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Developing a Consistent Database for Regional Geologic CO_2 Storage Capacity Worldwide

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—Ronald G. Prinn and John M. Reilly,
Joint Program Co-Directors

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Developing a consistent database for regional geologic CO_2 storage capacity worldwide

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Abstract

Assessments of the geologic storage capacity of carbon dioxide in the current literature are incomplete and inconsistent, complicating efforts to assess the worldwide potential for carbon dioxide capture and storage (CCS). We developed a method for generating first-order estimates of storage capacity requiring minimal data to characterize a geologic formation. We show this simplified method accounts for the majority of the variance in storage capacity found in more detailed studies conducted in the United States. We apply our method to create a worldwide database of storage capacity, disaggregated into 18 regions, and compare this storage capacity to CCS deployment in the MIT Economic Prediction and Policy Analysis (EPPA) model. Globally, we estimate there are between 8,000 and 55,000 gigatonnes (Gt) of practically accessible geologic storage capacity for carbon dioxide. For most of the regions, our results indicate storage capacity is not a limiting factor for CCS deployment through the rest of this century even if stringent emissions reductions are required.

Peer-review under responsibility of the organizing committee of GHGT-13.

Keywords: CCS; geologic storage capacity; integrated assessment model;

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1. Introduction

The Intergovernmental Panel on Climate Change (IPCC) and the International Energy Agency (IEA) have issued recent reports suggesting that deployment of carbon dioxide capture and storage (CCS) can significantly reduce the cost of achieving carbon dioxide (CO_2) emission reduction targets [1,2]. However, several questions remain [3]: Under what circumstances will large-scale deployment take place? Where and when will this occur? How large a role will CCS play in stabilizing atmospheric concentrations of CO_2?

This study is part of a larger project to use Integrated Assessment Models (IAMs) to help answer these questions. For IAMs to provide reliable insights, they need to include accurate descriptions of the various energy technologies. These include technology costs, as well as constraints to technology deployment. For CCS, a potential constraint is the amount of geologic storage capacity available. Existing evaluations of regional geologic storage capacity are, however, limited. As such, existing IAMs either make use of inconsistent and incomplete storage capacity data or unrealistically apply no limit to the amount of carbon dioxide that can be stored. In order to provide a more accurate assessment of the potential for CCS, the goal of this study is to produce a database of geologic storage capacity for the world, disaggregated regionally, that is consistent and complete. We then compare our storage capacity estimates to storage demand projections of the MIT Economic Projection and Policy Analysis (EPPA) model [4] to examine the effect of a geologic storage capacity limitations on estimates for CCS deployment. While we only apply our storage capacity estimates to the EPPA model, our capacity estimates could be applied beyond IAMs to other evaluations of CCS potential over large geographic areas.

2. Completeness and Comparability of Storage Capacity Assessments

Detailed regional storage capacity assessments have been conducted in China [5], Europe [6,7,8], Japan [9], and the United States and southern Canada [10,11], though these assessments differ in quality and detail. While these regions constitute the majority of global emissions, storage capacity in most of the world is uncharacterized, including for rising economies such as India and for areas geologically promising for carbon dioxide storage such as the Middle East and Russia. This paucity of regional storage capacity assessments for much of the world poses the first problem for use of current storage estimates in evaluations of the potential of CCS.

The second problem is that regional storage assessments, where they have been conducted, differ in their underlying assumptions making direct comparisons of their results inappropriate. Our review of available regional storage capacity estimates concurs with the conclusion reached by the IEA workshop—*Methods to Assess Geologic CO_2 Storage Capacity: Status and Best Practice*—that current "storage estimates are not all based on the same scientific assumptions and thus cannot be accurately compared or summed to provide regional or global estimates of CO_2 storage potential" [12]. The independent assessments of geologic storage capacity in the conterminous United States by the United States Geological Survey (USGS) and United States Department of Energy (DOE) are illustrative of the general problem of comparability between assessments. By adopting more optimistic assumptions, the DOE estimates over twice the storage capacity of the USGS in their medium scenarios when restricted to similarly defined regions. The disparity between estimates increases for the high scenarios, in which the DOE estimates a storage capacity nearly four times that of the USGS (Figure 1) [10,11].

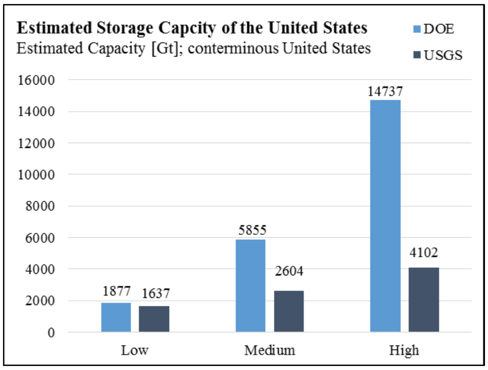


Figure 1. Disparity between U.S. storage capacity estimates. To ensure geographic comparability, estimates are restricted to only include storage capacity in saline and oil and gas formations located onshore or in state waters in the conterminous United States

The most common approaches to estimating regional storage capacity, used by each of the aforementioned regional assessments, are variations on the volumetric method. In essence, the volumetric method first estimates the volume of pore space available for CO_2 storage and then estimates the proportion of available pore space that is usable after accounting for various limitations (See Equation 1). These limitations may be technical, economic, and/or regulatory (encompassing public acceptance and acceptable levels of risk) and vary from study to study.

$$Storage\ Capacity = V * \rho(P,T) * E \tag{1}$$

Where V is the volume of pore space available, ρ is the density of CO_2 at subsurface pressure (P) and temperature (T), and E is the storage efficiency factor. The available pore space can be calculated as the product of the sedimentary area, sedimentary thickness, and porosity. The storage efficiency factor (E) refers to the proportion of available pore volume that is ultimately usable for storage. Various assumptions regarding geologic storage are incorporated into E (see [13] for further discussion of storage efficiency). Some studies break E into several components. For example, the DOE Atlas methodology represents E for saline formations as the product of the proportion of the formation volume meeting geologic suitability criteria, the proportion of pore space that is interconnected, the proportion of pore space coming in contact with the CO_2 plume, and the proportion of pore space not occupied by non-displaceable fluids [14].

While the literature is consistent in its use of storage efficiency factor in this general sense, assessments use varying definitions of *available* pore volume and *usable* pore volume leading the term to take on distinct meanings across studies. For example, the DOE Atlas uses a lower storage efficiency factor than the USGS assessment, but estimates higher storage capacities for the same areas because the DOE starts with a larger definition of available pore space than the USGS. The DOE begins with the pore volume of entire sedimentary basins and decreases its storage efficiency factor, as only a portion of that area will have an adequate seal and sufficient permeability, whereas the USGS uses sections of sedimentary basins pre-screened for adequate seals and permeability, but applies a higher storage efficiency factor to these more favorable sites [14,15]. Alternatively, European studies tend to assume less pore space is usable due to non-negligible pressure limitations [16] while the USGS and DOE studies implicitly assume pressure increases are either manageable or negligible. Due to the inconsistent use of the term, unqualified comparisons of storage efficiency factors between studies are misleading; furthermore, the underlying assumptions regarding storage mechanisms cannot be harmonized between studies by simply adjusting their estimates to use a common storage efficiency factor unless they begin from a common definition of available volume.

Table 1 provides examples of variously applied assumptions that make storage assessments incomparable. Some of these assumptions are technical, representing genuine disagreements on the mechanics of subsurface fluid injection, migration, or long-term stability. Other assumptions, however, relate to anticipated economic or regulatory limitations that are unrelated to technically feasible storage capacity. While such restrictions are useful, they also complicate meaningful cross-assessment comparisons or the construction of a global storage capacity database. Our review of assessment comparability concurs with the IEA recommendation that studies should publish their estimates for technically accessible storage alongside any estimates of storage considered practically accessible [12].

Table 1. Examples of assumed limiting factors variously applied to the volumetric storage capacity method

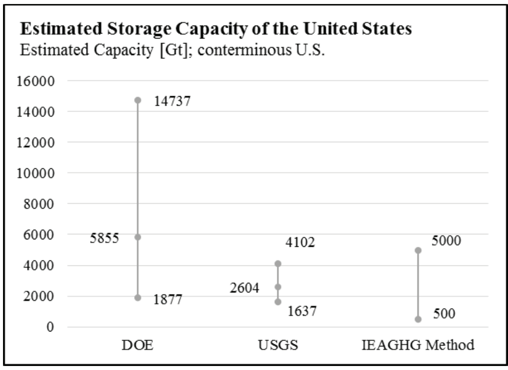
Limiting Factor	Type
Excluding storage offshore or far from point sources	Economic
Pressure increases manageable	Economic
Pressure increases negligible	Technical
Standards for sufficient depth	Technical
Standards for seal quality	Technical
Potable groundwater protection	Regulatory
Excluding storage onshore or near populated areas	Regulatory

3. Storage Capacity Assessment: IEAGHG Formation Area Method

Given the gaps in data availability and incompatibility of data that does exist, currently available storage capacity assessments are insufficient for use in evaluations of CCS potential. Particularly in the application of IAMs, there is value in examining storage capacity in a consistent and globally complete manner even if this approach sacrifices use of more detailed, local data.

The International Energy Agency Greenhouse Gas R&D Programme (IEAGHG) developed a method for estimating geologic storage capacity based on limited data [17]. The only input into the model is the area covered by sedimentary basins in the region. Half of this area is assumed to be covered by an adequate seal, and the average net thickness of the sedimentary layer is taken as 100 meters. To this volume, a storage efficiency factor is applied to estimate storage capacity. In sum, each square kilometer of a sedimentary basin's areal extent yields, on average, between 0.1 and 1 million tonnes of carbon dioxide storage capacity. The lower bound corresponds to the assumption of a closed system (pressure is unable to dissipate) while the upper bound assumes an open system (pressure is able to dissipate leading to negligible pressure increases). The key notion underlying this simple methodology is that the distribution of geologic conditions conducive for carbon dioxide storage (e.g. thickness, sufficient depth, adequate seal, high permeability) can be considered randomly distributed over sufficiently large areas.

While this method relies on a simplistic model, its estimates, over sufficiently large geographic areas, are in general agreement with those of more detailed regional assessments. We replicated the IEAGHG method in several regions where detailed assessments have been conducted using data from Robertson Tellus sedimentary basins of the world map [18] and GIS software, calculating the total area of the sedimentary basins in regions of interest. Applied to the onshore, conterminous United States, the IEAGHG method predicts between 500 and 5000 Gt of storage capacity (Figure 2). The low estimate based on the IEAGHG method is below the low estimates for both the DOE and USGS, which is expected as this estimate contains the assumption that all storage formations are closed systems. Applied to the North Sea, the IEAGHG method brackets the aggregated estimates from the UK Storage Appraisal Project (UKSAP) and the Norwegian Petroleum Directorate (NPD), for a similarly defined area (Figure 3) [7,8]. Note that the UKSAP and NPD assessments of the North Sea use similar assumptions and methodologies such that summing their results is a fair approximation of storage capacity in the region.



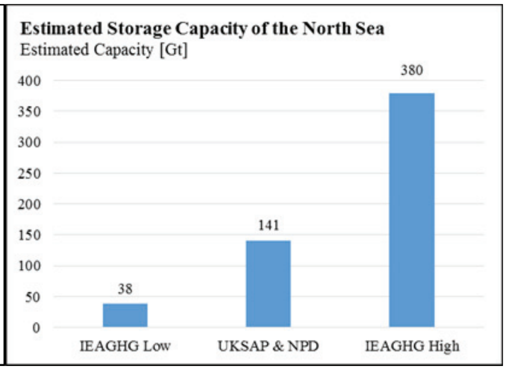
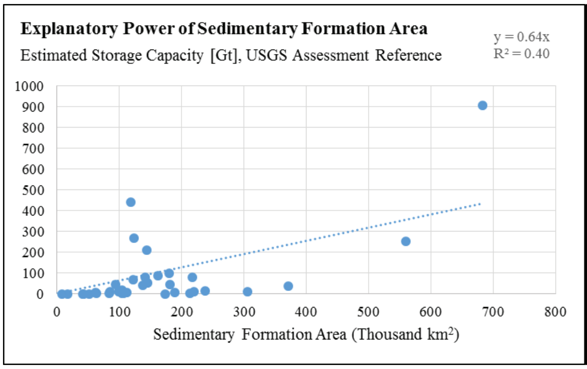


Figure 2. Comparison of storage capacity estimates in the conterminous United States. Chart shows the high and low of each estimate as well as the most-likely estimate in the case of the DOE and USGS
Figure 3. Comparison of storage capacity estimates in the British and Norwegian sections of the North Sea

While these comparisons suggest the original coefficients proffered by IEAGHG agree with more detailed assessments, of greater interest is the strength of sedimentary formation area as an explanatory variable for storage capacity. To evaluate the explanatory power of sedimentary formation area, we disaggregated the storage assessments by the USGS and DOE into individual state estimates and compared estimated storage capacity to sedimentary area in the state. Applying a linear regression, we find that the areal extent of sedimentary basins alone accounts for 40% of the variation in estimated storage capacity in the USGS assessment and 50% of the variation in estimated storage capacity in the DOE assessment (Figures 4 & 5).



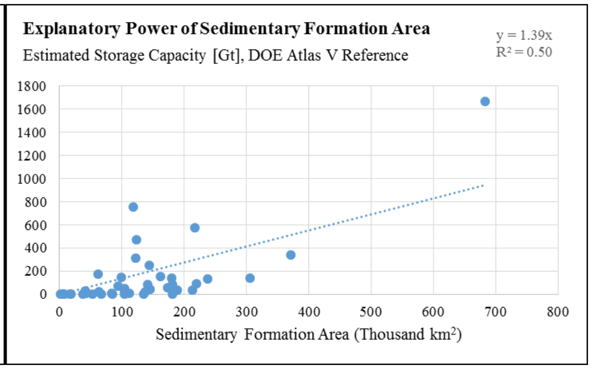


Figure 4. Ability of sedimentary area to explain variation in state storage capacity estimates in the USGS assessment
Figure 5. Ability of sedimentary area to explain variation in state storage capacity estimates in the DOE Atlas V

4. Storage Capacity Assessment: Formation Volume Method

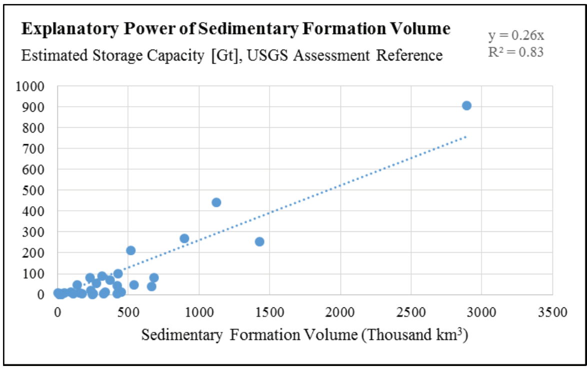
4.1. Methodology and Key Assumptions

The IEAGHG formation area method was modified by taking into consideration the formation thickness. This follows the general methodology of Equation 1 that relates storage volume to formation volume, but is adapted to make use of globally defined datasets and provide storage capacity estimates using minimum formation data. We assume sedimentary formation volume and storage capacity are proportional and apply a proportionality coefficient similar to the storage efficiency factor in other volumetric methods. Since we begin with formation volume while most assessments using a storage efficiency factor start from bulk pore volume (the product of sedimentary formation volume and porosity), our proportionality coefficient should not be directly compared to storage efficiency factors in other studies. We follow the IEAGHG method in assuming most factors contributing to favorable storage conditions can be treated as randomly distributed over large areas, but the IEAGHG method's treatment of sedimentary thickness as randomly distributed is particularly weak, even over large regions, and is easily avoided with available data. As sedimentary thickness has been globally characterized, incorporating thickness does not diminish the benefits of simplicity or completeness provided by the original IEAGHG method.

We estimate sedimentary formation volume using the Robertson Tellus sedimentary basins of the world map [18] and Laske et al.'s [19] compiled map of sediment thickness. Using GIS software, we calculated the average sediment thickness measurement for each basin or, in cases where the basin did not overlap with thickness data, extrapolated from the nearest available thickness measurements. We then calculated the sum of formation volume in various regions of interest and in each of the regions defined by the EPPA model, dividing basins when they crossed relevant boundaries (the full list of regional aggregation can be found in [20]). Finally, we examined how well formation volume can explain the variation in the DOE and USGS estimates for storage capacity in the same state-by-state manner as we evaluated the IEAGHG method.

4.2. Explanatory Power of Sedimentary Formation Volume

Following the same method used to evaluate the explanatory power of sedimentary area, we examine the degree to which state storage capacity estimates can be explained by the sedimentary formation volume within the state. Applying a linear regression, we find formation volume explains 83% of the variation in the storage capacity estimates of USGS assessment and 89% of the variation in the DOE Atlas (Figures 6 & 7), an improvement over the 40% and 50% explained by sedimentary basin area alone. Furthermore, the underlying assumption that geologic properties conducive to carbon dioxide storage can be treated as randomly distributed should be stronger when considering regional units larger than states, as we do in our comparison to the EPPA model. Given the logical connection between formation volume and storage volume, and the demonstrated correlation between formation volume and the USGS and DOE storage capacity estimates, we assert sedimentary formation volume can be used as a good initial estimate of storage capacity at a regional level.



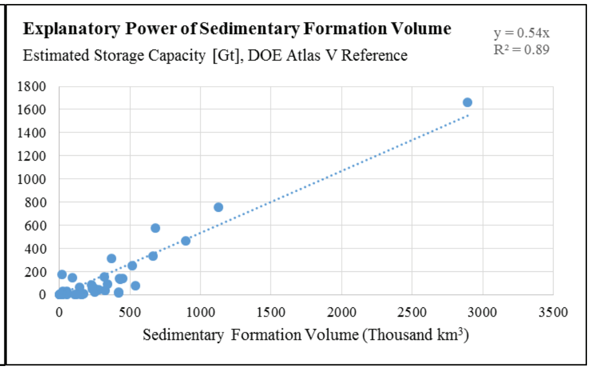


Figure 6. Ability of sedimentary formation volume to explain variation in state storage capacity estimates in the USGS assessment
Figure 7. Ability of sedimentary formation volume to explain variation in state storage capacity estimates in the DOE Atlas V

4.3. Proportion of Sedimentary Formation Volume Available as Storage Capacity

In order to use sedimentary volume to estimate regional storage capacity, we must determine an appropriate coefficient relating sedimentary formation volume to storage capacity. This coefficient is analogous to the storage efficiency factor used in other studies in that it defines the proportion of the sedimentary volume usable for storage of carbon dioxide, though, as previously noted, these coefficients should not be directly compared as they begin from different starting volumes. We identify two coefficients, one extrapolating from USGS assumptions and the other extrapolating from the more restrictive assumptions used by Szulczewski [21] leading, respectively, to an upper and lower estimate for storage capacity.

Our upper estimate uses the coefficient derived from the USGS assessment of 0.26 Gt of carbon dioxide storage capacity per thousand cubic kilometers of sedimentary basin (Figure 6). We chose the USGS assessment as our reference case over the DOE Atlas as, in our view, the USGS methodology better accounts for local geology and various trapping mechanisms than the DOE methodology. Additionally, the IEA workshop, *Methods to Assess Geologic CO_2 Storage Capacity: Status and Best Practice,* identified the USGS methodology as an example of best practice in capacity estimation methodology [12].

The USGS assessment, however, does not account for pressure limitations on injection rate, implicitly assuming most storage formations can be characterized as open formations with infinite time available for injection or that active pressure management will be employed. Therefore, it provides an upper estimate of storage capacity. To provide a lower estimate, we use an approach based on a study by Szulczewski that explicitly considers pressure increases and their impact on injection rate and storage capacity that could practically be achieved within a given time frame [21]. This study examines eleven promising, and well characterized, sedimentary basins in the conterminous United States in detail, considering limitations such as pressure dissipation and faulting, which other studies neglect or include only in the aggregated storage efficiency factor. The storage estimates from this study do not claim to be exhaustive of the storage capacity in the United States or any given state. Consequently, we regress the volume of each of these formations to the storage capacity estimated by Szulczewski. While Szulczewski examined the effect of pressure dissipation over time resulting in a time dependent estimate of storage capacity, we restrict our comparison to the study's fifty-year injection period estimate. Since the formations were chosen in part because of their potential for storage, extrapolating from these formations introduces some upward selection bias to our lower estimate, but we believe this is more than counteracted by the generally conservative approach taken by the original study. This is supported by our lower estimates being substantially lower than other estimates published for similarly defined regions. This approach yields a coefficient of 0.037 Gt of storage per thousand cubic kilometers of sedimentary basin (Figure 8).

Sedimentary volume explains less of the variance in Szulczewski's capacity estimates than those of the DOE Atlas or USGS assessment. One reason for this increased discrepancy is Szulczewski's exclusion of areas with major faults, which in some formations significantly reduces the sedimentary volume Szulczewski considers available for storage. This is, for example, the case with the Paluxy formation, which exhibits the second greatest deviation between the regression line and Szulczewski's estimate.

The correlations derived from both the USGS assessment and the Szulczewski study suffer from the shared weakness of extrapolating from a relation based only on U.S. geology to the rest of the world. This, however, is unavoidable until storage assessments adhering to a common methodology are conducted in multiple regions.

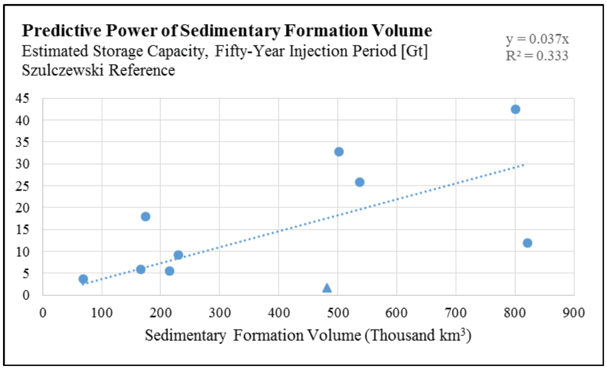


Figure 8. Ability of sedimentary formation volume to explain variation in basin storage capacity for a fifty-year injection period as estimated by Szulczewski. The point indicated by a triangle represents the aforementioned Paluxy formation

4.4. Results

We apply the two coefficients to the calculated sedimentary volume for each EPPA region leading to an upper and a lower estimate. Following the recommendation of the IEA workshop on storage capacity estimation methods, we present a technically accessible storage capacity that includes all available data for comparison purposes, though, for offshore areas, we consider much of this capacity practically inaccessible. For offshore storage, alongside the technically accessible storage capacity, we present our estimates for practically accessible storage capacity. To define practically accessible offshore storage capacity—a subset of technically accessible offshore storage capacity—we exclude a portion of offshore sedimentary formation volume from carbon dioxide storage based on three basic criteria: 1) water depth cannot exceed 300 meters, 2) site must be within 200 miles of shore (defined as a landmass greater than 10,000 square kilometers), and 3) site cannot fall in the Arctic or Antarctic regions (i.e. site must fall between 66 degrees north and 66 degrees south). The water depth exclusion results in the greatest reduction in storage capacity, particularly for Africa and Japan due to the steep continental shelf. Similarly, the Arctic exclusion causes a significant reduction in Canadian and Russian storage capacities. Though other economic or regulatory factors will likely also reduce suitable storage capacity sites, we include these criteria as we consider them the most restrictive on storage capacity and the most difficult to overcome. As we view these limitations as firm restrictions, we use practically accessible storage capacity in our totals and model applications. Our results are summarized in Table 2. A map of practically accessible sedimentary basins and their thickness is presented in Figure 9.

Table 2. Storage capacity estimates for regions defined by the EPPA 6 model using our high-level method. See Figure 13 for region definitions

EPPA 6 Region		Estimated Storage Capacity [Gt]							
		Lower Estimate[a]				Upper Estimate[b]			
		Onshore	Offshore		Total[c]	Onshore	Offshore		Total[c]
			Technical[d]	Practical[e]			Technical[d]	Practical[e]	
AFR	Africa	1344	880	220	1563	9444	6185	1543	10986
ANZ	Australia & New Zealand	334	699	261	595	2349	4912	1835	4184
ASI	Dynamic Asia	36	115	83	119	251	806	583	834
BRA	Brazil	224	267	73	297	1572	1877	515	2087
CAN	Canada	206	514	112	318	1445	3610	790	2236
CHN	China	325	100	77	403	2286	704	544	2830
EUR	Europe (EU+)	161	492	141	302	1129	3459	991	2120
IDZ	Indonesia	96	166	67	163	672	1163	472	1144
IND	India	75	264	25	99	525	1853	172	697
JPN	Japan	4	24	5	8	26	171	34	59
KOR	Korea	0	9	3	3	0	62	24	24
LAM	Other Latin America	443	614	163	606	3111	4317	1145	4257
MES	Middle East	370	218	121	492	2603	1530	851	3454
MEX	Mexico	79	200	58	138	556	1408	411	967
REA	Other East Asia	161	377	110	272	1135	2651	776	1911
ROE	Other Eurasia	415	202	70	485	2916	1422	494	3410
RUS	Russia	1180	621	54	1234	8291	4361	382	8673
USA	United States	551	445	261	812	3872	3130	1836	5708
	Global	6003	6208	1907	7910	42181	43622	13399	55581

[a] 0.037 Gt per thouand cubic kilometers sedimentary basin

[b] 0.26 Gt per thousand cubic kilometers sedimentary basin

[c] Onshore and practically accessible offshore

[d] All offshore areas for which data is available

[e] Water depth less than 300 meters, within 200 miles of a major landmass, and outside of Arctic or Antarctic regions

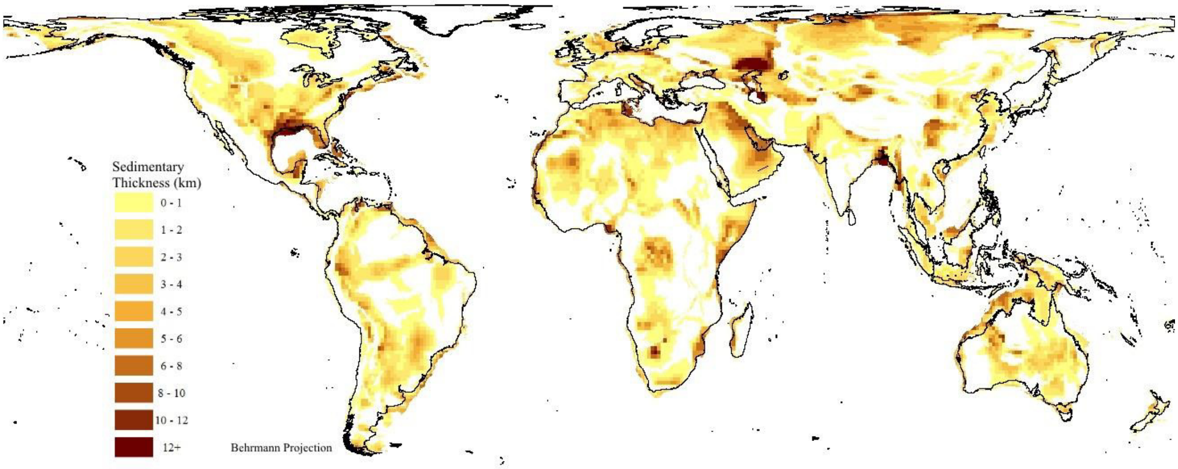


Figure 9. Global sedimentary basins and thicknesses. Map shows onshore basins and practically accessible offshore basins. Regions with high volumes of sedimentary basin are correlated to higher CO_2 storage capacities

4.5. Discussion

We estimate practically accessible global geologic storage capacity for carbon dioxide as approximately 8,000 Gt when extrapolating from Szulczewski's assumptions and up to 55,000 Gt following the assumptions adopted by the USGS. Our lower estimate, restricting storage capacity to account for unacceptable pressure increases and inaccessible offshore storage, indicates sufficient capacity to store over two centuries of all current global carbon dioxide emissions. These estimates are based on current technology, but it may be possible for storage capacity to increase over time due to technological change that allows greater utilization of the sedimentary formation volume.

Though certain regions are endowed with particularly favorable geology for storage, each of the economic regions defined by the EPPA model have approximately 100 Gt or more of accessible storage capacity in our lower estimate, excepting Korea and Japan. Our analysis, however, does not account for the possibility that storage capacity may be unevenly distributed within a given region, which is of particular importance for geographically disjointed regions. Finally, we find the exclusion of storage sites in deep water, far offshore, or in the Arctic or Antarctic, results in a major reduction in estimated offshore storage capacity, decreasing our estimate by about 70 percent.

A potential weakness of our analysis is our extrapolation of a capacity coefficient based only on U.S. data. Extrapolating from a single region's geology was unavoidable due to the lack of detailed storage assessments from different regions using a common methodology. As a check on the validity of our extrapolation, we also estimated storage capacity for the North Sea, as the UKSAP and NPD have studied the local geology and potential for carbon dioxide storage in this area extensively using similar methods [7,8]. We selected the North Sea as a check on the validity of our extrapolation because of the availability of quality data for the area; however, the existence of data for these regions may indicate a selection bias in that only regions with favorable geology have been characterized. The methodologies employed by the UKSAP and NPD are more similar to the USGS assessment than the Szulczewski study, but both the UKSAP and NPD also include pressure limitations where oil and gas exploration data indicates the formation is closed. Due to its location and shallow water depth, our practicality constraints do not reduce North Sea storage capacity.

Though the appropriateness of our assumptions weaken when applied to smaller regions, our estimates for the North Sea are consistent with the estimates from the UKSAP and the NPD. Our lower and upper estimates bracket the combined UKSAP and NPD estimate for the British and Norwegian sections of the North Sea (Figure 10).

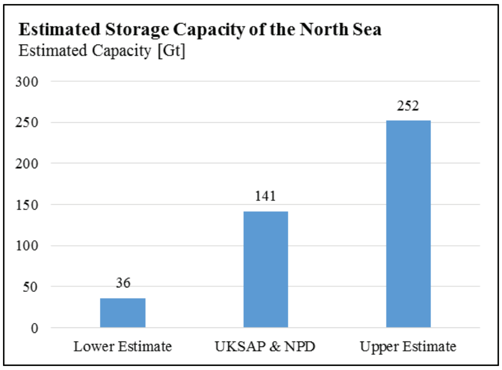


Figure 10. Comparison of our storage capacity estimates in the British and Norwegian sections of the North Sea to more detailed estimates

5. EPPA Model Comparison

To assess the relative size of the CO_2 storage capacity and the amount of CO_2 expected to be captured during the 21st century if steep emissions reductions policies are enacted, we employ a version of the EPPA model with a representation of several CCS technologies. This version of the EPPA model includes options for CCS in the power sector with fossil fuels (coal with CCS and natural gas with CCS) and bioenergy (BECCS) and forces atmospheric concentrations of CO_2 to stabilize at approximately 450 parts per million (ppm) and stabilization of all greenhouse gases to approximately 550 ppm of CO_2 equivalent by 2100. [22]. The IPCC concluded that the BECCS technology could be important in the stringent climate stabilization scenarios because it is a source of negative emissions that most likely will be needed in the second part of the 21st century if cumulative emissions reduction targets are to be met [1]. To provide an upper estimate for the need for CO_2 storage in the 21st century, we run the EPPA model with optimistic assumptions about the cost of bioenergy and CCS (see [22] for details). Figures 11 and 12 provide the results for the storage capacity estimates and the storage demand. Figure 13 shows the definitions of the EPPA regions. Our lower estimate of storage supply lead to capacity estimates that are close to storage demand in the optimistic CCS cost scenario in several regions such as China (CHN), Europe (EUR) and the United States (USA). Optimistic assumptions for CCS costs also lead to demand for CO_2 storage in India (IND), Rest of East Asia (REA), Japan (JPN), and Korea (KOR) that exceeds the lower estimate of storage supply in these regions (Figure 11). Demand for storage comes mostly from bioenergy with CCS. Our upper estimates for storage supply exceed demand for capacity, even with extensive CCS deployment, in all regions except Korea (KOR) (Figure 12).

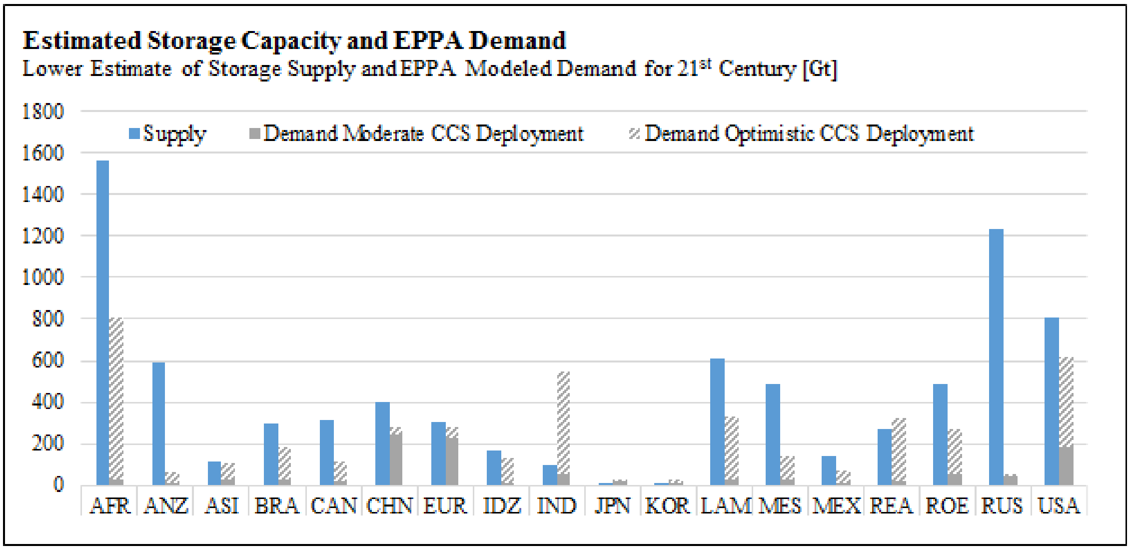


Figure 11. Comparison of the lower storage capacity estimate and the demand for stored carbon (with Optimistic and Medium CCS cost assumptions) by the EPPA model regions in the scenarios with stringent emission reductions in the 21st century

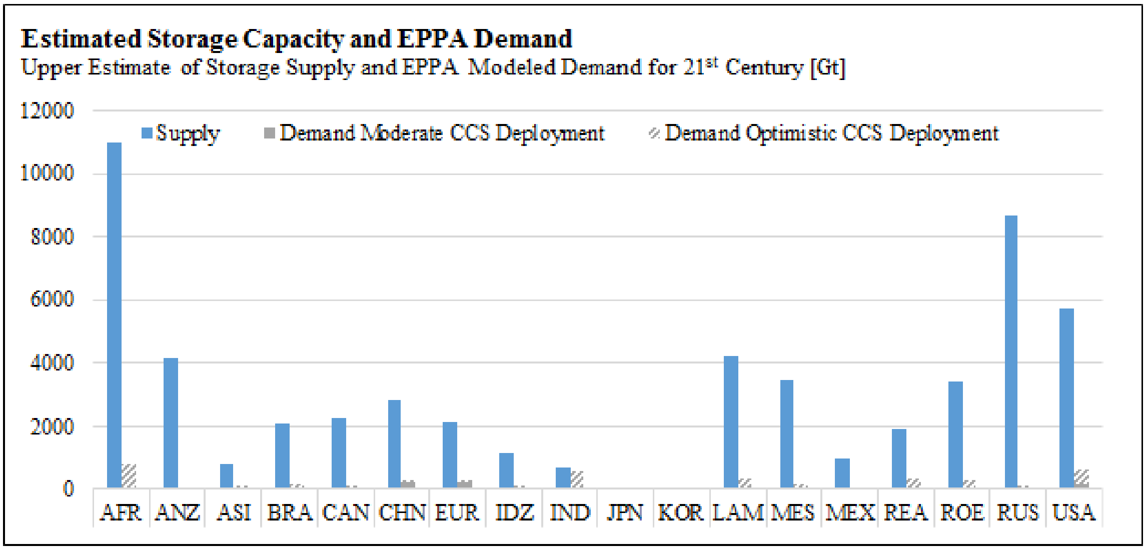


Figure 12. Comparison of the upper storage capacity estimate and the demand for stored carbon (with Optimistic and Medium CCS cost assumptions) by the EPPA model regions in the scenarios with stringent emission reductions in the 21st century

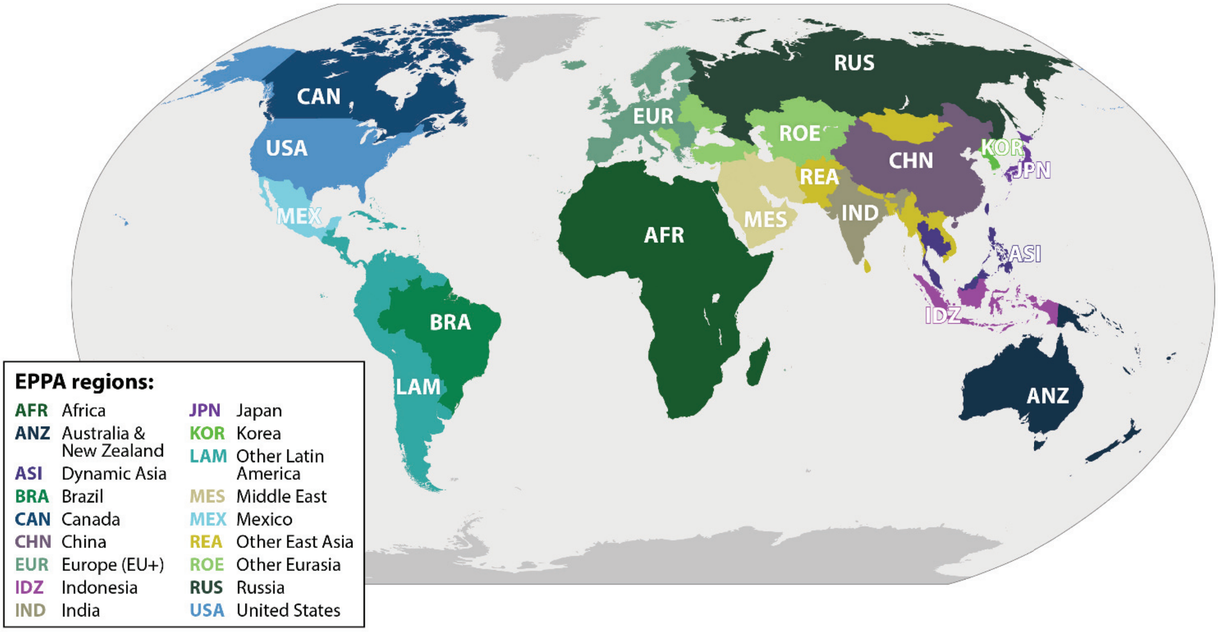


Figure 13. Regions as defined by the EPPA model

6. Conclusion

In this project, we developed a method of estimating regional storage capacity using globally available datasets, allowing us to create a consistent set of regional storage estimates worldwide. This methodology produces estimates in reasonable agreement with estimates from more detailed capacity assessments where they are available. We estimate practically accessible CO_2 storage capacity to be between approximately 8,000 Gt and 55,000 Gt globally using current storage technology. A comparison of our current regional storage capacity estimates to the demand for storage predicted by the EPPA model shows that, in most regions, our lower estimate of storage capacity is sufficient to meet demand for storage through the rest of the century even when policies and technological costs favor extensive CCS deployment in the power sector. Robust demand for storage capacity, however, could exceed our lower estimate for storage capacity in some regions, including India. Further work might investigate the realism of our practicality constraints and whether others should be considered, or integrate available data on major faults and other geologic considerations into our estimation methodology. Additionally, our estimates consider all storage capacity within a region as homogenous; further work could apply source-sink matching to our methodology to begin building storage supply curves on a regional basis.

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