Employment Effects of Investments in CO_2 Transport Infrastructure and Geologic Storage – the 2021 SCALE Act

February 2021

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INTRODUCTION

The U.S. and other countries around the world are pursuing multiple technologies to reduce emissions of carbon dioxide (CO_2) and other greenhouse gases that contribute to global climate change. Analysis from the Intergovernmental Panel on Climate Change as well as other organizations has shown that carbon capture, removal, and storage technologies are expected to be needed to deliver on net-zero emissions goals.[1] Thus, governments in several countries have begun to pursue near-term investment in the development of CO_2 infrastructure that would enable the collection of CO_2 from multiple sources and the transport of CO_2 to shared storage sites. To facilitate the deployment of this infrastructure in the United States, the Storing CO_2 and Lowering Emissions (SCALE) Act includes the authorization of funding to finance both the construction of CO_2 transport infrastructure and the development of commercial CO_2 storage capacity in underground geologic formations at several sites, among other provisions. More specifically, the bill authorizes $2.1 billion for a CO_2 infrastructure program over five years to jumpstart the construction of CO_2 transport infrastructure and $2.5 billion in federal matching funds to spur the development of geologic storage sites.

While policymakers and the public will likely be interested in the CO_2 mitigation impacts of these investments, in terms of the tons of CO_2 emissions captured and permanently stored over time, there may also be significant interest in the employment impacts associated with these investments. Due to the effects of COVID-19, the unemployment rate has increased from 3.5 percent in February 2020 to 6.7 percent in December 2020 and the number of Americans with jobs has fallen from 158.7 million to 149.8 million over that same period.[2] In this environment, understanding the degree to which federal government expenditures are likely to help stimulate economic activity and increase employment is of critical importance. To that end, this document provides an assessment of the employment impacts associated with the authorizations included in the SCALE Act for the development of CO_2 transport infrastructure and geologic storage. The scope of this analysis is limited to the development of these projects; we do not assess the employment impacts associated with operating or maintaining these facilities. We also do not assess the employment impacts of building or retrofitting carbon capture, removal, and storage facilities, which will likely create additional jobs along the carbon capture value chain.

APPROACH

To assess employment impacts, we applied the *Status* input-output model developed and maintained by Inforum, an economic research organization affiliated with the University of Maryland. Input-output models are a well-established framework for assessing the economic impacts associated with a change in expenditures for one or several industries across multiple sectors of the economy. Using detailed data on inter-industry relationships, input-output models estimate how a positive or negative shock in one

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[1] See IPCC (2018) *Global Warming of 1.5°C. An IPCC Special Report on the impacts of global warming of 1.5°C above pre-industrial levels and related global greenhouse gas emission pathways, in the context of strengthening the global response to the threat of climate change, sustainable development, and efforts to eradicate poverty*, available at https://www.ipcc.ch/sr15/download/ and International Energy Agency (2020) *World Energy Outlook 2020*, available at https://www.iea.org/reports/world-energy-outlook-2020.

[2] U.S. Bureau of Labor Statistics, The Employment Situation—December 2020, released January 8, 2021. Available at https://www.bls.gov/news.release/pdf/empsit.pdf.

industry (e.g., a change in output) cascades across the broader economy. Thus, in addition to capturing direct economic impacts for industries with increased (or decreased) production, input-output models capture spillover effects to other industries. These spillover effects include indirect impacts and induced impacts. Indirect impacts reflect inter-industry purchases and arise from firms purchasing inputs from their suppliers. For example, in the context of expenditures to develop CO_2 pipeline infrastructure, indirect impacts would include the employment associated with manufacturing the steel used to construct pipelines. Induced impacts, by contrast, result from wages paid to workers, who may spend these wages on consumer electronics, clothing, etc. Again, in the context of CO_2 pipeline infrastructure development, induced effects include the employment impacts associated with pipeline construction workers spending their earnings.

The *Status* input-output model used for this analysis is based on the industry and commodity database maintained by Inforum based on data published by the U.S. Bureau of Economic Analysis and other U.S. government agencies. The model has 121 commodity sectors and 71 industry sectors, classified according to the 2012 North American Industry Classification System (NAICS). The input-output framework on which *Status* is built contains annual data in both current and constant prices, from 1997 to 2019. Projections of the database after 2019 are obtained from a standard projection of Inforum's sectoral and commodity database, which includes projections of changes in input-output coefficients over time. The *Status* model has been used in multiple analyses for federal agencies, including an assessment of domestic output and jobs related to agricultural exports and imports (for the U.S. Department of Agriculture's Economic Research Service) and analysis of the direct and indirect components of health care supply (for the Center for Medicare and Medicaid Services).

Our application of *Status* for this analysis involved the following steps:

- **Specify dollar amounts to be modeled in *Status*:** The SCALE Act includes an authorization of $2.1 billion for an infrastructure program supporting the construction of CO_2 transport infrastructure and an authorization of $2.5 billion in cost-sharing for the development of geologic storage sites. This funding can enable investment several times larger than the federal funding itself. Based on the $2.1 billion authorization for the transport infrastructure program in the SCALE Act, an assumed 50:50 split in allocation between loan credit subsidies and growth grants, an assumed credit subsidy rate of 10 percent, and the maximum limit of 80 percent federal contribution to a project, the total investment generated is expected to be approximately $14 billion. In addition, given that the SCALE Act's funding for geologic storage is a 50:50 cost share, the $2.5 billion authorized by the Act could enable $5 billion in geologic storage investments. On this basis, our analysis examines the employment impacts associated with $14 billion in investment for CO_2 transport infrastructure and $5 billion for geologic storage. These investment expenditures are spread evenly over five years.
- **Specify sectors in *Status* for modeling investment expenditures:** When modeling the employment impacts associated with SCALE Act investments, these expenditures must be allocated to individual industries within *Status*, as the impacts associated with increased demand for one industry's output may differ from the corresponding impacts associated with output produced by another industry. We allocate investment spending related to CO_2 transport infrastructure based on a distribution of investment spending for the pipeline transportation sector. This information is derived from BEA's 1997 capital flow table, which has been updated through 2019 by Inforum. For investments in geologic storage, we allocate 65 percent of

expenditures to Inforum's pre-existing expenditure profile for construction of mining exploration – shafts and wells and the remaining 35 percent according to the investment profile for architectural, engineering, and related services.

- **Perform *Status* runs:** Based on the investment amounts above and the allocation of this investment spending to individual sectors in *Status*, we performed *Status* model runs that estimated the direct, indirect, and induced economic impacts associated with the CO_2 transport infrastructure and geologic storage.
- **Allocate impacts to the state level:** The *Status* model generates results at the national level. To allocate results to the state level, we follow two separate approaches: one for direct impacts and another for indirect and induced impacts. We allocate estimates of *direct* impacts to individual states based on the expected spatial distribution of investments in CO_2 transport infrastructure and geologic storage sites. Based on data published by researchers at Princeton University,[3] the construction of CO_2 trunk lines is likely to be concentrated in Texas, Oklahoma, Louisiana, Nebraska, Kansas, Missouri, Illinois, Iowa, Mississippi, Alabama, Georgia, Florida, and California. We assume that the direct impacts of constructing CO_2 transport infrastructure are uniformly distributed across these states. Similarly, based on information published by the U.S. Department of Energy's Carbon Storage Assurance Facility Enterprise (CarbonSAFE) Initiative, geologic storage sites are likely to be located in a limited number of states. Of the states identified by DOE with pre-feasibility projects or feasibility projects, we assume that investment in geologic storage under the SCALE Act, and the direct impacts of these investments, would be uniformly distributed between Louisiana, Texas, Illinois, Mississippi, California, and Nebraska.

  We allocate indirect and induced impacts using Inforum's State Employment Modeling System (STEMS). Using data derived from the Bureau of Labor Statistics' Employment and Earnings data, STEMS estimates employment for individual industries in each state. The industries are divided into two groups: base and secondary. Estimates for the base group industries are dependent on national levels of employment and trends in state shares of national employment. Estimates for the secondary group industries are also dependent on national levels and state trends, as well as on estimates for the base industries in the same state. The base industries are those engaged in manufacturing, agriculture, and mining, along with federal government "industry". Secondary industries are those engaged in providing services, and the construction industry. Employment estimates in STEMS are not based on constant shares, but respond to trends in individual industries.

RESULTS

Following the approach outlined above, we estimate that the annual number of jobs associated with investments in CO_2 transport infrastructure and geologic storage would range from 23,100 jobs in 2025 to 28,700 jobs in 2021. As shown in Exhibit 1, direct job impacts (jobs associated with industries directly

[3] E. Larson, C. Greig, J. Jenkins, E. Mayfield, A. Pascale, C. Zhang, J. Drossman, R. Williams, S. Pacala, R. Socolow, EJ Baik, R. Birdsey, R. Duke, R. Jones, B. Haley, E. Leslie, K. Paustian, and A. Swan, Net-Zero America: Potential Pathways, Infrastructure, and Impacts, interim report, Princeton University, Princeton, NJ, December 15, 2020. Available at https://environmenthalfcentury.princeton.edu/sites/g/files/toruqf331/files/2020-12/Princeton_NZA_Interim_Report_15_Dec_2020_FINAL.pdf.

involved in the development of the CO_2 transport infrastructure or geologic storage) account for approximately one-third of the estimated total. The slight decline in employment impacts over time between 2021 and 2025 reflects the fact that the annual investment amounts are in nominal dollars. Thus, in real (inflation-adjusted terms), the annual investment amount declines over time.

EXHIBIT 1. EMPLOYMENT IMPACTS BY YEAR ASSOCIATED WITH SCALE ACT CO_2 TRANSPORT INFRASTRUCTURE AND GEOLOGIC STORAGE INVESTMENTS (1000s OF PERSONS)

YEAR	DIRECT IMPACTS	INDIRECT IMPACTS	INDUCED IMPACTS	TOTAL IMPACTS
2021	9.3	4.8	14.6	**28.7**
2022	8.8	4.5	13.8	**27.2**
2023	8.4	4.3	13.1	**25.7**
2024	8.0	4.1	12.3	**24.4**
2025	7.7	3.8	11.5	**23.1**

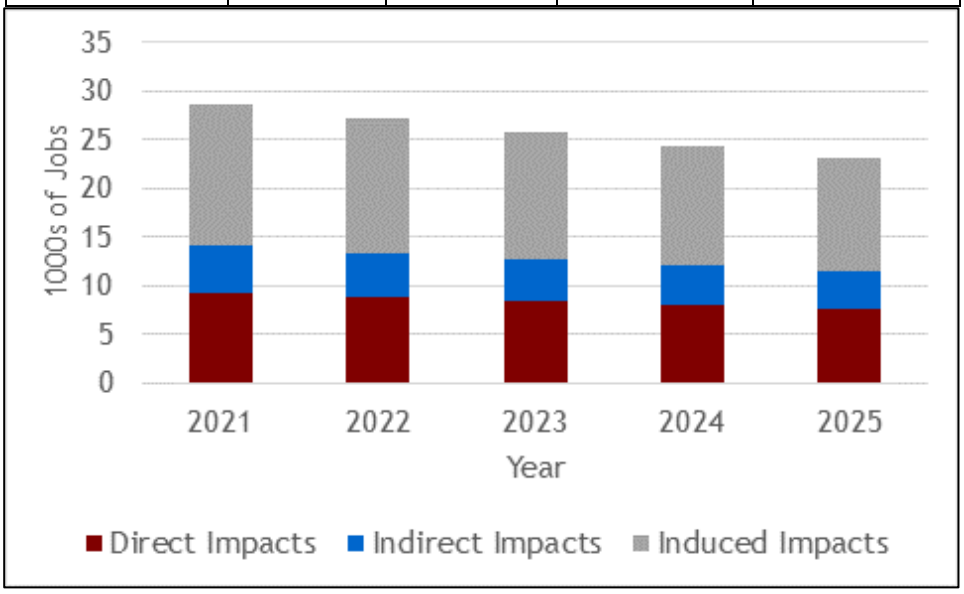

Exhibit 2 presents details on the spatial distribution of the employment impacts estimated for 2021. The exhibit shows estimated employment impacts by state for the 20 states with the largest estimated impacts. The exhibit accounts for total employment impacts by state, inclusive of direct, indirect, and induced effects. As the exhibit shows, estimated job impacts are highest in California, which has an estimated 3,200 jobs, followed by Texas, Florida, and Illinois. Among the 31 states (including the District of Columbia) *not* included in Exhibit 2, employment impacts in 2021 range from 29 jobs to approximately 500 jobs.

EXHIBIT 2. ESTIMATED EMPLOYMENT IMPACTS BY STATE RELATED TO DEVELOPMENT OF CO2 TRANSPORT INFRASTRUCTURE AND GEOLOGIC STORAGE – TOP 20 STATES