Modelling steel decarbonization pathways in 6 key regions: China, India, United States, Europe, South Korea, and Japan. Levers for decarbonization are: material efficiency, technology change, and increased energy efficiency.

The final run used in the report is located on pic at: /pic/projects/GCAM/Nina/wrk/running-steel-decarb-H2BF/10-23

Steel branch to recreate run: /pic/projects/GCAM/Nina/wrk/steel-decarb-2

1. Download this commit: <https://stash.pnnl.gov/projects/JGCRI/repos/gcam-core/commits/0d9cc32d2fff7f29e27e92cb5452bd73ea445d6a>

(if you have a branch of steel-decarbonization, you can do: git reset --hard 0d9cc32d2fff7f29e27e92cb5452bd73ea445d6a)

1. Copy paste the files in “steel data system csvs” (located inside of this folder) folder into input/gcamdata/inst/extdta/energy and IEA/CEDs data.
2. Copy paste the files in “input-steel files” to input/steel
3. Build the data system.
4. Run batch file using the configuration& batch file in /pic/projects/GCAM/Nina/wrk/running-steel-decarb-H2BF/10-23

# Levers for steel decarbonization / modelling assumptions background

* Material efficiency – possible reductions in steel production by improving
  + Material efficiency calculations are included in this spreadsheet: I[https://docs.google.com/spreadsheets/d/1WxOaM4EzZncMa2zlioH-cMkERBG0i2YE/edit#gid=1998695623](https://docs.google.com/spreadsheets/d/1WxOaM4EzZncMa2zlioH-cMkERBG0i2YE/edit" \l "gid=1998695623)
  + Potential % reductions in steel production (compared to the reference by 2050) are calculated for each key region by based on their existing steel market shares (buildings, transportation) and potential reduction within each market from various material efficiency strategies – see these assumptions in the “literature tab” and regional calculations on the “XXXX\_calcs” tabs (row 27 – 36). ROW calculations are calculated from a weighted average of EU and India reduction potentials, based on economic development.
  + Potential reductions from material efficiency were assumed to increase linearly from 0% in 2020 to their maximum in 2050 (row 41). Regions’ annual percent reductions multiplied by the reference case steel demand projections to make demand reduction calculations (new demand in Row 41). The demand reductions were subtracted from the reference case to calculate material efficiency scenario demand (row 44)
    - For each key region reference case 2020 projection was set to match 2019 historical production level
    - Caveat: in China, GCAM reference steel demand projections already matched literature estimates for material efficiency scenario production levels, so in China calcs, the potential demand reduction is added to the reference scenario, to calculation the true reference scenario and the original reference scenario is treated as the material efficiency scenario
    - Caveat: Japan reference steel demand is adjusted; it is calculated by assuming the demand per capita decreases by 1% each year (row 12)
    - Caveat: South Korea reference steel demand is adjusted; it is calculated by assuming the demand per capita decreases by 2% each year (row 18)
  + We created steel income elasticity xmls that produce steel production levels that closely match the reference and material efficiency production levels modeled in the spread sheet:
    - Material efficiency income elasticity xml: input/steel/iron\_steel\_incelas\_gssp2\_MEF.xml
    - Reference income elasticity xml: /input/steel/iron\_steel\_incelas\_gssp2\_REF.xml
* Technology change – increased scrap, hydrogen, CCS steel production technology
  + Share weight adjustments advanced tech assumptions used in the final report are in:
    - input/steel/iron\_steel\_techAdj41
    - input/steel/iron\_steel\_techAdj41\_noCSS (same share weights as previous xml, but turns off CCS technologies)
  + Share weight for reference scenario, fixed share weights in:
    - input/steel/iron\_steel\_fixed
  + Added H2BF technology (see documentation in H2BF documentation)
  + Changing subsector shareweights can either be done directly on the iron\_steel.xml or in the A323XXXX.csv’s in input/gcamdata/energy
  + Changing technology shareweights can either be done directly on the iron\_steel.xml or in the A323XXXX.csv’s in input/gcamdata/energy—if you want to change technology shareweights in all regions in the iron\_steel xml, hit CTRL+F, then “search global technology database” and change the shwts there, if you want to change technology shareweights for a specific country, CTRL+F the country of interest and change the shareweights in that section
* Energy efficiency – we assumed that energy efficiency of steel production technology would increase by 20% in 2050 (liner increase from 0% in 2020)
  + Xml to implement 20% energy efficiency:
    - <Value name = "energy\_eff">../input/steel/steel\_coefs\_advEff\_40pct\_2100.xml</Value>
  + If you want to create another xml with a difference % energy efficiency improvement, you can use the R script “adj\_steel\_coef.R” located on <https://github.com/ninablahut/steel-decarbonization>

Reproducing charts and figures in final report

1. Run steel branch with configuration in batch and config files in: /pic/projects/GCAM/Nina/wrk/running-steel-decarb-H2BF/10-23/configuration-sets
2. Query results using xmldb\_steel\_report.xml (located in /pic/projects/GCAM/Nina/wrk/running-steel-decarb-H2BF/10-23/exe)
3. Copy csv results into local folder. Within that folder, create two additional folders for figures and results.
4. Open waterfall\_materialEff\_charts.R, change run\_dir, results\_dir, and fig\_dir to match your local files. Run the script. This script produces waterfall charts and material efficiency steel production projections. (<https://github.com/ninablahut/steel-decarbonization>)
5. Open steel\_report.R, change run\_dir, results\_dir, and fig\_dir to match your local files. Run the script. This script produces all the other chart and calculations included in the report
6. Note: steel-decarbonization-figures includes other figures, not included in the report (<https://github.com/ninablahut/steel-decarbonization>)

Additional literature and background available on google drive: <https://drive.google.com/drive/folders/1Lv6WBzYXr37aGITdG082eF7faWf1hya9>

Brief description of folders in google drive linked above (Literature will probably be the most useful folder):

* 9-21 charts
  + Charts from a preliminary run in September
* Figures
  + Preliminary figures used for adjusting steel demand projections
* Literature
  + Literature used to inform modeling assumptions, organized based on name of folders
    - Material Efficiency folder includes the material efficiency calculations spreadsheet
* Results
  + Results from other preliminary runs