This guide assumes you are using Anaconda Prompt (Windows). Please install Miniconda or Anaconda before following these steps.

USEEIO_CARB_Runner

This repository provides a California-customized implementation of the U.S. EPA's Environmentally-Extended Input-Output (USEEIO) model. It includes a Python script that performs matrix decomposition, emissions estimation, and demand scaling using both national and California-specific data.

Overview

This project integrates:

- Official EPA models: `useeior`, `stateior`, `LCIAformatter`
- CARB-specific flow modifications using `flowsa_CARB_version`
- A custom Python script (`run_model.py`) for computing California-specific emissions and demand matrices at the detailed NAICS level

The model estimates total demand and greenhouse gas (GHG) emissions for:

- The United States (detailed level)
- California (summary and detailed levels)
- Rest of the U.S. (RoUS)

Repository Structure

```
USEEIO_CARB_Runner/
├── run_model.py                    # Main execution script
├── USEEIO.py                       # Python interface to useeior
├── environment.yml                 # Conda environment file
├── build_all_stateio_years.R      # R script to generate stateior output data
└── modelspecs/
    ├── bea_model_us_detailed_2017.yml
    └── bea_model_ca_summary_2022.yml
```

Prerequisites (IMPORTANT ORDER)

Before starting anything, follow this order:

1. **Install R 4.4.3** Download directly from CRAN (do NOT install R via Conda): https://cran.r-project.org/bin/windows/base/

   R 4.4.3 is recommended for full compatibility. R 4.5.0 may also work if you install R packages using RStudio, but could cause issues in `stateior` or `useeior` due to changes in data frame structure.

2. **Install Rtools 4.4**
   Rtools is required to compile R packages like `useeior` and `stateior` when using `devtools`.

Download the version that matches R 4.4.3:
[https://cran.rstudio.com/bin/windows/Rtools/rtools44/rtools.html]

After installation, restart RStudio to ensure the toolchain is detected.

3. **Install RStudio Desktop** (free IDE for R): https://posit.co/download/rstudio-desktop/

   Then:

   - Launch RStudio
   - Go to `Tools` → `Global Options` → `Packages`
   - Uncheck the box: **"Use secure download method for HTTP"**
   - Click "Apply"

4. **Install USEEIO and STATEIOR packages using RStudio**

   In RStudio Console:

```
install.packages("devtools")
devtools::install_github("USEPA/useeior")
devtools::install_github("USEPA/stateior")
```

   To confirm successful installation, run:

```
require(useeior)
require(stateior)
```

   Both should return TRUE. If not, revisit the installation steps above.

5. **Open Anaconda Prompt**

6. **Ensure `git` is available inside Conda**

If using the zipped version of `flowsa_CARB_version`, you do NOT need `git` installed.

If using GitHub to clone the repository (instead of ZIP), install:

```
conda install git
```

7. **Clone the repository (or extract the provided ZIP archive)**

If using the zipped version, unzip the `USEEIO_CARB_Runner.zip` file into a folder, and navigate into it:

```
cd path\to\unzipped\USEEIO_CARB_Runner
```

If using GitHub, type the following:

```
git clone https://github.com/leoal2/USEEIO_CARB_Runner.git
cd USEEIO_CARB_Runner
```

8. **Create the Conda environment**

   If you previously created the `buildings` environment, remove it first:

   ```
   conda remove -n buildings --all
   ```

   Then:

   ```
   conda env create -f environment.yml
   conda activate buildings
   ```

9. **(If needed) Set R environment variables (Windows users only)**

   Only if `rpy2` cannot find your R installation, manually set:

   ```
   set R_HOME=C:\Program Files\R\R-4.4.3
   set R_USER=%UserProfile%\Documents
   set R_LIBS_USER=C:\Program Files\R\R-4.4.3\library
   ```

Manual Setup Requirements

1. Copy YAML model spec files

Copy your model spec files into the following R folder:

```
copy modelspecs\*.* %R_HOME%\library\useeior\extdata\modelspecs
```

Required files:

- `bea_model_us_detailed_2017.yml`
- `bea_model_ca_summary_2022.yml`

2. Generate CA-specific emissions files using FLOWSA

If using the ZIP version of `flowsa_CARB_version`, make sure it's installed with pip:

```
pip install path\to\flowsa_CARB_version-main.zip
```

Run the following in Python:

```
import flowsa
from flowsa.flowbyactivity import getFlowByActivity
df_fba_ca = getFlowByActivity("StateGHGI_CA", 2022)

from flowsa.flowbysector import getFlowBySector
df_fbs_m1 = getFlowBySector("GHG_state_2022_m1")
df_fbs_ca = getFlowBySector("GHGc_state_CA_2022")
```

Generates:

```
flowsa/FlowBySector/GHGc_state_CA_2022_<version>.parquet
```

This file is required by the model YAML specifications in `useeior`.

Running the Model

Once everything is set up, run:

```
python run_model.py
```

The script will:

- Load both US and California EEIO models
- Generate `L`, `A`, `D`, and `N` matrices
- Scale and disaggregate California demand
- Estimate GHG emissions for 2022 and adjust to 2017 USD
- Export results to Excel

Outputs

The output will include:

- `CA_2022_2022USD_...xlsx`: results in 2022 dollars
- `CA_2022_2017USD_...xlsx`: results in CPI-adjusted 2017 dollars

Each file contains:

- Lifecycle matrices (L, A, D, N)

- Final demand vectors
- Sector-specific emissions for US, California, and RoUS

Notes

- EPA dependencies like `esupy`, `stewi`, and `fedelemflowlist` are installed automatically via the `flowsa_CARB_version` fork.
- All `.yml` model specs must be placed in the correct `useeior` folder.
- `.parquet` indicator and satellite files must be available locally.
- You may need Microsoft Visual C++ Redistributables for Python/R interop via `rpy2`.

Why this installation order? Installing R and Rtools before Conda ensures that the correct system paths (like `R_HOME`) are set and persist when Conda activates its environments. This avoids common issues with misaligned paths when using `rpy2`.

Important Notes on Runtime & SSL Setup

Some steps, like running FLOWSA or manually generating `stateior` .rds files, can take a significant amount of time. Please be patient and do not assume the script has failed if it appears inactive.

If you encounter SSL/TLS certificate errors when running Python or pip, install:

```
pip install pip-system-certs
```

Troubleshooting

R_HOME not found

If `rpy2` fails to locate your R installation, manually set:

```
set R_HOME=C:\Program Files\R\R-4.4.3
```

Generating `stateior` outputs locally if S3 access fails

If the model cannot download `.rds` files automatically, you can generate them manually:

```
source(paste0(Sys.getenv("USERPROFILE"),
"/USEEIO_CARB_Runner/build_all_stateio_years.R"))
```

Creates:

```
%LocalAppData%\stateio\TwoRegion_Summary_... .rds
%LocalAppData%\stateio\State_Summary_... .rds
```

Contact

This project is maintained by staff at the California Air Resources Board (CARB).

For questions, please contact embodiedcarbon@arb.ca.gov.