

EXPLORING THE ROLE OF NATURAL GAS POWER PLANTS WITH CARBON CAPTURE AND STORAGE AS A BRIDGE TO A LOW-CARBON FUTURE

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The 2005 to 2055 assumptions related to 20 parameters used for sensitivity runs are listed in Tables S1 through S7. Other parameters that are not included in the following tables have constant value from 2005 to 2055 based on Table 1 of the manuscript. The default values associated with each parameter is based on the EPAUS9r-14-v1.5 database. All costs are based on 2005\$.

Table S1. Natural gas price

Scenario	Natural gas price (\$/thousand cubic meter)										
	2005	2010	2015	2020	2025	2030	2035	2040	2045	2050	2055
Very low	322	149	112	129	151	139	152	151	161	173	183
Default	322	149	123	144	172	198	227	251	277	308	339
Very high	322	149	130	174	225	267	300	346	388	438	488

Table S2. NGCC-CCS Investment cost

Scenario	Investment cost for NGCC-CCS (M\$/GW)		
	2005-2015	2020	2025-2055
Very low	1426	1341	1255
Low	1506	1416	1326
Default	1623	1525	1428
High	2025	1904	1782
Very high	2424	2279	2133

Table S3. NGCC retrofit cost

Scenario	CO ₂ retrofit cost for NGCC (\$/KWh)		
	2005-2015	2020	2025-2055
Very low	0.034	0.031	0.027
Low	0.039	0.035	0.031
Default	0.052	0.047	0.041
High	0.068	0.062	0.054
Very high	0.091	0.082	0.072

Table S4. CCS retrofit cost for NGCC

Scenario	CCS retrofit cost penalty for NGCC (\$/KWh)		
	2005-2015	2020	2025-2055
Default	0.052	0.047	0.041
High	0.062	0.056	0.049
Very high	0.083	0.075	0.066

Table S5. Electricity storage cost

Scenario	Electricity storage investment cost (M\$/GW)				
	2005-2010	2015	2020	2025	2030-2055
Very low	4633	3725	2816	1908	1000
Low	4633	3975	3316	2658	2000
Default	4623	4623	4623	4623	4623

Table S6. The plug-in vehicles market shares in light duty vehicle (LDV) sector

Vehicle type	Share of electrified vehicles in LDV sector								
	2015	2020	2025	2030	2035	2040	2045	2050-2055	
Battery electric vehicles	1%	2%	8%	19%	29%	37%	46%	49%	
Plug-in electric vehicles	4%	18%	53%	73%	70%	62%	53%	50%	

Table S7. GHG50 scenario characteristics

Scenario	Very low	Low	High	Very high
1 GHG50+ Hurdle rate on BIOIGCC-CCS	-	-	-	X
2 GHG50+ Natural gas price	X	-	-	-
3 GHG50+ Natural gas price	-	-	-	X
4 GHG50+ Hurdle rate on nuclear	-	X	-	-
5 GHG50+ Hurdle rate on nuclear	-	-	X	-
6 GHG50+ Hurdle rate on nuclear	-	-	-	X
7 GHG50+ Investment cost for NGCC-CCS+ CO ₂ retrofit cost for NGCC	X	-	-	-
8 GHG50+ Investment cost for NGCC-CCS+ CO ₂ retrofit cost for NGCC	-	X	-	-
9 GHG50+ Investment cost for NGCC-CCS+ CO ₂ retrofit cost for NGCC	-	-	X	-
10 GHG50+ Investment cost for NGCC-CCS+ CO ₂ retrofit cost for NGCC	-	-	-	X
11 GHG50+ CO ₂ capture rate for NGCC-CCS and CCS retrofit in NGCC	X	-	-	-
12 GHG50+ CO ₂ capture rate for NGCC-CCS and CCS retrofit in NGCC	-	X	-	-
13 GHG50+ CO ₂ capture rate for NGCC-CCS and CCS retrofit in NGCC	-	-	X	-
14 GHG50+ CO ₂ capture rate for NGCC-CCS and CCS retrofit in NGCC	-	-	-	X
15 GHG50+ NGCC-CCS efficiency+ CCS retrofit efficiency	X	-	-	-
16 GHG50+ NGCC-CCS efficiency+ CCS retrofit efficiency	-	X	-	-
17 GHG50+ NGCC-CCS efficiency+ CCS retrofit efficiency	-	-	X	-
18 GHG50+ CCS retrofit cost for NGCC	-	-	X	-
19 GHG50+ CCS retrofit cost for NGCC	-	-	-	X
20 GHG50+ Hurdle rate for NGCC-CCS and CCS retrofit in NGCC	-	X	-	-
21 GHG50+ Hurdle rate for NGCC-CCS and CCS retrofit in NGCC	-	-	X	-
22 GHG50+ Hurdle rate for NGCC-CCS and CCS retrofit in NGCC	-	-	-	X
23 GHG50+ Battery storage requirement for renewables	X	-	-	-
24 GHG50+ Battery storage requirement for renewables	-	X	-	-
25 GHG50+ CO ₂ storage cost	X	-	-	-
26 GHG50+ CO ₂ storage cost	-	X	-	-

27 GHG50+ CO ₂ storage cost	-	-	X	-
28 GHG50+ CO ₂ storage cost	-	-	-	X
29 GHG50+ Electricity storage investment cost	X	-	-	-
30 GHG50+ Electricity storage investment cost	-	X	-	-
31 GHG50+ Methane leakage rate during extraction	X	-	-	-
32 GHG50+ Methane leakage rate during extraction	-	X	-	-
33 GHG50+ Methane leakage rate during extraction	-	-	X	-
34 GHG50+ Methane leakage rate during extraction	-	-	-	X
35 GHG50+ Max electrification of light duty vehicles	Fixed 99% of LDV fleet purchases			
36 GHG50+ Max wind and solar	27,778 billion KWh upper bound on wind + 2,083 billion Kwh lower bound on total wind and solar electricity generation			
37 GHG50+ No BIOIGCC-CCS	No biomass with CCS plant option			
38 GHG50+ No CCS gas retrofit	No CCS retrofit option for natural gas combined cycle plants			
39 GHG50+ No lifetime extension on existing coal	No investment option to extend 50-year lifetime of existing coal plants			
40 GHG50+ No gasification technologies	No biomass- and coal-IGCC plant options			
41 GHG50+ No lifetime extension on existing nuclear	No investment option to extend 40-year lifetime of existing nuclear plants			
42 GHG50+ High nuclear output	833 billion KWh lower bound limit on electricity from nuclear plants			
43 GHG50	2050 GHG emissions to be reduced by 50% relative to the 2005 level			
44 GHG50+CO ₂ 50	2050 GHG and CO ₂ emissions to be reduced by 50% relative to the 2005 level			

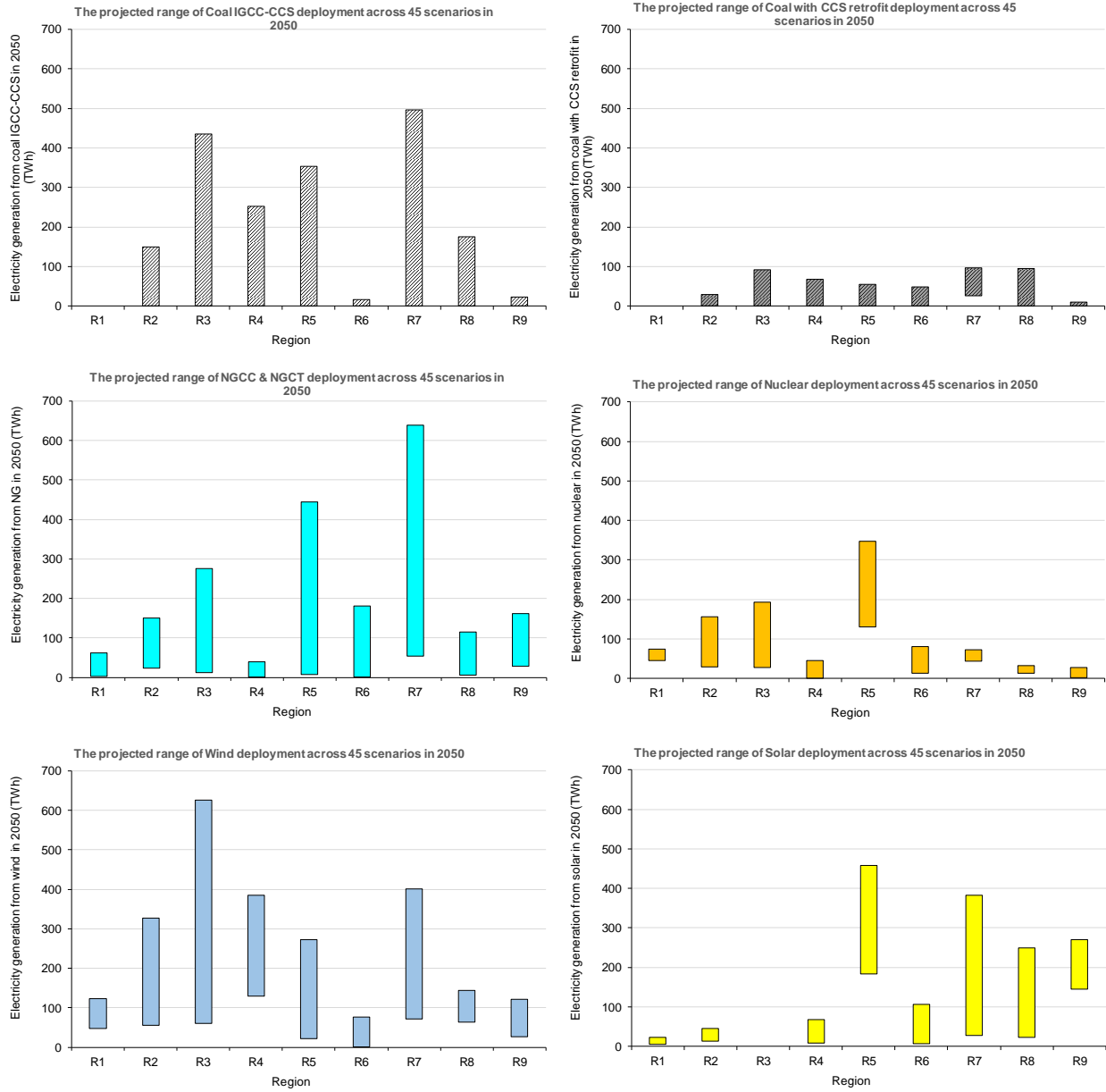
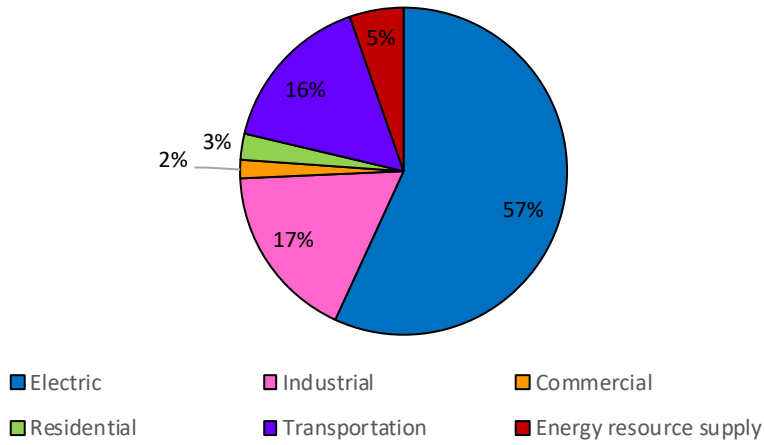


Fig. S1. The projected range of power plants adoption across 45 scenarios in each region in 2050.

2050 GHG reductions for the lowest NGCC-CCS scenario



2050 GHG reductions for the highest NGCC-CCS scenario

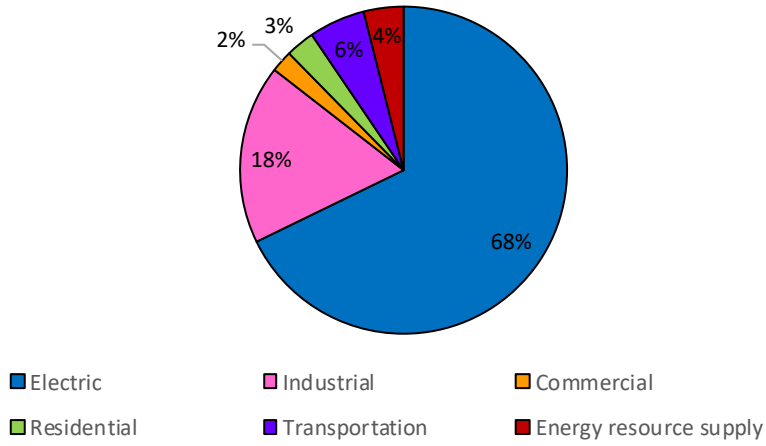


Fig. S2. The sector-specific GHG reductions in 2050 for the lowest (top) and the highest (bottom) NGCC-CCS deployment scenarios.

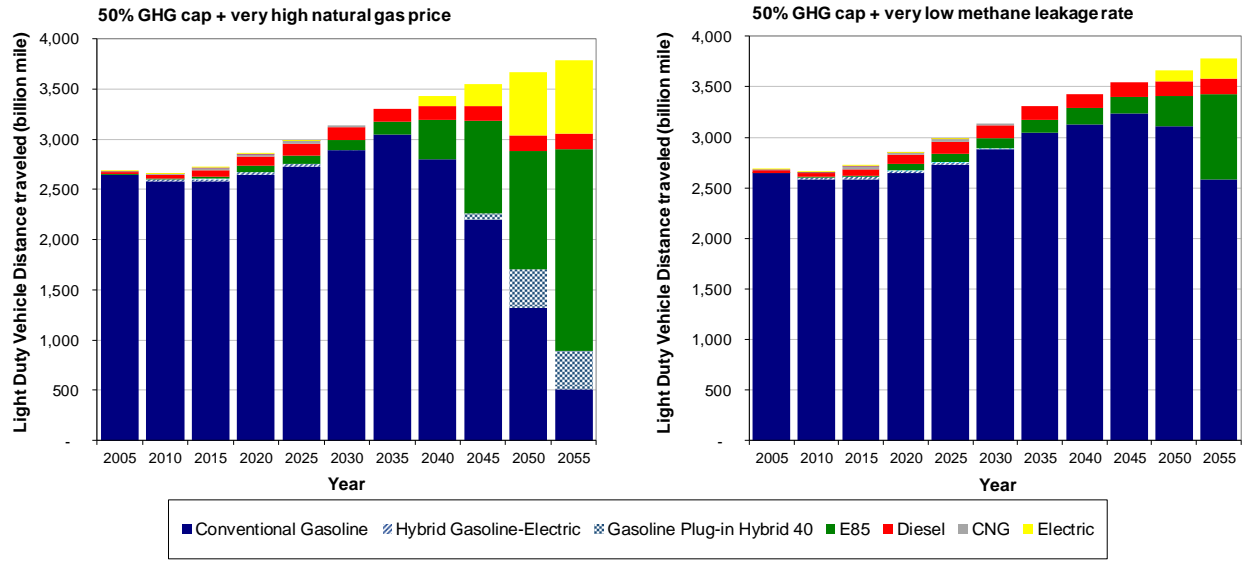


Fig. S3. Light duty travel demand by technology type over time for the lowest NGCC-CCS deployment scenario (left) and the highest NGCC-CCS deployment scenario (right).