CARBON CAPTURE USAGE AND STORAGE *(CCUS)*

WSP provides a full Carbon Capture Usage and Storage (CCUS) chain capability covering the advisory and engineering challenges in this emerging global market

Our service offering in the global CCUS market is multi-targeted. It starts with a proven program of cost and performance advice to government bodies looking to provide public funding to support commercial-scale, full chain CCUS projects. In addition, WSP can provide developers with specific technical support to help secure contracts through proof of carbon capture technology readiness. We also provide consulting services to developers regarding scaling up of pilot and pre-commercial scale projects.

Being able to mobilize our global CCUS expertise, whether in injection well design and delivery, reservoir characterization, process modeling, CO2 transportation or economic reviews, we can create flexible teams to fit the specific requirements of a project. We provide a single point of contact for full chain CCUS projects, applying the cross-sector skills needed for a successful outcome.

Having these projects successfully integrated is a key area of risk which WSP is able to manage. Our experience in the delivery of energy and infrastructure projects can be readily transferred to full-scale CCUS projects.

Technical advisory support was provided to the U.K. government over a period of five years. Some of the first deliverables were determining the potential for CCS in the U.K. and providing an underpinning contribution to the final decision to move forward with an ambitious policy program.

Advisory support was provided on an ongoing basis throughout the first U.K. CCS demonstration competition covering: procurement processes and documentation; evaluation of pre-qualification and initial submissions; negotiation support; capital and operating cost estimation; project planning; risk management services; development of regulatory guidance; and assistance in the education of regulatory bodies. This support was provided across the full spectrum of the CCUS chain from power plant through capture to transportation, injection and storage.

WSP acted as the lead technical advisor to ensure that there was consistency in the delivery across the large team of specialists required. This model for provision of support has been replicated for the Australian CCS Flagships and the EU NER300 CCS competitions.

SERVICES

Our services in the global carbon capture usage and storage market bring together a wide range of diverse skills and experience across a number of industries

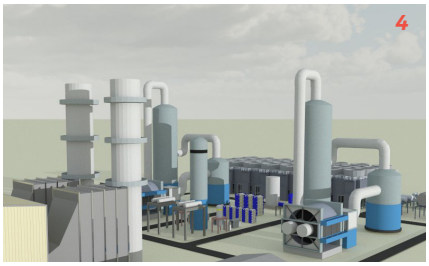
The value WSP delivers to clients is based on a strong design capability and a deep understanding of the strategic, economic and technical risks and issues related to the integration of CCUS technology with new and existing plants, coupled with a strong capability in transportation and storage options and challenges.

Services include:

Full scale, full chain program management from initial development through operation.

- *Engineering, procurement and construction management (EPCM) services for complete CCUS project delivery, including detailed design, tendering and procurement support, tender review, construction integration and management support and commissioning*
- *Integration and interface engineering of existing or new power or process plants with carbon capture plant technologies, including post-combustion capture, oxy fuel combustion and pre-combustion capture*
- *Engineering design of CO2 drying, compression and liquefaction plant in preparation for transportation*
- *Engineering design of complete CO2 transportation projects including pipeline assessments, route selection and approvals, or tanker transport for CCUS plant facilities*
- *Engineering design of above-ground infrastructure for carbon dioxide sequestration sites*
- *Engineering analysis of storage sites*
- *Greenhouse gas emissions accounting, reporting services, and climate change adaptation strategies and forecasting*
- *Feasibility level studies, including concept design, risk assessments, technology options, cost estimation and program development based on a deep knowledge of vendors*
- *Environmental services, including planning permits, consultation and approvals*
- *Carbon capture ready studies as required for planning application for new build power plants*
- *Thermal modeling of power plant integrated with CCS*
- *Conceptual process design and technology selection*
- *Industry benchmarked project cost estimation*

PROJECTS



1 IEAGHG: CCUS on Gas Fired Power Plants
2 CarbonNet project
3 Calix (Europe) Ltd, TSB (image supplied by Calix)
4 EU NER300 Project Evaluation

CarbonNet project, Victoria Gov DPI

Victoria Gov DPI engaged WSP to undertake a transport study for the CarbonNet Project in Australia. Our services addressed the onshore and offshore aspects of transporting carbon dioxide (CO2) leading to a further detailed feasibility study. These studies have defined the environmental constraints associated with various pipeline route corridors and set a boundary for the CO2 specification, a key concern in relation to transportation of CO2. Cost estimates provided certainty, initially to +/-30%, and subsequently to +/-10% for the development, the objective being to strike a balance between installing sufficient capacity for expanding throughput, while limiting the cost risk exposure and budget impact of upfront capital expenditure.

EU NER300, EU, European Investment Bank

WSP supported the European Union and the European Investment Bank in implementing the New Entrant Reserve competition for new and innovative renewable and CCUS projects. Technologies covered included wind, concentrated solar power, pre and post-combustion CCS, geothermal, hydroelectric and biomass. We provided the technical knowledge required to ensure the conversion of the EU Directive principles into workable and transparent processes. We then implemented this methodology as part of the due diligence assessment of the project sponsor submissions for EU grant support for their CCS projects. The benefit was a consistent and equitable application of the Directive principles ensuring fair competition.

CCS on gas fired power plants, IEAGHG

WSP supported IEAGHG in studying the impacts of CCS technologies on the performance of a range of gas fired power plants. These included non-typical arrangements such as methane reforming hydrogen fueled gas turbines. Our input required process modeling of the CCS plant and thermal power plant elements to give the full process cycle efficiency, resulting in P&IDs, equipment lists, capital costs and leveled costs of electricity. Using the ASPENPlus and Thermoflow modeling tools gave confidence in the study outcomes. This report provided IEAGHG with a basis for gas fired CCS and allows government and industry to identify cost effective solutions to decarbonize gas fired power plants. There was a subsequent presentation of the findings to the GHGT conference in Kyoto to disseminate the study results.

Calix (Europe) Ltd, TSB

Calix (Europe) Ltd needed an independent review of its developing calcium looping carbon capture technology. WSP worked with Calix to develop a successful tender for Technology Strategy Board grant support. Working with the ASPENOne and Thermoflow modeling software, we undertook a high level review of the process, delivering an external challenge to the technology development and base assumptions used to premise the expected technology benefits. Issues identified during the review provided additional input to the development process, resulting in several revisions being made to improve the process and advance the commercialization of the technology.

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