyer. Dr. Meyer provided reference to two paper demonstrating severe corrosion of carbon steel (Schemp and Roberson, 1975; Newton and. McClay, 1977.

We know the stainless steel components have corrosion problem, Meyer, 2007. Further investigation establishes that only one stainless steel 316 wellhead assembly has ever been made in the U.S. This means EPA already has approved CO_2 sequestration wells which are subject to severe carbonic acid corrosion, making the wells current CERLA eminent hazards. Meyer (2007) also discusses use of epoxy coated tubing for enhanced oil recovery. The plastic coated tubing is pulled and inspected yearly. Yearly inspection of tubing does not

appear practical for CO_2 sequestration wells! Each time the tubing is pulled, the coating at the threaded joint wears and/or chips, exposing the carbon steel to carbonic acid corrosion. This corrosive attack will result in rapid exteriorization of the tubing. The frequent round trips of the tubing results in exposing the casing to corrosion. With time, the inside of the casing will be exposed to carbonic acid attack, if a leak in the tubing or tubing connection occurs.

The packer presents a particularly difficult design problem. A stainless steel packed body can be manufactured. But, the slip must be hardened carbon steel so they set in the casing to compress the elastomer seal. Stainless steel work hardens, but it is not heat treatable. Thus making stainless steel slips appears highly questionable. Packer elastermers, e.g. Buna-N and Nitrile rubbers, are available, but never tested over long time periods, e.g., 50 years, in the presence of carbonic acid. Schemp, and Roberson, (1975) report "[T]ests showed nonmetallic seals to be susceptible to acid and mechanical damage."

Tubingless completions are possible, but this would expose the casing to acid attack. Multiple cemented casing strings can be run. However, steel is known to corrode rapidly in the presence of carbonic acid. Admixed cements have been "accelerated" tested in the presence of carbonic acid for a period of 6-12 months, but not for decades (personal communication with Vaughn Morgan, Halliburton). Thus, un-field tested specialty cements have been short term laboratory tested, but not over a 50 year period! Halliburton (http://www.patentstorm.us/patents/6904971.html) makes a acid resistant cement "with improved corrosion resistance.' Halliburton does not claim the cement to be acid resistant!

What is particularly disturbing is the statement by EPA at 73 FR 43510, col. 1, "[t]oday's proposal does not specify materials that may be used, rather, proposes providing the owner or operator with the flexibility to choose, as long as the materials used in GS wells are corrosion-resistant and meet standards approved for such materials by API or ASTM International or comparable standards approved by the [nontechnically trained] Director". This statement says in effect, "We don't know what materials are appropriate for CS well completions. Thus, EPA places the responsibility on Industry and the untrained, non-engineer Regional Director to solve the materials dilemma. The EPA's statement at 73 FR 43510 raises even a greater concern:

> [t]oday's proposal would require that the cements and cement additives used in GS wells be appropriate to address long-term injection of CO2 and assure that the well can maintain integrity throughout the proposed life span of the project,

e.g., without EPA specifications materials, expected longevity, corrosion resistance requirements, etc., EPA places the responsibility on an industry which government, the public and regulators have never trusted. By this ruse, EPA sidesteps the responsibility for any CS well failures.

The proposed rule must be withdrawn!

CS WELLS ARE NOT NECESSARY.

Carbon dioxide sequestration will not stop climate change! EPA in the preamble to the CS proposed rule (73 FR 43496-43502) discusses the reasons for the need for CO_2 sequestration. Nowhere in those pages does EPA state that carbon dioxide emissions cause climate warming or what the optimum earth temperature is, or how the Agency knows when the optimum temperature is reached, so sequestration can be discontinued. Is EPA suggesting sequestration be continued until it causes the next ice age? A review of the Department of Energy reports demonstrates a similar lack of CO_2 cause and effect.

We can find no peer reviewed technical paper, referenced by EPA or anyone else, not based on computer simulation, showing CO_2 causes climate change. EPA relies heavily on Intergovernmental Panel on Climate Changes (IPCC) reports. Reference to IPCC reports subjects EPA to serious question regarding the technical validity of the information presented. The use of the Hockey Stick Figure (Figure 22, IPCC, 1996) brings into sharp focus the political nature of the IPCC reports. McIntyre and McKitrick (2003) demonstrated conclusively the Hockey Stick Figure was based on truncated data, obsolete data, contained calculation errors and quality control deficiencies. Also, Figures 5.20 and 5.21 (IPCC, 2005) , well details, demonstrate IPCC is technically

deficient because IPCC blithely suggests pulling cemented casing from Class VI at the completion of injection, IPCC Figure 5.21. Experience demonstrates cemented casing cannot be pulled. IPCC (2005 at page 231) suggests milling the casing at the shoe to remove corrodible metal from contact with the carbonic acid. Milling is possible. Modern mills can "hog out" 10 feet of casing per hour, but the metal chips settle-out in the Blowout Preventer, preventing proper operation in the event of an emergence. The ludicrous suggestion of using a milling stone as a means of connecting to a fixed packer defies all understanding, IPCC Figure 5.20. Astute scientists and engineers are very wary of IPCC reports, because of the frequent and consistent errors contained in the reports.

Also, EPA, in the proposed sequestration rule, does not provide any indication of the benefit sequestration will provide other than reduce CO_2 concentration in the atmosphere. Even that goal appears questionable. Our extensive review of the technical literature demonstrate no peer reviewed reports based on field observations are available showing a direct relationship global warming caused by increase in the atmospheric CO_2. However, Lucas, 2008, states the "We Can Solve It" (www.wecansolveit.org) campaign compares "your commitment to solving the climate crisis as [being equivalent to solving] the World War II, Normandy landing, the civil rights movement and putting a man on the moon" combined. Unfortunately, www.wecansolveit.org offers no supporting data, but it offers new high income opportunities, which appears to be the major driving force behind temperature change projects.

If a relationship between CO_2 and global temperature increase is real and the quantity of anthropogenic CO_2 is infinitesimally small compared with naturally occurring CO_2 as shown by DOE, Figure 1, below, CO_2 sequestration is meaningless. The U.S. Department of Energy (www.fossil.energy.gov/programs/sequestration/overview.html) developed the graph, Figure 1, showing CO_2 entering the atmosphere in 2008 from anthropogenic sources is 6.0 GtC/yr.: Forests and soils release >100 GtC/yr: Geologic >300 GtC/yr and Oceans 1,400 GtC/yr. It appears sequestering all of the anthropogenic CO_2 in minuscule when compared with natural sources. Will sequestering such a small quantity be effective?

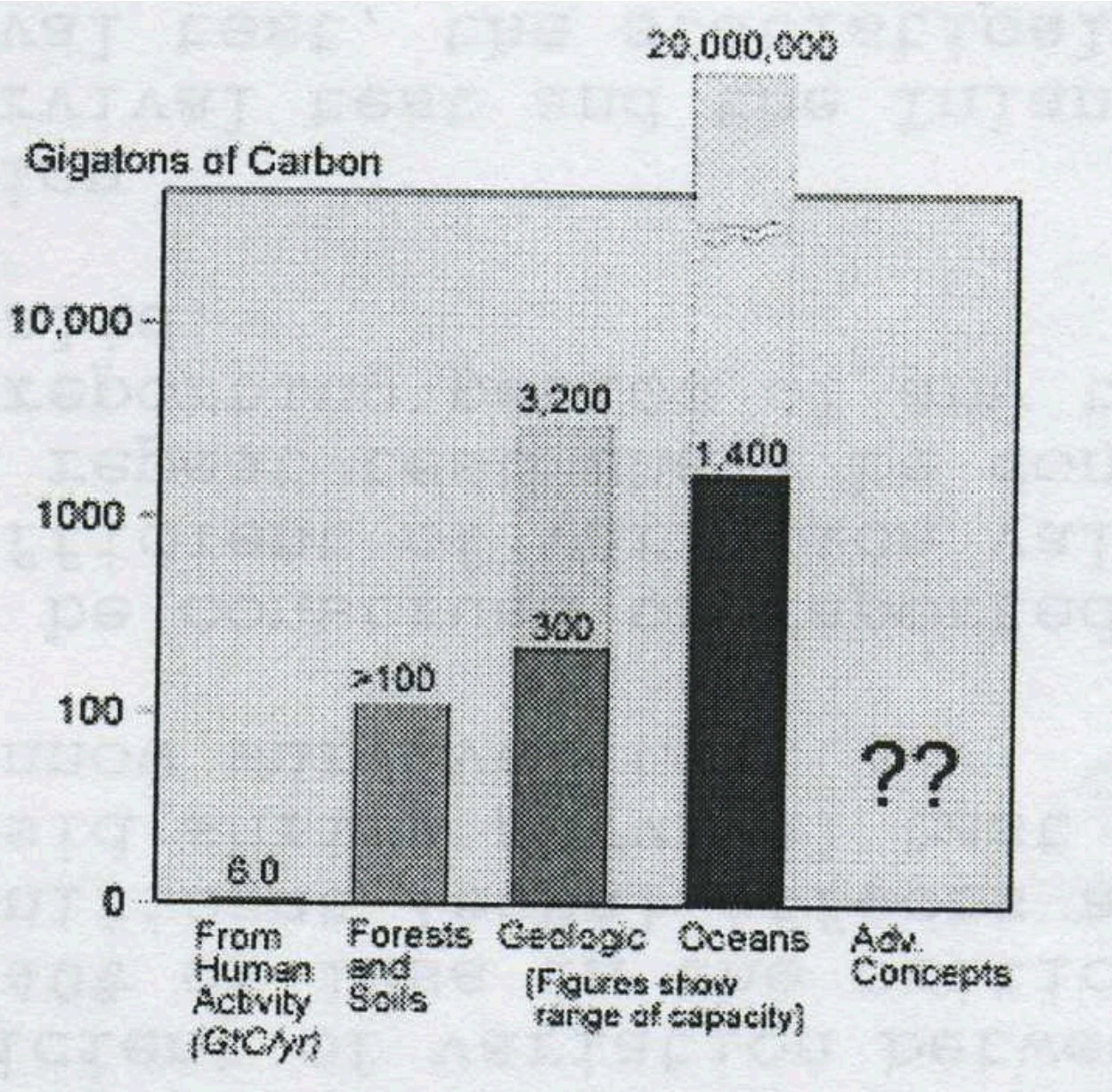

Figure 1. 2008 Estimated United States CO2 Emissions for 2008

CO_2 SEQUESTRATION IS COSTLY AS WELL AS USELESS

Xie and Economides (2008) discuss the uncertainties and risks of CO_2 sequestration in oil and gas reservoirs (see Attachment 1, below). The authors conclude the cost just to satisfy the United States Kyoto Protocol requirements will cost more than $1 Trillion per year. The paper gives a "realistic situation [view] on the potential impacts on commercial CO_2 sequestration projects, environment and the global climate change."

SEQUESTRATION IS NOT NECESSARY

Holliday (2008), Attachment 2, shows, based on existing technical papers, CO_2 emissions are not causing climate temperature change. There have been climate changes for at least 900,000 years. Life has struggled forward under climate temperature increases and decreases without being annulated.

During these temperature changes, Greenland has gone from a marginal framing area to a bleak cold frozen area, but life continues taking advantage of the warmer climate by moving away from the cold areas. The belief

that these climate changes can be mitigated by sequestering carbon dioxide has no scientific support, since previous climate changes occurred in the absence of anthropogenic CO_2.

Climate models, which are being used to suggest CO_2 is causing temperature increase are inaccurate at best, because climate predictions are very complicated and beyond our current technical capabilities. Relying on computer modeling for the basis for needing the instant rule proposal is a cruel hoax.

LACK OF QUALIFIED EPA PERSONNEL

EPA requests comments on many aspects of CO_2.. For example at 73 FR 43514, col. 2, EPA request help learning to track CO_2 underground plumes. I have worked with the UIC rules as a commenter since 1979. At no time did EPA use an EPA Professional Engineer (P.E.) for developing the UIC rules. During the initial stages of writing the 1979 draft rules, EPA used an Ancient English graduate as the Agency lead technical supervisor. Ancient English is not considered a technical background.

I have not found any of the current EPA UIC Regional employees to be professional engineers. When I requested the information from EPA, I was told privacy laws prohibited providing such information. Reviewing and understanding CO_2 sequestration projects is a technically exacting task. Assigning an EPA non-professional engineer to this review task exposes the U.S. public to severe risk. Placing the final approval in the hands of a Regional Administrator, who traditionally has not been an engineer, means the EPA is disregarding public safety. At a minimum, the reviewing engineer and Regional Administrator must be Professional Engineers. EPA at 40 CFR Part 112 requires a Professional Engineer certify a Spill Prevention, Control and Countermeasure (SPCC) Plan, which typically is intrinsically a safe procedure, but EPA does not rely on EPA Professional Engineers to review high pressure, corrosive fluid injection projects, that can be intrinsically unsafe. This demonstrates the Agency is ill-equipped to approve CO_2 sequestration projects using the current organizational practices.

EPA has likened Class VI projects to Class I hazardous waste injection wells and Class II CO_2 enhanced recovery wells. It is true Class I disposal wells sequester hazardous waste, but these wastes are not buoyant and typically are combined with other waste to make them non-corrosive. Further, the Agency has been reviewing Class I and II well plans submitted by experienced oil and gas company engineers. An anticipated shortage of trained oil and gas industry engineers (Bryant, 2007) and the political nature of CO_2 sequestration projects (www.wecansolveit.org) will attract spectators, who do not intend to see the project through to completion. Thus, the Agency will be forced to correct many problems caused by poor review and oversight on the part of the untrained EPA employees

The mixture of hazardous wastes associated with Class I injection wells do not aggressively attack carbon steel or cement. Also, hazardous waste will not change phase, as supercritical CO_2 does when the pressure is decreased. The change in fluid phase results in formation of a gas, which is large in volume and better able to find its way to the surface of the earth through minute cracks. The earth's surface is full of examples of oil seeps, e.g., the underwater seeks at Santa Barbara, California, and oil seeps in and around the Pennsylvania oil fields, to name a few areas where leaks are known to occur.

Thus, the hazardous wastes stored in Class I wells are retained underground because, the column of waste formed when a leak occurs, provides a controlling head of weighted fluid. In the case of CO_2 the head in the event of a leak becomes less as the over burden pressure reduces. This is a much more dangerous condition than experienced with Class I wells. Also, a Class I injection well is associated with producing wells, which can be protected from corrosion by injecting corrosion inhibitor into the producing well during the producing phase.

Class II enhanced oil recovery (EOR) wells are not abandoned with a high residual head of buoyant gas. Typically, the well is produced until the field becomes un-economical (depleted) to produce. This, unlike the CO_2 sequestration wells is not under high supercritical pressure (2200 psig pressure) at the time of abandonment.

EPA CAREFULLY SELECTS CITATIONS

EPA, at 73 FR 43515, col. 2, cites Burton et al. (2007) as supporting the availability and adequacy of "current monitoring technologies" for monitoring pressures in GS project (sic)." EPA does not cite the serious questions raised by Nicot and Hovarka (2008) at the EPA January 16, 2008 CO_2 meeting in New Orleans, wherein Nicot and Hovarka (2008) presented a PowerPoint slide show regarding monitoring insitu. Hovarka (2008) reiterates serious concern raised in 2007 regarding field monitoring capabilities of currently available tools

Again, at 73 FR 43515, col. 3, EPA selects the Nimiz and Hudson (2005) report to justify insitu monitoring of CO_2. EPA did not cite the Nicot and Hovarka (2007) presentation, which makes a point of expressing serious concern regarding insitu monitoring using current techniques.

EPA cites Flett, et al. at 73 FR 43519. The reader is directed to the EPA reference section (73 FR 43533) of the proposed rule preamble and EPA (2008b). The reader finds a) no citation as to the origin of the reference at 73 FR 43533 and b) EPA 2008b is a paper regarding "Vulnerability Evaluation Framework ···", which, in turn, refers the reader to the instant proposed rule.

EPA consistently, excludes reference which do not support the EPA preconceived ideas!

EPA DOES NOT HAVE PROPER STATUTORY AUTHORITY TO PROPOSE CO_2 SEQUESTRATION RULE

EPA relies on the Safe Drinking Water Act (SDWA) to protect USDWs from CO_2 sequestration. The SDWA authorizes EPA to protect drinking water, not encourage indefinite storage of a corrosive, high press fluid. CO_2 is known to attack carbon and stainless steel, Meyer (2007). The fact that Meyer reported stainless steel 404 was badly corroded by "dry" CO_2 indicates wet CO_2 (carbonic acid) is a RCRA corrosive waste, since it meets the RCRA definition of corrosive. In addition, the fact a leak of CO_2 could enter a building basement suffocating the inhabitants, demonstrates CO_2 sequestration is not an environmental problem, but it is a pervasive and dangerous life threatening hazard. EPA is ill equipped to control potentially unsafe activities under the guise of protecting drinking water using the Safe Drinking Water Act.

EPA Guesses at the required Class VI Monitoring Period

EPA at 73 FR 43518 – 43527 discuss how EPA decided to monitor a sequestration project for 50 years; EPA said 50 years is a long time and if EPA extends the time longer the cost will be too high! EPA provide no rational argument for selecting 50 years: EPA says at 73 FR 43 43518, "EPA is tentatively proposing a post-injection site care (monitoring) period of 50 years with Director's discretion to change that period to lengthen or shorten the 50- year period, if appropriate." The best support EPA offers (73 FR 43520) for the 50 year monitoring period is:

> "To ensure that the post-injection site care monitoring timeframe is long enough to determine that there is no threat of endangerment to USDWs from injection activities; EPA is proposing a default post-injection site care period of 50 years. During this 50-year period, the owner or operator would be required to submit periodic reports providing monitoring results and updated modeling results as appropriate until a demonstration of non-endangerment to USDWs can be made."

EPA is willing to rely on a technically untrained Regional Administrator counseled by uncertified EPA employees, because EPA does not have a clue how to determine the appropriate monitoring time period! We question the probability of speculators being in business 50 years after the injectors stop producing income and become a liability. Since EPA is charged only with protecting USDWs and not human life, EPA can slough the real burden onto someone else. In our opinion this is an Arbitrary and Capricious and a life threatening action on the part of EPA.

EPA does not include a recommended means of funding sequestration long term corrective action.
EPA at 73 FR 43501, tells the reader of the proposed rule to go to http://www.epa.gov/safewater/uic/ so as to read the findings of the various Class VI Workshops. Unfortunately, the presentation are, for the most part, PowerPoint slideshow without voice over. Thus, the slideshows are difficult to interrupt and only contain EPA presented materials. When EPA refers to comments and questions from the attendees, EPA provides only an interpretation of the questions or comments, thus no context is provided. This places the commenter regarding the proposed rule at a severe disadvantage. Reading of the various documents available on the website demonstrates no issues of post closure monitoring or long term funding for corrective action were raised, or discussions recorded. The EPA reference to the website suggests substantive discussions occurred during the Workshops. The EPA record demonstrates, little or nothing was accomplished during the meetings. Again, the commenter is deprived of accurate input from the Workshops. EPA at 73 FR 43520 EPA states:

> "…SDWA does not have explicit provisions for financial responsibility, as included in RCRA, EPA believes that the general authorities provided under the SDWA authority to prevent endangerment of USDWs include the authority to set standards for financial responsibility to prevent endangerment of USDWs from improper plugging, remediation, and management of wells after site closure. The SDWA authority does not extend to financial responsibility for activities unrelated to protection of USDWs (e.g., coverage of risks to air, ecosystems, or public health unrelated to USDW endangerment). It also does not cover transfer of owner or operator financial responsibility to other entities, or creation of a third party financial mechanism where EPA is the trustee."

The Agency suggests the Safe Drinking Water Act is not appropriate to regulate CO_2 sequestration. Further, EPA believe they can assume the RCRA type authority for Class VI wells under the SDWA. If challenged in court, the court most likely will disagree, because the SDWA was written only for protection of USDW.

When one considers the emphasis on enhanced income available from climate change presented on www.wecandoit.org, it is difficult to imagine the speculative companies being willing to fund long term remedial funds. After the financial income ceases, these companies will fade away, particularly if the IOGCC (2007) trust fund recommendation is followed. The trust fund is similar to insurance. The Trust Fund input per ton of CO_2 will be considered part of the cost of doing business.

EPA appears to be waiting for counsel from the Environmental Financial Advisory Board (EFAB) regarding long term financial responsibility for corrective action. Review of the EPA documents regarding EFAB shows the "important topic" of Class VI well financial responsibility was not discussed at the **Workshop on Financial Assurance in EPA Programs, June 17, 2008 - New York, NY**
http://www.epa.gov/efinpage/publications/FinancialAssuranceWorkshopSummary.pdf.

At the **EPA, Environmental Financial Advisory Board Meeting 27 March 10-11, 2008,** the minutes record the follow action regarding "this important topic":

> *"DFO Meiburg* described EFAB's role in paying for activities especially in the area of SRFs for water programs. EFAB has expanded in the last few years into the transportation sector which is related to climate change. For example, the CO_2 injection program would require financial assurance, if something goes wrong in the clean up. EFAB has been working with the Office of Solid Waste and the Office of Enforcement over financial assurance related to Resource Conservation and Recovery Act (RCRA)."

The sense of urgency expressed by the Agency appears to be lacking in these Board minutes. If in fact since EFAB is discussing "transportation sector", the discussion may relate to a different agenda item. In any event, EFAB does not appear to be actively engaged in long term correct action funding of Class VI wells.

The entire EPA discussion from 73 FR 43520 to 43522 regarding surety provisions is not formulated as a rule. The presentation resembles an Agency thinking "out loud trying to find an answer." We are given no opportunity to comment on a rational proposal, because the data are withheld!

COST ESTIMATE FOR PLUGGING CLASS VI WELLS

EPA at 73 FR 43522 EPA discusses having funds available to plug Class VI wells. They question if the owner/operator will have sufficient funds to plug and abandon the injection well. We have expressed the same concern previously in these comments. EPA proposes to solve this problem by having a contractor make the cost estimate. Any cost estimate reflects the assumption used to develop the estimate. We recall when EPA instructed their contractor to assume all existing SPCC Plans (67 FR 47140, July 17, 2002) were in compliance with the proposed unpublished SPCC rule. The resulting cost estimate was unethical, but reflected the given assumptions and showed the proposed revisions to 40 CFR Part 112 reduce regulatory costs. Is there a chance the same unethical approach is possible when estimating the plug and abandonment costs for Class VI by unethical speculators? Will the technically untrained EPA employee recognize the estimate is not correct or for that matter, how will untrained EPA employee recognize the estimate is correct?

ADAPTIVE APPROACH

EPA, at 73 FR 43522, requests input regarding using electronic means of involving the public in the rule making process. From our vantage point of reading the Federal Register daily, the use of the web is highly satisfactory. However, we find most citizens don't know the Federal Register exists. Thus, the public does not have any idea what regulation are being proposed or promulgated. EPA needs to be out-going with their information, e.g., put notices in the newspapers, sponsor television Public Notices, etc. Currently, the public is uninformed!

PRIMACY

We find many of the state regulator are knowledgeable, but many state regulators are not formally trained and certainly not Professional Engineers. CO_2 sequestration is too dangerous an undertaking to leave the highly technical review and decision making to non-Professional Engineers. Any Class VI rule must be based on Primacy only being given to State and Tribes employing and using specially trained Professional Engineers for review and approval of CO_2 sequestration projects.

COST ESTIMATE

EPA at 73 FR 43524 presents the results of an analysis of the cost to protect USDWs from a Class VI wells. EPA was very specific regarding what they did not include in the regulatory estimate. EPA based the cost estimate on a Class I of unknown depth, unknown casing size, unknown location and type of reservoir. EPA used this unspecified well and calculated the incremental cost to convert it to a Class VI well. This approach excludes commenters from verifying the accuracy of the EPA estimate by these omissions. This is reminiscent of the 2004 SPCC Plan cost estimate, where commenters were not privileged to the assumptions EPA provide to its contractor. Unethical instructions, e.g., current SPCC Plans are in compliance with the unpublished proposed rule or unstated assumptions prevent testing the accuracy of the cost estimate. We have no means of knowing if EPA provided unethical instructions to the contractor for development of the Class VI well costs. Apparently, EPA told the contractor to use a 25 year after closure monitoring time period (73 FR 43524). When EPA proposing 50 years at 40 CFR 146.91 (73 FR 43540). Either the Agency changed its mind after giving the go-ahead to the contractor or the Agency was attempting reduce cost of the rule.

EPA at Table VII-2 (73 FR 43525) says the cost of baseline project plus Alternate 3 and Alternate 3 increment varies between $94.6 and $98.4 million for 22 sequestration projects or $4.3 million to $4.5 million per project. EPA at 73 FR 42504 provides a non-specific definition of Alterative 3. The definition is words without specificity! We have no inkling of want Alternative 3 entails.

On 28 August 2007, I discussed these cost figures with the Chairman of the Society of Petroleum Engineers Sequestration Panel. His response was "there is no way in Hell we can conduct a sequestration project for that little money."

EPA notes at 73 FR 43526 "····CO_2 injection··[as]··already practiced···(i.e. EOR), is expected to expand rapidly···." This statement can be interpreted to mean CO_2 EOR will be come under the Class VI well rule. If this is the case EPA will in effect reduce oil and gas production significantly during an existing server energy shortage! Since operating conditions of CO_2 EOR are different, e.g., Supercritical CO_2 is not left in the reservoir at abandonment, casing penetrating the cap-rock can be protected from corrosion, etc., the converting of CO2 EOR wells is not justified or appropriate.

Respectfully submitted

s/ G, H, Holliday
G. H. Holliday, PhD., P.E., BCEE, Life Fellow ASME

References

Bryant, S., 2007. Geologic CO_2 Storage—Can the Oil and Gas Industry Help Save the Planet? J Pet. Tech (JPT), p 98-105, September

Burton, E., R. Myhre, L. Myer, and K. Birkinshaw. 2007. Geologic Carbon Sequestration Strategies for California. Report to the Legislature. November, 2007. CEC–500–2007–100–SF.

Environmental Enterprise: Carbon Sequestration using Texaco Gasification Process. Presented at the First National Conference on Carbon Sequestration, Washington, D.C. May 14-17. 2001

Hovarka, S., 2008. "Recent Progress and Big Ideas on Geologic Sequestering, US/International Perspective." 11 January.

IPCC, 1996. Second Assessment Report, Summary for Policymakers.

Lucas, F., 2008. Cashing in on Climate Change. Human Events, 64:28;15, August 14, 2008

McIntyre, S. and R.M. McKitrick, 2003. "Correction of Mann et al. Proxy Data Base and Northern Hemisphere Average Surface Air Temperature Series" Energy and Environment, 14:751-771

Meyer, J.P. 2007. "Summary of Carbon Dioxide Enhanced Oil Recovery (CO2EOR) Injection Well Technology" prepared for American Petroleum Institute, p 21.

Moore, J.J. M. Nord and K. Brun, 2007. Novel Concepts for Compression of Large Volumns of Carbon Dioxide, Oil and Gas Journal, June

Newton Jr., L.E., and R.A. McClay, 1977. Corrosion and Operational Problems, CO2 Project, Sacroc Unit, SPE 6391-MS

Nicot, J.P. and S.D. Hovorka. 2008. Role of Geochemical Monitoring in Geologic Sequestration. Presented at the CO2 Geologic Sequestration Technical Workshop on Measurement, Monitoring, and Verification, January 16,. New Orleans, LA.

Schemp, F.W., and G.R Roberson, 1975. Effect of Supercritical Carbon Dioxide (CO2) on Construction Materials, SPE Journal, 15:3, June. Paper 4667-MS..

Xie, X and M.J. Economides, 2009. "The Impact of Carbon Geological Sequestration". SPE 120333-P.

ATTACHMENTS

Attachment 1

ABSTRACT

The Impact of Carbon Geological Sequestration
By
Xina Xie and M.J, Economides
SPE 120333-P

Although CO2 geological sequestration is the most popular carbon storage method promoted and pilot tested, the economic feasibility and technical risks for commercial scale sequestration projects are rarely mentioned. More significant, is that, apart from rhetorical pronouncements, the would-be impact of the operation on climate change is not discussed. This work studies the technical risks, regulatory issues, and economic burden of CO2 geological sequestration on the U.S. by using the Kyoto Protocol emission requirements as the base line. The potential effect of burying all the extra CO_2 regulated by Kyoto Protocol on global temperature change is also evaluated.

The lack of regulatory framework is blamed as one of the obstacles for slowing or stopping CO_2 geological sequestration practice. However, any regulatory issues are intertwined and dominated by the physics of the injection process itself and its economic viability. This study analyzes the uncertainty and/or risks caused by CO_2 geological sequestration in oil and gas reservoirs, saline aquifers, and coal beds. The work shows that the potential technical and legal risks and financial costs for sequestering CO2 underground make it impossible to promulgate any regulatory framework without causing detrimental effects on economic development and energy utilization. It is estimated that CO_2 sequestration in U.S. will cost over $1 trillion annually for CO_2 geological sequestration by complying with the Kyoto Protocol. Even if the global temperature increase of 0.7 degrees Celsius over the past 100 years is solely caused by anthropogenic CO_2 emissions, the change on the global temperature by sequestering all the CO_2 emitted exceeding the 95% of 1990 level will be negligible. The dynamic climate and weather patterns on Earth will make it impossible to be verified.

This work gives a realistic situation on the potential impacts of commercial scale CO_2 sequestration projects on economics, environment, and the global climate change. The findings of this study can be used to evaluate the risks of the CO_2 geological sequestration projects.

Attachment 2

Climate Change

George H. Holliday, PhD., P.E., BCEE
Holliday Environmental Services, Inc.
SPE

Abstract

I am neither an atmospheric physicist nor climatologist, but I have read, studied and thought extensively about climate change on earth. Based on my reading and study, I am convinced the present climate change on earth is real and occurs naturally due to changes in solar cycles.

Earth has experienced climate change for at least 900,000 years, as documented by ice core gas analyses and more recently, written documentation of the Roman Warming and the Little Ice Age. In 1984 analyses of gas in ice cores suggested climate change occurs about every 2,500 years. Additional data shows climate change cycle at 1,500 years ±500 years. These results are ignored or politicized for the general public. Seldom is the Roman Warming or the Little Ice Age mentioned, even though Little Ice Age evidence is before us in the form of drastic change in the temperature of Greenland from marginal farmland to cold temperatures causing the inhabitants to abandon previously productive lands. Also, during the Little Ice Age, the Maunder Sunspot Minimum occurred (1640-1710) during which, the climate temperature was very low and virtually no sunspots were observed. These scientific truths cast severe doubts on current suspected climate change proposed corrective actions, such as CO_2 sequestration or abandonment of a carbon based economy. In addition, the references cited in the paper clearly demonstrate CO_2 is not causing climate change.

Introduction

The earth's climate forever changes in a predicable cyclic manner, apparently dictated by solar activity, Bond et al. (2001). We know Romans recorded climate warming between 200 BC and 600, AD, Lamb (1977a). In Europe, between 600 and 1300 AD, the Medieval Warming occurred. The Little Ice Age (1300 to 1850 AD) is dramatically documented by tax records of the abandonment of Greenland by the Norse population in about 1300 after nearly 300 years of moderate temperatures, when farming prospered.

Weather History

Ice Core Records

Dansgaard and Oeschger during 1983cored the ice sheet of Greenland. Dansgaard, et al. (1984) reported a link between climate cycles and sun activity. The link shows a moderate cyclic variation in ambient air temperature with time. The original analyses of ice cores gathered from coreholes spanning 900,000 years suggested a repeating cycle lasting about 2,500 years. Based on more research this periodicity was revised to 1,500 years ±500 years by Bond (1997). The ice core temperature analyses are based on the ratio of oxygen–18 to oxygen–16 at the time the snow was laid down. This ratio is not time impacted. Ice core analyses showed persistent temperature cycles within cycles, Singer and Avery (2007a). These cycles make weather modeling extremely difficult and complex, even with modern computers.

Tree Ring Data

Tree ring analyses from long living Pakistani trees confirm ambient temperature warming from AD 800 to 1,000 and cold temperatures from AD 1,500 to 1,700, Esper, et al. (2002). These findings compare favorably with ice core data.

Written History

Lamb (1977b) documented climate change history for the past 1,000 years. Romans (30-60 AD) reported grape cultivation advancing slowly northward in Italy. This history shows both grapes and olives growth receded as the ambient temperature changed (decreased). Lamb (1977c) discusses the cold temperature history reported in Europe during the 1500's AD. This history correlates well with the severe change in Greenland temperature causing the Norsemen to evacuate Greenland.

Sun's Irradiation

Perry and Hsu (2000) using a solar-luminosity model based solar-related isotopes-variations scanned 90,000-year glacial cycle. They observed excellent correlation using carbon-14 variations and carefully dated tree rings data as far back as the Medieval Warming (900-1300 AD). They extrapolated findings to 90,000 years using the correlated model. Soon (2005) shows how well solar activity correlates with arctic temperature during the past 130 years and how poorly CO_2 correlates arctic temperature, **Figure 1**. The temperature data comes from Polyakow et al. (2003) using arctic station measurements, while the solar activity data comes from five databases. Willson (2003) reports the sun's radiation increased by nearly 0.05 percent from the late 1970s based on 25-year record assembled by NASA. The cited trend is significant, because the total energy output of the sun is enormous. Willson cannot support the data before 1978, but he says, if the trend persisted during all of the 20th century, the increase in solar activity would produce "a substantial component" of the observed climate temperature increase.

Climate Warming

The Earth has warmed since 1850. The highest temperatures were recorded in the late 1930s, Figure 1. During the late 1930s, the increase in temperature was rapid, e.g., 2.5ºC in 20 years in the Arctic region. No one recognized the worldwide temperature increase, except the farmers, who took advantage of the warming, by expanding their agricultural areas to the north, just as the Romans did during the Roman Warming. Also, the population increased, because of the abundance of food.

Good correlation between solar activity and arctic temperature is seen in Figure 1. Galileo first collected sun spot data in 1609. Therefore, we have data substantiating Maunder Solar Minimum, the coldest period (1645-1710) of the Little Ice Age, when sunspots were at low ebb.

Now, there is discussion regarding capturing and sequestering CO_2 as a means of mitigating climate temperature increase. Sequestration would be an expensive mistake if the climate change is the result of solar activity. In addition, having to compress CO_2 from atmospheric pressure to injection pressure is energy intensive. The U.S. will have great difficulty providing the additional energy, if the 25-year moratorium on domestic drilling and producing continues. Further, objection to building nuclear generation plants may prevent providing the needed power. Lack of power could cause a repeat of the California rolling blackouts of 2001, but this time on a massive scale. Even wind turbines may not help, because the wind does not always blow and an adequate power grid to move the electricity is not available. We are experiencing this situation now (2008) in Texas, where wind turbine generated power cannot be introduced into the distribution system because of lack an adequate grid to serve the wind turbines.

Some concerned citizens raise the specter of sea level rise as a result of climate increase. Singer and Avery (2007c) state the sea level for the last 5,000 years has risen at the rate of about seven feet per century. On the other hand, during the last century, tide gauges show the sea level has raised about six inches, in spite of the recorded high temperatures from 1916 to 1940, Figure 1. Accordingly, except in very low-lying areas, sea level rise does not appear to be a major concern.

Climate Cooling

The possibility of climate cooling raises interesting questions, e.g., what is the desired climate temperature, when do we know when the optimum temperature is attained, were the temperatures of the late 1930s or temperatures of the 1870s the desired levels? Warming produces abundant crops, increased area of agricultural viable land and moderate sea level rise. On the other hand climate cooling reduces crop yield, reduces useable land, and more importantly, climate cooling will increase need for additional energy for home and building heating. Also, freezing weather kills far more humans and animals than warm weather. Interestingly, on 23 March 2008, the Hadley Climate Research Unit in Britain, the NASA Goddard Institute for Space Studies in New York, the Christy Group at the University of Alabama, and the Remote Sensing Systems, Inc. in California reported global temperatures decreased 0.7°C during 2007, The Australian, 2008. The reported lowered climate temperature is reflected in decrease solar activity, **Figure 2**.

Lack of Experimentation

There are no scientific data, experiments or hypotheses demonstrating climate change results from greenhouse gases generation. IPCC modeling, Houghton, et al. (1995), demonstrates exaggerated computer predictions of climate change from 1978–1998 when compared with field measured temperatures for the same time period between latitudes 83 N and 83 S, Robinson (2007b). Shindell and Schmidt (2004), based on observed trends, predicted global warming would cause the Southern (Hemisphere) Annular Mode (SAM) to become neutral, thereby markedly reducing polar cooling. This situation has not occurred, in fact the highest arctic temperature occurred in the 1930s, Przybylak (2002), Polyakov (2002). Also, Antarctic temperatures are decreasing and the ice caps are thickening, Taylor (2006).

Weather Predictions

The Intergovernmental Panel on Climate Change (IPCC)

The Intergovernmental Panel on Climate Change (IPCC) was formed in 1988 as a body of climate scientists interested in furthering knowledge of weather behavior. These scientists published peer reviewed technical weather assessments. For example, the 1996 IPCC "Second Assessment" provided a graph showing "The Last 1,000 Years of Earth Temperatures from Tree Rings, Ice Cores and Thermometers" (Figure 22, IPCC Climate Change, 1996), **Figure 3**. This graph clearly shows the Medieval Warming (900 – 1300 AD) and the Little Ice Age (1300 – 1850 AD).

The 2001 assessment prepared by the IPCC Executive Committee, a group of policymakers, rather than scientists, Horner (2007a), displayed a totally new rendition of Figure 3; the 1996 technical data and plot. Instead of an accurate assessment of historical temperature trends, the new graph, **Figure 4**, eliminated the last 1000 years of temperature variations and historical records, Mann (1998). The 2001 version of the historical data, Figure 4 portrayed the past 1,000 year of temperatures as an almost straight line having an obvious, consistent and abrupt upward curve starting at the end of the Little Ice Age, e.g., the so-called "hockey stick" graph (Figure 2.20, IPCC Climate Change, 2001), Mann, (1998). The hockey stick graph ignores the Medieval Warming Period and the Little Ice Age.

2001 IPCC Data Review

McIntyre and McKitrick (2003) reviewing the Mann data observed critical data correlation errors, e.g., unjustified truncation of data, use of obsolete data, calculation errors and quality control deficiencies in the data and statistics. McIntyre and McKitrick using a

corrected set of Mann data showed the "Hockey Stick" interpretation is wrong. Erroneous graphical data sponsored by IPCC Executive Committee and computer simulations by Houghton, et al. (1995) resulted in frightening the uninitiated public to near hysteria.

The IPCC (2001) included the Hockey Stick graph in their Executive Committee Assessments. Further, IPCC advocated the Kyoto Protocol even in the face of Ice Core data demonstrating long trending temperature cycles. In contrast, Robinson (2007a), reports obtaining signatures of 18,000 (now report to be 31,000) American university degreed physical science graduates opposethe Kyoto Protocol, which recommends limits on greenhouse emissions. Interestingly, after the McIntyre and McKitrick interpretation, IPCC report (2007) includes no mention of the Hockey Stick graph.

A Global Warming Industry developed as a result of misinterpretation and misreporting of climate change by IPCC, This industry finds government financial assistance is readily available, if the research proposal, in some fashion, suggests the research findings could be a solution to the perceived Global Warming problem. Michaels (2006) reports "in the United States the taxpayer outlay for so-called global change science is now in excess of $4 billion annually."

Based on the scientific findings of persistent and repeated climate change cycles, the temperature records show the Little Ice Age stopped in 1850. After that date, the climate temperature consistently increased, except for an anomalous high in 1940. Frohlich and Lean, (2002) show this temperature increase is due to solar irradiation. Also, the analysis shows no significant increase of CO_2 concentration occurred with increased temperature, Figure 1. Carbon dioxide is a lagging indicator of warming, Singer and Avery (2007b). The observed CO_2 increase is due to the ocean warming, which releases more CO_2. There is no question we have observed climate temperature increasing. This temperature change is likely to be small. Robinson et al. (2007b) estimate the increase will be about 4ºC.

2007 IPCC Report

The 2007 Intergovernmental Panel on Climate Change (IPCC) Climate Change report (http://www.ipcc.ch/pdf/assessment-report/ar4/syr/ar4_syr_spm.pdf) generated considerable criticism from climate scientists, who claim the report provides grossly inaccurate information as reported by the U.S. Senate Committee on Environment and Public Works (http://epw.senate.gov/public/index.cfm?FuseAction=Minority.Blogs&ContentRecord_id=f80a6386-802a-23ad-40c8-3c63dc2d02cb). The Senate Committee said "Over 400 prominent scientists from more than two dozen countries recently voiced significant objections to major aspects of the so-called "consensus" on man-made global warming. These scientists, many of whom are current and former participants in the UN IPCC (Intergovernmental Panel on Climate Change), criticized the climate claims made by the UN IPCC···". This should raise concern regarding the validity of the newer IPCC reports.

Greenhouse Gases

The greenhouse gas theory suggests emissions of greenhouse gases, especially CO_2, from human activities are causing heating of the Earth beyond the levels of past climate variation, and creating serious danger for the planet's ecosystems, IPCC (2007a). The theory has obvious flaws.

1. CO_2 changes do not account for the past climate variations, including the Roman Warming (200 BC – 900 AD), Medieval warming and the Little Ice Age (1300 – 1850), Figures 1 and 3. If CO_2 were the cause of climate change, what would cause the presence or absence of CO_2 to result in these past documented temperature variation over time?
2. The Greenhouse Theory does not explain the recent temperature changes. Most of the observer climate warming occurred prior to 1940, Figure 1 (top)**,** before there was much anthropogenic CO_2 in the atmosphere. In fact, the CO_2 lags the temperature rise, Figure 1 (top); no increase in CO_2 in the 1930s, when climate increase was observed. After 1940, climate temperature decreased until 1960, in spite of an increase in CO_2 emissions. On the other hand, solar activity tracks Arctic temperature well, Figure 1 (bottom). Bond (2001) states, "···over the last 12,000 years virtually every centennial time-scale increase in drift ice documented in our North Atlantic records was tied to a solar minimum." The regularity and correlation of temperature increases and drift ice occurrences with solar activity demonstrate the interaction of these observations.
3. The increase in CO_2 concentration has not produced the increases in atmospheric temperature predicted by the computer models over a 20-year-period. The Earth's surface temperature has warmed more rapidly than the temperature of the lower atmosphere up to 30,000 feet. The Greenhouse theory states the "lower atmosphere" will warm first. This disparity places the Greenhouse Theory in serious question.
4. CO_2 is a lagging indicator by about 600-800 years, of climate warming for the last 240,000 years, e.g., warming produces CO_2 rather than CO_2 producing warming, Singer and Avery (2007a).
5. The Greenhouse Theory predicts CO_2–driven warming of the Earth's surface will start, and be strongest at the polar the regions. This is not happening. Horner (2007b), Taylor (2006). Polyakov (2002) supports lack of pole warming by showing no pole temperature increase and perhaps, a slight temperature decrease in the arctic since 1937.

One of the reasons the greenhouse gas theory is flawed is computer programs do not consider other greenhouse gases. For example, water vapor is a strong greenhouse gas, e.g., the atmosphere contains nearly 2 percent water (compared to 0.037% for CO_2). Water vapor is responsible for about two-thirds of the natural greenhouse effect. Modeling water vapor in climate-change models is very difficult and currently is rudimentary. In fact, the Environmental Protection Agency did not include water vapor in the 1990-2006 Inventory of U.S. Greenhouse Gas Emissions and Sinks, EPA (2008). EPA stated water vapor was too difficult to inventory.

Discussion

IPCC Executive Committee abrogated its contract to provide useful, forward-looking climate information. Instead, the IPCC Executive Committee ignored peer-reviewed climate science and, in some cases, knowingly and willingly refused to correct erroneous data previously published, e.g., Hockey Stick Graph. The greenhouse gas misconception fostered by the IPCC Executive Committee led to the Kyoto Treaty. This treaty is now languishing because, most participating nations cannot, without causing havoc to their country's economy, achieve the greenhouse gases reductions proposed by the treaty. In July 2008, the major industrialized countries abandoned the Kyoto treaty by agreeing to half the greenhouse gas emission by 2050, http://www.foxnews.com/story/0,2933,377622,00.html.

The concept of reducing greenhouse gases to mitigate climate change is hopeless task, if temperature change is the result of solar radiation, as the scientific community shows. We observe energy wasting by well-meaning persons and companies trying to sequester CO_2 by underground injection, OSPAR, http://www.ospar.org/eng/html/welcome.html. Gas compression is energy intensive. CO_2 is a minor greenhouse gas compared with water vapor or methane. Elimination of CO_2 will not prevent climate temperature increases. Svante Arrhenius (1895) showed a reduction in CO_2 down to about 60 percent of the concentration of atmospheric CO_2 existing at the time of his calculations, would have been necessary to cause the Little Ice Age. Ice core gas analyses show such a drastic reduction in CO_2 did not occur. Thus, we can conclude, CO_2 is not a major actor in climate change. On the other hand, good correlation exists between solar activity and climate change on earth, Figure 1.

The current climate-warming scare has fostered an entire industry seeking financial grants for weather related research. Also, there is developing a need by industry to show the public their commitment to mitigate climate temperature increase by reducing greenhouse gases. There is or was a move towards emissions trading. Kyoto Annex I Parties can trade emission, at a price, to satisfy the protocol. Unfortunately, if a problem exists, emission trading simply allows the emissions to enter the atmosphere, rather than a reduced emissions quantity. This may no longer be a problem since, for the most part, the EU is unable to achieve the Kyoto prescribed reductions and the Kyoto protocol will most likely dissolve in 2012 and the 2008 proposal to reduce CO_2 by 50 using unspecified methods will be substituted for Kyoto. Proposals to reduce greenhouse gases will result in increased cost of doing business, which will be passed onto the consumer without affecting climate change.

The carbon tax is another remedy being proposed to reduce CO_2 emissions. Such collected taxes likely will be spent on ill-conceived projects. Congress spent billions of dollars on Synfuel Projects during the 1970's, but provided no economic viable synthetic fuel.

Even when politics is not involved, there is little agreement between opposing groups. In this regard, your attention is directed to Appendix A of the 1 October 2006 New Zealand Climate Science Coalition at http://nzclimatescience.net2.php?option=com-content&do-pdf=1&id=20. The report is a response from the Coalition to Dr. Wratt (listed author of IPCC Assessment Reports), who took issue with the Coalition's statement "the science [of climate change] is not settled" regarding the issue of anthropogenic activities. Further, The Oregon Institute for Science and Medicine (2008) announced 31,000 physical science university degreed professionals, including 9,000 PhDs signed a petition stating climate change is not the result of anthropogenic greenhouse gasses. This demonstrates the magnitude of the disagreement.

There are no experimental data supporting CO_2 causes climate change. On the contrary, Jones et al. (1986) developed an 11 year running average of terrestrial Northern Hemisphere temperature as deviations from the 1951-1970 mean temperature for the period 1750-2000 AD. These data are compared by Baliunas and Soon (1995) with solar magnetic cycle length in years. The resulting match of climate change vs. solar cycle length is almost perfect, Robinson, (2007a, Figure 4), Figure 1.

Conclusions

1. The earth's climate temperature is increasing.
2. The temperature change is a natural, cyclic occurrence driven by solar activity,
3. There are no experimental hypotheses and supporting data demonstrating greenhouse gases causes climate change. On the contrary ice core and tree ring data show climate change is a long-term cyclic occurrence.
4. Controlling anthropogenic greenhouse gases, including CO_2, will **not** stop climate change, if the climate change is due to solar activity.
5. The most convincing hypothesis and supporting data demonstrate the earth's cyclic temperature change results from solar activity

Recommendations

1. Encourage governments to establish laws based on science.
2. Discourage governments and research groups appropriating and spending tax monies on inappropriate anthropogenic climate change experiments.

References.

Arrhenius, S., 1895. "On the Influence of Carbonic Acid in the Air Upon the Temperature of the Ground." Presented at Stockholm Physical Society.

Baliunas, S.L., and W.H. Soon (1995). Are variations in the length of the activity cycle related to changes in brightness in solar-type stars? Astrophysical Journal 450: 896-901.

Bond, G., 1997. "A Pervasive Millennial Scale in North Atlantic Holocene." *Science*, 278:1257-266.

Bond, G., et al., 2001. "Persistent Solar influence on North Atlantic Climate During the Holocene," *Science* 294, 16 November: 2130-136.

Dansgaard, W., et al., 1984. "North Atlantic climate Oscillations Revealed by Deep Greenland Ice Cores," in *Climate Processes and Climate Sensitivity*, ed. F. E. Hansen and T Takahashi (Washington, DC: American Geophysical Union) Geophysical monograph 29, 288-98.

EPA, 2008. Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2006, 73 FR 13414,
7 March
Esper, J., et al., 2002. "1300 Years of Climate History for Western Central Asia inferred from Tree Rings," *The Holocene* 12:267-77.

Frohlich, C. and Lean, J., 2002. "Solar irradiance variability and climate." *Astronomische Nachrichten* **323**: 203-212

Horner, C. C., 2007a "The Political Incorrect Guide to Global Warming and Environmentalism," 84: Regnery Publishing, Inc.

Horner, C. C., 2007b "The Political Incorrect Guide to Global Warming and Environmentalism," 145: Regnery Publishing, Inc.

Houghton, J. T., 1995. "Report of the Intergovernmental Panel on Climate Change," Cambridge University Press.

IPCC, 1996. "Second Assessment Report, Summary for Policymakers."

IPCC, 2001. "Third Assessment Report, Summary for Policymakers."

IPCC, 2007. Summary for Policymakers of Synthesis Report of the IPCC Forth Assessment Report, Draft Copy 16 November.

IPCC, 2007a. Summary for Policymakers of Synthesis Report of the IPCC Forth Assessment Report, Draft Copy 16 November, 13

Jones, P. D., S.C.B. Raper, P.M. Kelly, and T.M.L. Wigley, R.S. Bradley and H.F. Diaz, 1986. "Northern Hemisphere Surface Air Temperature Variations: 1851-1984," *Journal of Applied Meteorology*: 25, No. 2: 161-179

Lamb, H. H., 1977a. "Climate, History and the Future," Methuen, London, 156.

Lamb, H. H., 1977b. "Climate, History and the Future," Methuen, London, 365.

Lamb, H. H., 1977c. "Climate, History and the Future," Methuen, London, 212.

Mann, M. E., 1998. "Global Scale Temperature Patterns and Climate Forcing over the Past Six Centuries," *Nature* 392: 779-87.

McIntyre, S. and R. M. McKitrick, 2003. "Correction of Mann el al., Proxy Data Base and Northern Hemispheric Average Temperature Series," *Energy and Environment* 14.:751-71.

Michaels, P. J., 2006. "Is the Sky Really Falling? A review of Recent Global Warming Scare Stories," Cado Policy Analysis Series No. 576, 22, August 23

Oregon Institute for Science and Medicine, 2008. http://www.worldnetdaily.com/index.php?fa=PAGE.view&pageId=64734

Perry, C. A and K .J. Hsu, 2000. "Geographical, Archaeological, and Historical Evidence Support a solar-Output Model for Climate Change," Proceedings of the National Academy of Science USA 97 12433-438.

Polyakov, I. V., et al, 2003. "Variability and Trends of Air Temperature and Pressure in the Maritime Arctic, 1875-2000." *Journal of Climate* 16: 2067-77.

Przybylak, Raymond, 2000. "Temporal and Spatial Variation of Surface Air Temperature over the Period of Instrument Observations in the Arctic." *International Journal of Climatology* 20: 587-614.

Robinson, A. B, 2007a. "Global Energy Rationing," at www.lewrockwell.com/orig8/robinson1.html

Robinson, A.B., et al., 2007b. " Environmental Effects of Increasing Atmospheric Carbon Dioxide." At www.oism.org/pproject/s33p36.htm

Shindell, D. T., and G. A. Schmidt, 2004. "Southern Hemisphere Climate Response to Ozone Changes and Greenhouse Gas Increases," *Geophysical Research letters* 31: L18209.

Singer, S. F., and D. T. Avery, 2007a. “Unstoppable Global Warming every 1,500 years.” Rowman & Littlefield Publishing, Inc. 11

Singer, S. F., and D. T. Avery, 2007b. “Unstoppable Global Warming every 1,500 years.” Rowman & Littlefield Publishing, Inc. 23

Singer, S. F., and D. T. Avery, 2007c. “Unstoppable Global Warming every 1,500 years. Updated and Expanded” Rowman & Littlefield Publishing, Inc. 8

Soon, W. (2005). Geophysical Research Letters **32**, 2005.

Taylor, George H., 2006. “Antarctic Temperature and Sea Ice Trends Over the Last Century –An Assessment of Antarctic Climate Trends.” http://icecap.us/images/uploads/antarctica_white_paper_final.pdf

The Australian, 2008. http://www.theaustralian.news.com.au/story/0,25197,23612876-11949,00.html

Willison, Richard C., 2003. “NASA Study Finds Increasing Solar Trend That Can Change Climate.” Goddard Space Center “Top Story,” press release 20 March.

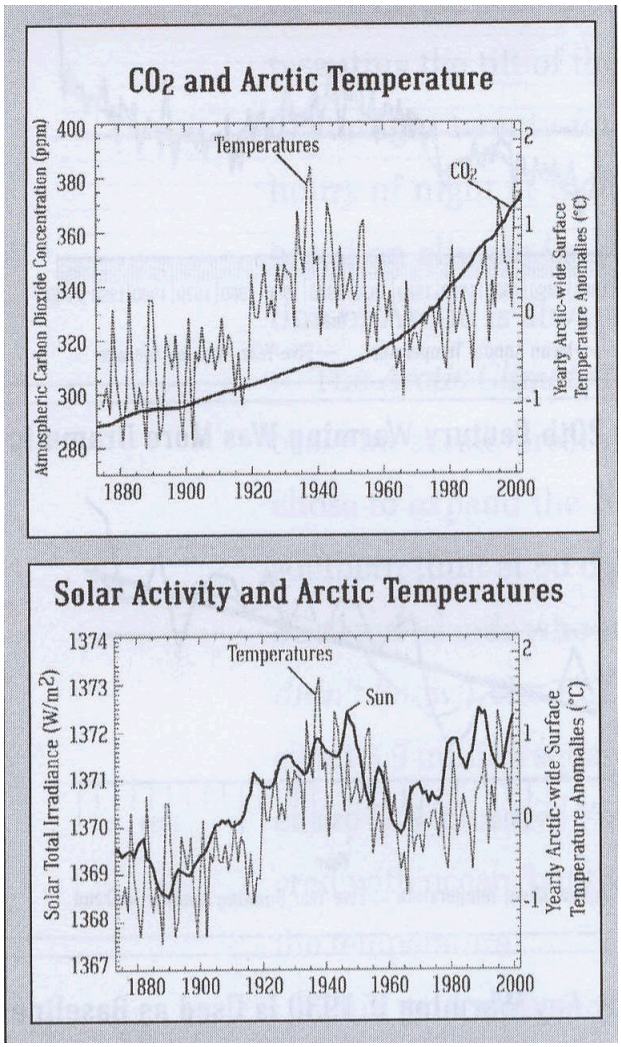

Figure 1. Carbon Dioxide and Solar Activity Arctic Temperatures. .
Horner (2007b) p146. Courtesy of Dr. Willie Soon

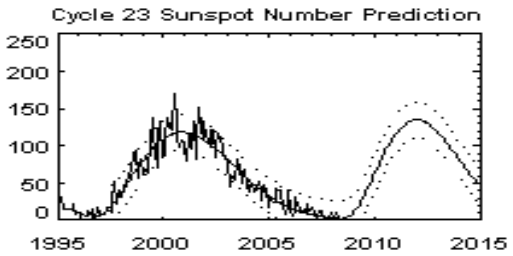

Figure 2. Solar Cycle Prediction
http://solarscience.msfc.nasa.gov/predict.shtml

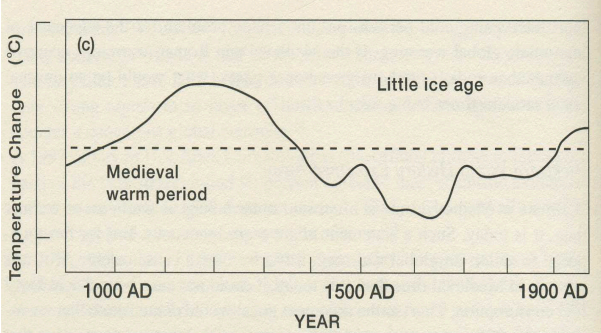

Figure 3. Climate history for the last 1,000 years.

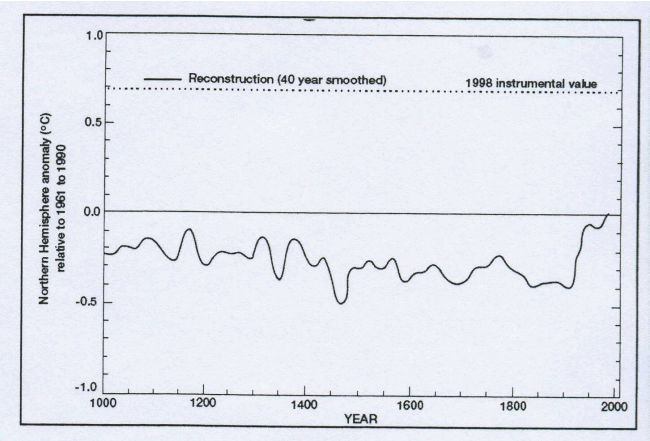

Figure 4. The 2001 IPCC Report "Hockey Stick"