%%Original_data_clean

```
#############################################################################################################
rm(list = ls())
cat("\14")

#=============================================================================================================
=
wdir='F:/ISO3_v1.1'
setwd(paste(wdir))
library(reshape2)
library(openxlsx)
library(writexl)
library(dplyr)
library(abind)
#=============================================================================================================
=
#=============================================================================================================
=

temp1=openxlsx::read.xlsx('./AR6_Scenarios_Database_metadata_indicators_v1.1.xlsx',sheet=2,colNames=TRUE)
ms = temp1[which(temp1$Category %in% c("C1",'C3','C5','C6','C7','C8')), c(1:4,8,12)]; dim(ms)
ms$ms = paste(ms$Model, ms$Scenario, sep='--')
ms %>% dplyr::count(Category)
#=============================================================================================================
=
ms$Model_family = "Others"
ms[which(ms$Model %in% c("AIM/CGE 2.0","AIM/CGE 2.1","AIM/CGE 2.2", "AIM/Hub-Global 2.0")), ncol(ms)] = "AIM"
ms[which(ms$Model %in% c("C-ROADS-5.005")), ncol(ms)] = "C-ROADS"
ms[which(ms$Model %in% c("COFFEE 1.1")), ncol(ms)] = "COFFEE"
ms[which(ms$Model %in% c("EPPA 6")), ncol(ms)] = "EPPA"
ms[which(ms$Model %in% c("GCAM-PR 5.3", "GCAM 4.2","GCAM 5.3")), ncol(ms)] = "GCAM"
ms[which(ms$Model %in% c("GEM-E3_V2021")), ncol(ms)] = "GEM-E3"
ms[which(ms$Model %in% c("IMAGE 3.0","IMAGE 3.0.1","IMAGE 3.0.2","IMAGE 3.2")), ncol(ms)] = "IMAGE"
ms[which(ms$Model %in% c("MESSAGE-GLOBIOM 1.0","MESSAGEix-GLOBIOM 1.0","MESSAGEix-GLOBIOM_1.1",
                         "MESSAGEix-GLOBIOM_1.2","MESSAGEix-GLOBIOM_GEI 1.0")), ncol(ms)] = "MESSAGE"
ms[which(ms$Model %in% c("POLES ADVANCE","POLES EMF30","POLES EMF33","POLES ENGAGE","POLES GECO2019")),
ncol(ms)] = "POLES"
ms[which(ms$Model %in% c("REMIND 1.6","REMIND 1.7","REMIND 2.1","REMIND-Buildings 2.0","REMIND-MAgPIE
1.5","REMIND-MAgPIE 1.7-3.0",
                         "REMIND-MAgPIE 2.0-4.1","REMIND-MAgPIE 2.1-4.2","REMIND-MAgPIE 2.1-4.3","REMIND-
Transport 2.1")), ncol(ms)] = "REMIND"
ms[which(ms$Model %in% c("TIAM-ECN 1.1")), ncol(ms)] = "TIAM"
ms[which(ms$Model %in% c("WITCH 5.0","WITCH-GLOBIOM 3.1","WITCH-GLOBIOM 4.4")), ncol(ms)] = "WITCH"
#which(ms$Model_family=="Others")
ms <- ms[!(ms$Model_family %in% c('COFFEE', 'GEM-E3', 'TIAM', 'WITCH')), ]
length(unique(ms$Model_family)) # 12 model families

ms %>% dplyr::count(Category,Model_family)
ms %>% dplyr::count(Category, Project_study)
save(ms, file=paste(wdir,'./data generation/AR6-v1.1_C1-C8_metadata.Rdata',sep=''))

#=============================================================================================================
=
#############################################################################################################
rm(list = ls())
cat("\14")

#=============================================================================================================
=
wdir='F:/ISO3_v1.1'
setwd(paste(wdir))
library(reshape2)
library(openxlsx)
library(writexl)
library(plyr)
library(abind)
library(zoo)
#=============================================================================================================
=
#=============================================================================================================
=
load('./data generation/AR6-v1.1_C1-C8_metadata.Rdata')
ind = which(colnames(ms) %in% c('ms','Category','Model_family','Project_study','Scenario_project','IMP_marker'))
ms2 = ms[,ind]
temp = read.csv('./AR6_Scenarios_Database_ISO3_v1.1.csv', header=TRUE)
dim(temp)
colnames(temp)
unique(temp$Region)
vars=unique(temp$Variable)
temp$ms = paste(temp$Model, temp$Scenario, sep='--')

data=temp[which(temp$ms %in% ms$ms),]
data = merge(ms2, data, by='ms')
colnames(data) <- gsub("^X", "", colnames(data))
save(data, file='./data generation/AR6-v1.1_C1-C3_allvars.Rdata')
```

```
#=============================================================================================================
=

load('./data generation/AR6-v1.1_C1-C3_allvars.Rdata') # data
sv=sort(c("Emissions|CO2|Energy"))

data=data[which(data$Variable %in% sv),]
years=c(2010:2100)
itv=seq(2010,2100,by=5)
ind=which(colnames(data) %in% itv)
ind2=which(colnames(data)=="Unit")
data=data[,c(1:ind2,ind)]


icol = which(colnames(data)=="2010")
temp = data[,icol:ncol(data)]
temp2 = matrix(NA, nrow=nrow(temp), ncol=ncol(temp))

for(i in 1:nrow(temp)){
   v = as.numeric(temp[i,])
   temp2[i,]=na.approx(v, na.rm=FALSE)
}

colnames(temp2)=seq(2010,2100,5)
count_na_func <- function(x) sum(is.na(x))
apply(data[,12:ncol(data)], 2, count_na_func)
apply(temp2, 2, count_na_func)

data = cbind(data[,1:(icol-1)], temp2)

pw = sort(unique(data$Category))
sv = sort(unique(data$Variable))
itv=seq(2010,2100,by=5)
icols = which(colnames(data) %in% itv)
ind2=which(colnames(data)=="Unit")
df = data[which(data$Variable %in% sv),c(1:ind2,icols)]
write.csv(df,'./data generation/ISO_ar6_mainmodel.csv',row.names = F)
#=============================================================================================================
=
#=============================================================================================================
=
rm(list = ls())
cat("\14")

#=============================================================================================================
=
wdir='F:/R5_regions_v1.1'
setwd(paste(wdir))
library(reshape2)
library(openxlsx)
library(writexl)
library(plyr)
library(abind)
library(zoo)
#=============================================================================================================
=
#=============================================================================================================
=
load('F:/ISO3_v1.1/data generation/AR6-v1.1_C1-C8_metadata.Rdata')
ind = which(colnames(ms) %in% c('ms','Category','Model_family','Project_study','Scenario_project','IMP_marker'))
ms2 = ms[,ind]

temp = read.csv('./AR6_Scenarios_Database_R5_regions_v1.1.csv', header=TRUE)
dim(temp)
colnames(temp)
unique(temp$Region)
vars=unique(temp$Variable)
temp$ms = paste(temp$Model, temp$Scenario, sep='--')

data=temp[which(temp$ms %in% ms$ms),]
data = merge(ms2, data, by='ms')
colnames(data) <- gsub("^X", "", colnames(data))
save(data, file='./data generation/AR6-v1.1_C1-C3_allvars.Rdata')

#=============================================================================================================
=
load('./data generation/AR6-v1.1_C1-C3_allvars.Rdata')
sv=sort(c("Emissions|CO2|Energy"))

data=data[which(data$Variable %in% sv),]

years=c(2010:2100)
itv=seq(2010,2100,by=5)
ind=which(colnames(data) %in% itv)
ind2=which(colnames(data)=="Unit")
data=data[,c(1:ind2,ind)]
```

```
icol = which(colnames(data)=="2010")
temp = data[,icol:ncol(data)]
temp2 = matrix(NA, nrow=nrow(temp), ncol=ncol(temp))

for(i in 1:nrow(temp)){
   v = as.numeric(temp[i,])
   temp2[i,]=na.approx(v, na.rm=FALSE)
}

colnames(temp2)=seq(2010,2100,5)
count_na_func <- function(x) sum(is.na(x))
apply(data[,12:ncol(data)], 2, count_na_func)
apply(temp2, 2, count_na_func)

data = cbind(data[,1:(icol-1)], temp2)
#=============================================================================================================
=
pw = sort(unique(data$Category))
sv = sort(unique(data$Variable))
itv=seq(2010,2100,by=5)
icols = which(colnames(data) %in% itv)
ind2=which(colnames(data)=="Unit")
df = data[which(data$Variable %in% sv),c(1:ind2,icols)]

write.csv(df,'./data generation/R5_ar6_mainmodel.csv',row.names = F)
```

%% model_average annual growth rate

```
clear all

[~,~,CO2_ISO_total]=xlsread('F:\ISO3_v1.1.csv\data generation\ISO_ar6_mainmodel.csv');
[~,~,CO2_R10_total]=xlsread('F:\R5_regions_v1.1.csv\data generation\R5_ar6_mainmodel.csv');
CO2_total_cha=[CO2_ISO_total;CO2_R10_total(2:end,:)];
CO2_total=CO2_total_cha;
CO2_total(strcmp(CO2_total, 'NA')) = {0};

initialValues = cell2mat(CO2_total(:,11:end-1));
finalValues = cell2mat(CO2_total(:,12:end));


CAGR_each_column = (finalValues ./ initialValues).^(1/5) - 1;
CO2_FINAL=[CO2_total(:,1:10),num2cell(CAGR_each_column)];
CO2_FINAL=[CO2_total(1,1:end-1);CO2_FINAL];
clearvars -except CO2_FINAL
```

%% actual_average annual growth rate

```
clear all
[~,~,CO2_hist_own]=xlsread('F:\co2sec17ene8v2_2024.xlsx','60 countreis');
[~,~,CO2_hist_IEA]=xlsread('F:\IEA.xlsx','IEA_MT');

CO2_hist_own_filteredData = CO2_hist_own(~(strcmp(CO2_hist_own(:, 3), 'Biomass') | strcmp(CO2_hist_own(:, 3), 'Others')) &
strcmp(CO2_hist_own(:, 4), 'Total sector'), :);
countries = CO2_hist_own_filteredData(:, 1);
years = cell2mat(CO2_hist_own_filteredData(:, 2));
values = cell2mat(CO2_hist_own_filteredData(:, 5));

T = table(countries, years, values, 'VariableNames', {'Country', 'Year', 'Value'});


summedData = varfun(@sum, T, 'GroupingVariables', {'Country', 'Year'}, 'InputVariables', 'Value');


CO2_hist_own_summedMatrix = table2cell(summedData);
CO2_hist_IEA=transpose(CO2_hist_IEA);

CO2_h_final_own(1,3:14)=num2cell(2010:1:2021);
[~,~,ISO_name_match]=xlsread('F:\ISO3_v1.1.csv\data generation\三位码和国家名称匹配.xlsx','60_ISO');
CO2_coun_unique = unique(CO2_hist_own_summedMatrix(:,1));
for i=1:length(CO2_coun_unique)
      CO2_1=CO2_hist_own_summedMatrix(find(ismember(CO2_hist_own_summedMatrix(:,1),CO2_coun_unique(i,:))==1),:);

      years = cell2mat(CO2_1(:, 2));

      rows_greater_than_2010 = years >= 2010;

      filtered_data = CO2_1(rows_greater_than_2010, :);
      aa=[CO2_1(1,1),ISO_name_match(find(ismember(ISO_name_match(:,1),CO2_1(1,1))==1),2),filtered_data(:,4)'];
      if length(aa)==14
      CO2_h_final_own=[CO2_h_final_own;aa];

      end
end
CO2_h_final_own(1,1:2)={'Country','ISO'};
CO2_h_final_own=CO2_h_final_own(:,1:13);
```

```
CO2_h_final_IEA(1,3:13)=num2cell(2010:1:2020);
[~,~,ISO_name_match]=xlsread('F:\ISO3_v1.1.csv\data generation\三位码和国家名称匹配.xlsx','IEA_ISO');

error_index = strcmp(ISO_name_match(:, 2), 'ActiveX VT_ERROR: ');


ISO_name_match = ISO_name_match(~error_index, :);

CO2_hist_IEA=CO2_hist_IEA(2:end,:);
for i=1:length(CO2_hist_IEA)
    CO2_1=[CO2_hist_IEA(i,1),CO2_hist_IEA(i,12:22)];


    aa=[CO2_1(1,1),ISO_name_match(find(ismember(ISO_name_match(:,1),CO2_1(1,1))==1),2),CO2_1(1,2:end)];
    if length(aa)==13
    CO2_h_final_IEA=[CO2_h_final_IEA;aa];

    end
end
CO2_h_final_IEA(1,1:2)={'Country','ISO'};


%combined
CO2_h_final=[];
CO2_h_final_IEA=CO2_h_final_IEA(2:end,:);
for i=1:size(CO2_h_final_IEA,1)
    if ~isempty(find(ismember(CO2_h_final_own(:,2),CO2_h_final_IEA(i,2))==1))
    A=CO2_h_final_own(find(ismember(CO2_h_final_own(:,2),CO2_h_final_IEA(i,2))==1),:);
    else
      A=CO2_h_final_IEA(find(ismember(CO2_h_final_IEA(:,2),CO2_h_final_IEA(i,2))==1),:);

    end

    CO2_h_final=[CO2_h_final;A];
end
change_rate=diff(cell2mat(CO2_h_final(:,3:end)),1,2)./ cell2mat(CO2_h_final(:,3:end-1));
change_rate_temporary=[CO2_h_final(:,1:2),num2cell(change_rate)];

annual_change_rate_temporary_1 = (cell2mat(CO2_h_final(:,8)) ./ cell2mat(CO2_h_final(:,3))).^(1/5) - 1;
annual_change_rate_temporary_2 = (cell2mat(CO2_h_final(:,13)) ./ cell2mat(CO2_h_final(:,8))).^(1/5) - 1;
annual_change_rate_temporary=[CO2_h_final(:,1:2),num2cell(annual_change_rate_temporary_1),num2cell(annual_change_rate_temporary
_2)];

[mapping_country_model, ~, country_match] = xlsread('F:\IAM_All_Country_Match(test) R5.xlsx','AIM|CGE');

  mapping_country_model(isnan(mapping_country_model))=0;
  country_match=country_match(2:end,:);
  country_match(3:end-2,5:end)=num2cell(mapping_country_model);
  country_match(end-1:end,5:end)=num2cell(zeros(2, size(mapping_country_model, 2)));
  country_match=[country_match(:,1:9),country_match(:,12)];
  mapping_country_model=cell2mat(country_match(3:end,5:end));
  region_aggregate=[];
   for i=5:size(country_match,2)
        name_region=country_match(:,i);
        name_V1=country_match(3:end,1:2);
        indivmodel_name_region=name_V1(find(cell2mat(name_region(3:end,1))==1),:);
     carbon_R=[];
              for h=1:size(indivmodel_name_region,1)
             match_idx = find(strcmp(CO2_h_final(:,2), indivmodel_name_region(h,2)));%区域的总 GDP
              CO2_c=[CO2_h_final(match_idx,2),CO2_h_final(match_idx,3:end)];
              carbon_R=[carbon_R;CO2_c];
              end
              carbon_R1=sum(cell2mat(carbon_R(:,2:end)),1);
              hu=[name_region(1,1),name_region(1,1),num2cell(carbon_R1)];
               region_aggregate=[region_aggregate;hu];
   end
change_rate_region=diff(cell2mat(region_aggregate(:,3:end)),1,2)./ cell2mat(region_aggregate(:,3:end-1));
change_rate_1=[region_aggregate(:,1:2),num2cell(change_rate_region)];
change_rate_final=[change_rate_temporary;change_rate_1];
annual_change_rate_1 = (cell2mat(region_aggregate(:,8)) ./ cell2mat(region_aggregate(:,3))).^(1/5) - 1;
annual_change_rate_2 = (cell2mat(region_aggregate(:,13)) ./ cell2mat(region_aggregate(:,8))).^(1/5) - 1;
annual_change_rate=[region_aggregate(:,1:2),num2cell(annual_change_rate_1),num2cell(annual_change_rate_2)];
annual_change_rate_final=[annual_change_rate_temporary;annual_change_rate];
clearvars -except CO2_FINAL change_rate_final annual_change_rate_final

xlswrite('F:\data_generation/change_rate.xlsx',change_rate_final,'actual');
xlswrite('F:\data_generation/change_rate.xlsx',annual_change_rate_final,'annual actual');
```

%% actual_regions_emissions

```
clear all

[~,~,CO2_ISO_total]=xlsread('F:\ISO3_v1.1.csv\data generation\ISO_ar6_mainmodel.csv');
[~,~,CO2_R10_total]=xlsread('F:\R5_regions_v1.1.csv\data generation\R5_ar6_mainmodel.csv');
CO2_total_cha=[CO2_ISO_total;CO2_R10_total(2:end,:)];
CO2_total=CO2_total_cha;
CO2_total(strcmp(CO2_total, 'NA')) = {0};
```

```
for i=1:size(CO2_total,1)-1
x = cell2mat(CO2_total(1,11:end));
y = cell2mat(CO2_total(i+1,11:end));

xi = 2011:1:2099;

yi = pchip(x, y, xi);
yc=[y(1,1),yi,y(1,end)];
CO2_total_cha(i+1,11:11+length(yc)-1)=num2cell(yc);
end
CO2_total_cha(1,11:11+length(yc)-1)=num2cell(x(1,1):x(1,end));
clearvars -except CO2_total_cha

[~,~,CO2_hist_own]=xlsread('F:\co2sec17ene8v2_2024.xlsx','60 countreis');
[~,~,CO2_hist_IEA]=xlsread('F:\IEA.xlsx','IEA_MT');


CO2_hist_own_filteredData = CO2_hist_own(~(strcmp(CO2_hist_own(:, 3), 'Biomass') | strcmp(CO2_hist_own(:, 3), 'Others')) &
strcmp(CO2_hist_own(:, 4), 'Total sector'), :);
countries = CO2_hist_own_filteredData(:, 1);
years = cell2mat(CO2_hist_own_filteredData(:, 2));
values = cell2mat(CO2_hist_own_filteredData(:, 5));

T = table(countries, years, values, 'VariableNames', {'Country', 'Year', 'Value'});

summedData = varfun(@sum, T, 'GroupingVariables', {'Country', 'Year'}, 'InputVariables', 'Value');


CO2_hist_own_summedMatrix = table2cell(summedData);
CO2_hist_IEA=transpose(CO2_hist_IEA);

CO2_h_final_own(1,3:14)=num2cell(2010:1:2021);
[~,~,ISO_name_match]=xlsread('F:\ISO3_v1.1.csv\data generation\三位码和国家名称匹配.xlsx','60_ISO');
CO2_coun_unique = unique(CO2_hist_own_summedMatrix(:,1));
for i=1:length(CO2_coun_unique)
    CO2_1=CO2_hist_own_summedMatrix(find(ismember(CO2_hist_own_summedMatrix(:,1),CO2_coun_unique(i,:))==1),:);

    years = cell2mat(CO2_1(:, 2));

    rows_greater_than_2010 = years >= 2010;


    filtered_data = CO2_1(rows_greater_than_2010, :);
    aa=[CO2_1(1,1),ISO_name_match(find(ismember(ISO_name_match(:,1),CO2_1(1,1))==1),2),filtered_data(:,4)'];
    if length(aa)==14
    CO2_h_final_own=[CO2_h_final_own;aa];

    end
end
CO2_h_final_own(1,1:2)={'Country','ISO'};
CO2_h_final_own=CO2_h_final_own(:,1:13);

CO2_h_final_IEA(1,3:13)=num2cell(2010:1:2020);
[~,~,ISO_name_match]=xlsread('F:\ISO3_v1.1.csv\data generation\三位码和国家名称匹配.xlsx','IEA_ISO');

error_index = strcmp(ISO_name_match(:, 2), 'ActiveX VT_ERROR: ');


ISO_name_match = ISO_name_match(~error_index, :);

CO2_hist_IEA=CO2_hist_IEA(2:end,:);
for i=1:length(CO2_hist_IEA)
    CO2_1=[CO2_hist_IEA(i,1),CO2_hist_IEA(i,12:22)];


    aa=[CO2_1(1,1),ISO_name_match(find(ismember(ISO_name_match(:,1),CO2_1(1,1))==1),2),CO2_1(1,2:end)];
    if length(aa)==13
    CO2_h_final_IEA=[CO2_h_final_IEA;aa];

    end
end
CO2_h_final_IEA(1,1:2)={'Country','ISO'};


CO2_h_final=[];
CO2_h_final_IEA=CO2_h_final_IEA(2:end,:);
for i=1:size(CO2_h_final_IEA,1)
    if ~isempty(find(ismember(CO2_h_final_own(:,2),CO2_h_final_IEA(i,2))==1))
    A=CO2_h_final_own(find(ismember(CO2_h_final_own(:,2),CO2_h_final_IEA(i,2))==1),:);
    else
      A=CO2_h_final_IEA(find(ismember(CO2_h_final_IEA(:,2),CO2_h_final_IEA(i,2))==1),:);

    end

    CO2_h_final=[CO2_h_final;A];
end
```

```
 [mapping_country_model, ~, country_match] = xlsread('F:\IAM_All_Country_Match(test) R5.xlsx','AIM|CGE');
  mapping_country_model(isnan(mapping_country_model))=0;
  country_match=country_match(2:end,:);
  country_match(3:end-2,5:end)=num2cell(mapping_country_model);
  country_match(end-1:end,5:end)=num2cell(zeros(2, size(mapping_country_model, 2)));
  country_match=[country_match(:,1:9),country_match(:,12)];
  mapping_country_model=cell2mat(country_match(3:end,5:end));
  region_aggregate=[];
    for i=5:size(country_match,2)
          name_region=country_match(:,i);
          name_V1=country_match(3:end,1:2);
          indivmodel_name_region=name_V1(find(cell2mat(name_region(3:end,1))==1),:);
      carbon_R=[];
                for h=1:size(indivmodel_name_region,1)
               match_idx = find(strcmp(CO2_h_final(:,2), indivmodel_name_region(h,2)));%区域的总 GDP
                CO2_c=[CO2_h_final(match_idx,2),CO2_h_final(match_idx,3:end)];
                carbon_R=[carbon_R;CO2_c];
                end
                carbon_R1=sum(cell2mat(carbon_R(:,2:end)),1);
                hu=[name_region(1,1),name_region(1,1),num2cell(carbon_R1)];
                 region_aggregate=[region_aggregate;hu];
    end
CO2_h_final=[CO2_h_final;region_aggregate];
clearvars -except CO2_total_cha CO2_h_final
CO2_actual_final=[];
CO2_origin_final=[];
for i=2:size(CO2_total_cha,1)
      hu=CO2_h_final(find(ismember(CO2_h_final(:,2),CO2_total_cha(i,8))==1),3:13);
      if ~isempty(hu)
      hui=[CO2_total_cha(i,1:10),hu];
      CO2_origin_final=[CO2_origin_final;CO2_total_cha(i,1:21)];
      CO2_actual_final=[CO2_actual_final;hui];
      end
end
CO2_actual_final=[CO2_total_cha(1,1:21);CO2_actual_final];
CO2_origin_final=[CO2_total_cha(1,1:21);CO2_origin_final];
xlswrite('F:\data_generation/emissions_total.xlsx',CO2_actual_final,'actual');
xlswrite('F:\data_generation/emissions_total.xlsx',CO2_origin_final,'origin_models');
```

%% individual_countries_scenarios

```
clear all

[~,~,CO2_ISO_total]=xlsread('F:\ISO3_v1.1.csv\data generation\ISO_ar6_mainmodel.csv');
[~,~,CO2_R10_total]=xlsread('F:\R5_regions_v1.1.csv\data generation\R5_ar6_mainmodel.csv');
CO2_total_cha=[CO2_ISO_total;CO2_R10_total(2:end,:)];
CO2_total=CO2_total_cha;
CO2_total(strcmp(CO2_total, 'NA')) = {0};

for i=1:size(CO2_total,1)-1
x = cell2mat(CO2_total(1,11:end));
y = cell2mat(CO2_total(i+1,11:end));

xi = 2011:1:2099;

yi = pchip(x, y, xi);
yc=[y(1,1),yi,y(1,end)];
CO2_total_cha(i+1,11:11+length(yc)-1)=num2cell(yc);
end
CO2_total_cha(1,11:11+length(yc)-1)=num2cell(x(1,1):x(1,end));

models_name = CO2_R10_total(2:end,1);
models_name_1 = CO2_total_cha(:,1);

unique_models_name = unique(models_name);


model_data = cell(size(unique_models_name));


model_data_name=[];
for i = 1:numel(unique_models_name)
      model = unique_models_name(i);
      model_data{i}=CO2_total_cha(find(ismember(models_name_1,model)==1),:);
      model_data_name=[model_data_name;model];
end



[~,~,GDP_Country]=xlsread('F:\SSP_scenarios.xlsx','SSP_scenarios (2)');
[~,~,POP_Country]=xlsread('F:\SSP_scenarios.xlsx','SSP_scenarios (2)');
[~,~,CO2_hist_own]=xlsread('F:\co2sec17ene8v2_2024.xlsx','60 countreis');
[~,~,CO2_hist_IEA]=xlsread('F:\IEA.xlsx','IEA_MT');


[Type Sheet Format]=xlsfinfo('F:\ISO3_v1.1.csv\data generation\IAM_All_Country_Match(test).xlsx');
```

```
CO2_hist_own_filteredData = CO2_hist_own(~(strcmp(CO2_hist_own(:, 3), 'Biomass') | strcmp(CO2_hist_own(:, 3), 'Others')) &
strcmp(CO2_hist_own(:, 4), 'Total sector'), :);
countries = CO2_hist_own_filteredData(:, 1);
years = cell2mat(CO2_hist_own_filteredData(:, 2));
values = cell2mat(CO2_hist_own_filteredData(:, 5));

T = table(countries, years, values, 'VariableNames', {'Country', 'Year', 'Value'});

summedData = varfun(@sum, T, 'GroupingVariables', {'Country', 'Year'}, 'InputVariables', 'Value');


CO2_hist_own_summedMatrix = table2cell(summedData);
CO2_hist_IEA=transpose(CO2_hist_IEA);
[~,~,SSP_C]=xlsread('F:\ISO3_v1.1.csv\data generation\IAM_All_Country_Match(test) R5.xlsx','SSP-C');

CO2_h_final_own(1,3:14)=num2cell(2010:1:2021);
[~,~,ISO_name_match]=xlsread('F:\ISO3_v1.1.csv\data generation\三位码和国家名称匹配.xlsx','60_ISO');
CO2_coun_unique = unique(CO2_hist_own_summedMatrix(:,1));
for i=1:length(CO2_coun_unique)
    CO2_1=CO2_hist_own_summedMatrix(find(ismember(CO2_hist_own_summedMatrix(:,1),CO2_coun_unique(i,:))==1),:);

    years = cell2mat(CO2_1(:, 2));


    rows_greater_than_2010 = years >= 2010;


    filtered_data = CO2_1(rows_greater_than_2010, :);
    aa=[CO2_1(1,1),ISO_name_match(find(ismember(ISO_name_match(:,1),CO2_1(1,1))==1),2),filtered_data(:,4)'];
    if length(aa)==14
    CO2_h_final_own=[CO2_h_final_own;aa];

    end
end
CO2_h_final_own(1,1:2)={'Country','ISO'};
CO2_h_final_own=CO2_h_final_own(:,1:13);

CO2_h_final_IEA(1,3:13)=num2cell(2010:1:2020);
[~,~,ISO_name_match]=xlsread('F:\ISO3_v1.1.csv\data generation\三位码和国家名称匹配.xlsx','IEA_ISO');

error_index = strcmp(ISO_name_match(:, 2), 'ActiveX VT_ERROR: ');


ISO_name_match = ISO_name_match(~error_index, :);

CO2_hist_IEA=CO2_hist_IEA(2:end,:);
for i=1:length(CO2_hist_IEA)
    CO2_1=[CO2_hist_IEA(i,1),CO2_hist_IEA(i,12:22)];


    aa=[CO2_1(1,1),ISO_name_match(find(ismember(ISO_name_match(:,1),CO2_1(1,1))==1),2),CO2_1(1,2:end)];
    if length(aa)==13
    CO2_h_final_IEA=[CO2_h_final_IEA;aa];

    end
end
CO2_h_final_IEA(1,1:2)={'Country','ISO'};

coun_name_WDI=GDP_Country(find(ismember(GDP_Country(:,3),{'gdp'})==1),:);
filtered_GDP_Country = coun_name_WDI(find(ismember(coun_name_WDI(:,4),{'update'})==1),:);
filtered_GDP_Country = filtered_GDP_Country(find(ismember(filtered_GDP_Country(:,5),{'million 2005$PPP'})==1),:);

POP_Country=POP_Country(find(ismember(POP_Country(:,3),{'pop'})==1),:);
POP_Country_1=POP_Country(find(ismember(POP_Country(:,4),{'update'})==1),:);
filtered_POP_Country = POP_Country_1;


gdp_result = filtered_GDP_Country;



GDP_result_cha=gdp_result;
for i=1:length(gdp_result)
xx=(2026:4:2030);
x = (2030:5:2100);
yy= cell2mat(gdp_result(i,52:53));
y = cell2mat(gdp_result(i,53:end));

xxi=2027:2029;
xi = 2031:1:2099;

yyi=pchip(xx,yy,xxi);
yi = pchip(x, y, xi);
yyc=[yy(1,1),yyi,yy(1,end)];
yc=[y(1,1),yi,y(1,end)];
GDP_result_cha(i,52:52+length(yyc)-1)=num2cell(yyc);
```

```
GDP_result_cha(i,52+length(yyc)-1:52+length(yyc)-1+length(yc)-1)=num2cell(yc);
end
title=[{'iso3c'},{'SSP'},{'x'},{'version'},{'unit'},num2cell(1980:1:2100)];
GDP_result_cha=[title;GDP_result_cha];
GDP_result_cha=[GDP_result_cha(:,1:3),GDP_result_cha(:,5),GDP_result_cha(:,24:end)];



gdp_result_history=gdp_result(find(ismember(gdp_result(:,2),{'SSP1'})==1),:);
CO2_new_intensity=[];
for i=1:size(gdp_result_history,1)
    au=[gdp_result_history(i,1:2),gdp_result_history(i,36:46)];
    if ~isempty(find(ismember(CO2_h_final_own(:,2),gdp_result_history(i,1))==1))
    ui=CO2_h_final_own(find(ismember(CO2_h_final_own(:,2),gdp_result_history(i,1))==1),3:end);
    uii=[au(1,1),{'CO2'},ui];
    elseif ~isempty(find(ismember(CO2_h_final_IEA(:,2),gdp_result_history(i,1))==1))
       ui=CO2_h_final_IEA(find(ismember(CO2_h_final_IEA(:,2),gdp_result_history(i,1))==1),3:end);
    uii=[au(1,1),{'CO2'},ui];
    else
        uii=[];
    end
    if isempty(uii)
        o=1;
    else
       uuii=[au;uii];
    CO2_new_intensity=[CO2_new_intensity;uuii];
    end
end
for i = 1:size(CO2_new_intensity, 1)
    for j = 1:size(CO2_new_intensity, 2)
        if isnan(CO2_new_intensity{i, j})
            CO2_new_intensity{i, j} = 0;
        end
    end
end
intensity_1=cell2mat(CO2_new_intensity(:,3:end));
intensity_final=[];
for i=1:size(intensity_1,1)./2
    intensity_2=intensity_1((i-1)*2+2,:)./intensity_1((i-1)*2+1,:);
    trans=[CO2_new_intensity((i-1)*2+2,1),num2cell(intensity_2)];
    intensity_final=[intensity_final;trans];
end

CO2_h_final=[];
for i=1:size(intensity_final,1)
    if ~isempty(find(ismember(CO2_h_final_own(:,2),intensity_final(i,1))==1))
    A=CO2_h_final_own(find(ismember(CO2_h_final_own(:,2),intensity_final(i,1))==1),:);
    elseif ~isempty(find(ismember(CO2_h_final_IEA(:,2),intensity_final(i,1))==1))
      A=CO2_h_final_IEA(find(ismember(CO2_h_final_IEA(:,2),intensity_final(i,1))==1),:);
    else
        A=[];
    end

    CO2_h_final=[CO2_h_final;A];
end

yc=2100;
yh=2020;
r=log(0.01)/(yc-yh);


allmodel_matchhistory_CO2=[];
allmodel_CO2=[];
allmodel_GDP=[];
allmodel_EIc_coun=[];
allmodel_EIc_coun_final=[];

for i=1:length(model_data)
    hu=model_data{i};
    %gg=cellfun(@(x) x(1:3), hu(1,1), 'UniformOutput', false);
    %g=Sheet{find(strcmp(match_a(:,:),gg))};
        [mapping_country_model, ~, country_match] = xlsread('F:\IAM_All_Country_Match(test) R5.xlsx','AIM|CGE');
        mapping_country_model(isnan(mapping_country_model))=0;
       country_match=country_match(2:end,:);
       country_match(3:end-2,5:end)=num2cell(mapping_country_model);
       country_match(end-1:end,5:end)=num2cell(zeros(2, size(mapping_country_model, 2)));
        country_match=[country_match(:,1:4),country_match(:,find(ismember(country_match(1,:),hu(:,8))==1))];
        mapping_country_model=cell2mat(country_match(3:end,5:end));
       hangNo=find(sum(mapping_country_model,2)~=1&sum(mapping_country_model,2)~=0)+2;
       double_hang=country_match(hangNo,1:2);
       a=hu;
       a(strcmp(a, 'NA')) = {0};

       EIc_all_coun=[];
       EIc_all_coun_final=[];
       AIM_CGE_h_CO2=[];
```

```
        AIM_CGE_new_CO2=[];
        AIM_CGE_new_GDP=[];
    for j=1:size(a,1)
        if sum(find(ismember(country_match(1,:),a(j,8))==1))~=0
            name_region=country_match(:,find(ismember(country_match(1,:),a(j,8))==1));

            if sum(cell2mat(name_region(3:end,1)))==1
                AIM_CGE_new_CO2=[AIM_CGE_new_CO2;a(j,:)];
              match_idx_1 =
country_match(find(cell2mat(country_match(3:end,find(ismember(country_match(1,:),a(j,8))==1)))==1)+2,2);
              match_idx = find(strcmp(GDP_result_cha(:, 1), match_idx_1) & strcmp(GDP_result_cha(:,
2),SSP_C(strcmp(SSP_C(:,1),a(j,2)),3)));
              GDP_c=[a(j,1:8),'GDP','US',GDP_result_cha(match_idx,17:end)];
              AIM_CGE_new_GDP=[AIM_CGE_new_GDP; GDP_c];
              EIc=cell2mat(a(j,11:end))./cell2mat(GDP_c(:,11:end));
              combine=[a(j,1:10),num2cell(EIc)];
              EIc_all_coun=[EIc_all_coun;combine];

              b=a(j,:);
            growth_rate = diff(cell2mat(b(:,11:end)))./ cell2mat(b(:,11:end-1));
            b(2,11:end-1)=num2cell(growth_rate);

            Country_CO2=CO2_h_final((find(ismember(CO2_h_final(:,2),match_idx_1)==1)),:);
            b(3,11:21)=Country_CO2(1,3:end);
            cc_1=cell2mat(b(2,11:end));
            cc_2=cell2mat(b(3,11:end));
            cc_1(2,1:11)=cc_2;
            for u=12:size(cc_1,2)+1
            cc_1(2,u) = cc_1(2,u-1) * (1+cc_1(1,u-1));
            end
            b(2:end,11:end)=num2cell(cc_1);
            b(3,1:10)=b(1,1:10);
            AIM_CGE_h_CO2=[AIM_CGE_h_CO2;b(3,:)];
            EIc_final=cell2mat(b(3,11:end))./cell2mat(GDP_c(:,11:end));
              combine=[a(j,1:10),num2cell(EIc_final)];
              EIc_all_coun_final=[EIc_all_coun_final;combine];
            else
            name_region=country_match(:,find(ismember(country_match(1,:),a(j,8))==1));
            name_V1=country_match(3:end,1:2);
            indivmodel_name_region=name_V1(find(cell2mat(name_region(3:end,1))==1),:);
            if find(strcmp(name_region(1,1),country_match(1,:)))<9
            isMatched = ismember(indivmodel_name_region(:,:),double_hang(:,:));

            hui=reshape(indivmodel_name_region(isMatched), length(indivmodel_name_region(isMatched))./2,2);
            huii=country_match(find(ismember(country_match(:,2),hui(:,2))),:);
            [row, col] = find(cellfun(@(x) isnumeric(x) && x == 1, huii(:, 5:end)));
            col = col + 4;
            huiii=transpose(country_match(1,unique(col(col>9))));
            sumsum=sum(cell2mat(a(find(ismember(a(:,8),huiii(:,1))),11:end)),1);
            if isempty(sumsum)
                sumsum=zeros(1,size(a(j,11:end),2));
            end
            a(j,11:end)=num2cell(cell2mat(a(j,11:end))-sumsum);

            indivmodel_name_region(isMatched) = [];
            if any(isMatched(:) ~= 0)
            indivmodel_name_region=reshape(indivmodel_name_region, size(indivmodel_name_region,2)./2,2);
            end
            else
                indivmodel_name_region=indivmodel_name_region;
            end
            GDP_R=[];
              for h=1:size(indivmodel_name_region,1)
            match_idx = find(strcmp(GDP_result_cha(:,1), indivmodel_name_region(h,2)) & strcmp(GDP_result_cha(:,
2),SSP_C(strcmp(SSP_C(:,1),a(j,2)),3)));
              GDP_c=[a(j,1:7),GDP_result_cha(match_idx,1),'GDP','US',GDP_result_cha(match_idx,17:end)];
              GDP_R=[GDP_R;GDP_c];
              end

              carbon_R=[];
              for h=1:size(indivmodel_name_region,1)
            match_idx = find(strcmp(CO2_h_final(:,2), indivmodel_name_region(h,2)));
              CO2_c=[a(j,1:7),CO2_h_final(match_idx,2),a(j,9:10),CO2_h_final(match_idx,3:end)];
              carbon_R=[carbon_R;CO2_c];
              end
              carbon_R1=cell2mat(carbon_R(:,11:end));
              carbon_R1(isnan(carbon_R1))=0;
              carbon_R(:,11:end)=num2cell(carbon_R1);


              b=a(j,:);
            growth_rate = diff(cell2mat(b(:,11:end)))./ cell2mat(b(:,11:end-1));
            b(2,11:end-1)=num2cell(growth_rate);

            b(3,11:21)=num2cell(sum(cell2mat(carbon_R(:,11:end)),1));
            cc_1=cell2mat(b(2,11:end));
            cc_2=cell2mat(b(3,11:end));
```

```
                cc_1(2,1:11)=cc_2;
                for u=12:size(cc_1,2)+1
                cc_1(2,u) = cc_1(2,u-1) * (1+cc_1(1,u-1));
                end
                b(2:end,11:end)=num2cell(cc_1);
                b(3,1:10)=b(1,1:10);

                 GDP_region=sum(cell2mat(GDP_R(:,11:end)),1);
                 GDP_region_final=[a(j,1:8),'GDP',a(j,10),num2cell(GDP_region)];
                 intensity_r=num2cell(cell2mat(b(3,11:end))./cell2mat(GDP_region_final(:,11:end)));
                 intensity_r_1=num2cell(cell2mat(a(j,11:end))./cell2mat(GDP_region_final(:,11:end)));
                 AIM_CGE_new_CO2=[AIM_CGE_new_CO2;a(j,:)];
                 AIM_CGE_h_CO2=[AIM_CGE_h_CO2;b(3,:)];
                 AIM_CGE_new_GDP=[AIM_CGE_new_GDP;GDP_region_final];

                 intensity_r_final=[a(j,1:10),intensity_r];
                 intensity_r_1_final=[a(j,1:10),intensity_r_1];
                 EIc_all_coun_final=[ EIc_all_coun_final;intensity_r_final];
                 EIc_all_coun=[ EIc_all_coun;intensity_r_1_final];
                 if isempty(find(cell2mat(b(3,11:end))<0))


                for m=1:size(indivmodel_name_region,1)
                       count_intensity=intensity_final(find(ismember(intensity_final(:,1),indivmodel_name_region(m,2))==1),end);
                ac=(cell2mat(intensity_r_final(:,end))-cell2mat(count_intensity))/(exp(r*yc)-exp(r*yh));
                bc=(cell2mat(intensity_r_final(:,end))-0.01*cell2mat(count_intensity))/(1-0.01);
                        EIc_final=[];
                       for y=2021:2100
                          EIc=ac*exp(r*y)+bc;
                          EIc_final=[EIc_final,num2cell(EIc)];

                       end


                       match_idx = find(strcmp(intensity_final(:,1), indivmodel_name_region(m,2)));

                       combine=[a(j,1:7),strjoin([name_region(1,1),indivmodel_name_region(m,2)], '_'),a(j,9:10),
intensity_final(match_idx,2:12),EIc_final];
                       EIc_all_coun=[ EIc_all_coun;combine];

                       CO2_C=[combine(:,1:10),num2cell(cell2mat(GDP_R(m,11:end)).*cell2mat(combine(1,11:end)))];
                       AIM_CGE_new_CO2=[AIM_CGE_new_CO2;CO2_C];
                       AIM_CGE_new_GDP=[AIM_CGE_new_GDP;GDP_R(m,:)];
                end
                 else
                       yu=find(cell2mat(b(3,11:end))<0);
                       yc_neg=2010+yu(1,1)-2;
                       r_neg=log(0.01)/(yc_neg-yh);
                            for m=1:size(indivmodel_name_region,1)
                         count_intensity=intensity_final(find(ismember(intensity_final(:,1),indivmodel_name_region(m,2))==1),end);
                ac=(cell2mat(intensity_r_final(:,yu(1,1)+9))-cell2mat(count_intensity))/(exp(r_neg*yc_neg)-exp(r_neg*yh));
                bc=(cell2mat(intensity_r_final(:,yu(1,1)+9))-0.01*cell2mat(count_intensity))/(1-0.01);
                          EIc_final=[];
                       for y=2021:yc_neg
                          EIc=ac*exp(r_neg*y)+bc;
                          EIc_final=[EIc_final,num2cell(EIc)];

                       end
                      EIc_final(:,size(EIc_final,2)+1:80)=intensity_r_final(:,yu(1,1)+10:end);

                       match_idx = find(strcmp(intensity_final(:,1), indivmodel_name_region(m,2)));

                       combine=[a(j,1:7),strjoin([name_region(1,1),indivmodel_name_region(m,2)], '_'),a(j,9:10),
intensity_final(match_idx,2:12),EIc_final];
                       EIc_all_coun=[ EIc_all_coun;combine];

                       CO2_C=[combine(:,1:10),num2cell(cell2mat(GDP_R(m,11:end)).*cell2mat(combine(1,11:end)))];
                       AIM_CGE_new_CO2=[AIM_CGE_new_CO2;CO2_C];
                       AIM_CGE_new_GDP=[AIM_CGE_new_GDP;GDP_R(m,:)];
                end
                 end
                region_actual=AIM_CGE_h_CO2(end,:);
                region_CO2_temporary=AIM_CGE_new_CO2(end-size(GDP_R,1)+1:end,:);
                ratio=cell2mat(region_actual(:,11:end))./sum(cell2mat(region_CO2_temporary(:,11:end)),1);
                zuizhong=[region_CO2_temporary(:,1:10),num2cell(cell2mat(region_CO2_temporary(:,11:end)).*ratio)];
                AIM_CGE_h_CO2=[AIM_CGE_h_CO2;zuizhong];
                EI_zuizhong=[EIc_all_coun(end-
size(GDP_R,1)+1:end,1:10),num2cell(cell2mat(zuizhong(:,11:end))./cell2mat(GDP_R(:,11:end)))];
                EIc_all_coun_final=[ EIc_all_coun_final;EI_zuizhong];
                end
            else
                bi=1;
            end
        end
            allmodel_matchhistory_CO2{i}=AIM_CGE_h_CO2;
            allmodel_CO2{i}=AIM_CGE_new_CO2;
            allmodel_GDP{i}=AIM_CGE_new_GDP;
```

```
        allmodel_EIc_coun{i}=EIc_all_coun;
        allmodel_EIc_coun_final{i}=EIc_all_coun_final;
end
allmodel_matchhistory_CO2_final=vertcat(allmodel_matchhistory_CO2{:});
allmodel_CO2_final=vertcat(allmodel_CO2{:});
allmodel_GDP_final=vertcat(allmodel_GDP{:});
allmodel_EIc_coun_final=vertcat(allmodel_EIc_coun{:});
allmodel_EIc_coun_final_final=vertcat(allmodel_EIc_coun_final{:});
xlswrite('F:\data_generation/final_result_IEA_own.xlsx',allmodel_matchhistory_CO2_final,'CO2_match');
```