


Horizon 2020 Societal challenge 5: Climate action, environment, resource efficiency and raw materials

# COP21 RIPPLES

## COP21: Results and Implications for Pathways and Policies for Low Emissions European Societies

GA number: 730427, Funding type: RIA

| **Deliverable number** (relative in WP) | **D2.1** |
|---|---|
| **Deliverable name:** | Scenario database of existing or updated national decarbonisation scenarios for NDCs and 2°C/1°5C |
| **WP / WP number:** | 2 |
| **Delivery due date:** | Project month 11 (October 2017) |
| **Actual date of submission:** | Draft (scenarios available until date): October 2017; Final: 29/06/2018 |
| **Dissemination level:** | Confidential |
| **Lead beneficiary:** | IDDRI |
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| **Estimated effort (PM):** | |
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| **Estimated effort contributor(s) (PM):** | 3 |
| **Internal reviewer:** | IDDRI |

1. **Changes with respect to the DoA**

   D2.1 was scheduled for month-11. By then, it was submitted as a draft. The reason for this was the evolving nature of the database in order to serve the purpose of data provider to other tasks. There was the need to continuously update the database as country teams submitted their new or updated scenarios, or new global scenarios emerged.

2. **Dissemination and uptake**

   The database is internally instrumental for a number of COP21 RIPPLES tasks which require access to GHG emissions scenarios. In particular, the database has been designed to organise input data for Task 2.2, Task 2.4 in WP2 and Tasks 3.1 to 3.4 in WP3.

3. **Short Summary of results (<250 words)**

   As a result of an extensive literature review of GHG emissions pathways, an excel-based database has compiled a total of 90 scenarios. A total of 51 come from global teams and models, and the remaining 39 are sourced from in-country teams. 15 national scenarios are new, developed in the context of COP21 RIPPLES by its consortium partners. The review of the scenarios has supported the identification of key decarbonization drivers in major emitting sectors to limit warming to well-below 2°C and 1.5°C. The analysis leads to the selection of indicators for the development of the COP21 RIPPLES narratives (under Task 2.2). A main finding from the literature review is the lack of 1.5C-compatible scenarios that contain sufficient level of detail to support the assessment of socio-economic implications or the identification of enabling conditions. Activity-data is often lacking in the global scenarios. In-country national scenarios are harder to find, thus, the importance of the 15-newly generated scenarios under COP21 RIPPLES, even if it is not the objective of the project *per se*.

4. **Evidence of accomplishment**

   The excel-based database is delivered, together with an accompanying document that summarises the content of the database.

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## 1. Purpose of the database

The National Determined Contributions (NDCs) provide important indications regarding the future GHG emissions and related policies, in relation to the international energy market, technological, economic, trade and financial context. This key information on the development trajectories of major economies is an essential information of EU policies as it will determine the global context in which EU policies will evolve. Nevertheless, the NDCs adopt a medium-term horizon and do not provide all the required information to fully characterize the detailed energy system pathways that meet the Paris Agreement (PA) goals. NDCs therefore fall short of characterizing the global trajectories at a sufficiently granular and long-term perspective for informing EU policies.

To close this knowledge gap, COP21 RIPPLES aims at analysing the underlying transformations required in the different sectors of the economy to meet the PA mitigation targets. This database compiles both national and global scenarios that will be used throughout the project. These scenarios are selected according to their ability to support the identification of key decarbonization drivers in major emitting sectors to limit warming to well-below 2°C and 1.5°C. The database includes a set of existing scenarios, combined with new scenarios produced for the COP21 RIPPLES project by consortium partners.

The scenarios database becomes the basis for other analysis within the project. Specifically:

1. It is used for providing some high-level benchmarks to guide the design of the transition storylines under Task 2.2
2. It is the basis for the Decarbonisation Wedges (DW) analysis, to be performed in Task 2.3
3. It provides inputs for the country level downscaling to be run with the SIAMESE model under Task 2.4
4. It contains the scenarios to be run by modelers under WP3 to analyse socio-economic implications and enabling conditions

## 2. Scope and Data Sources

In terms of geographical coverage, the project has collected a set of country level and global level scenarios. The scenarios come from both global models (mainly IAMs) and national models. Most of the global models' scenarios included in the database have also a national coverage for the main country emitters. National scenarios are included for major economies, including major EU Member States. The new national scenarios developed under COP21 RIPPLES employ different models and methods.

The scenarios gathered in the database represent different narratives that COP21 RIPPLES aims to explore in WP2 and WP3. The detailed characterization of those narratives is provided in Task 2.2., though the initial scope includes:

- Paris compatible scenarios with early action, where countries accelerate action from 2020 compared to the ambition level of the set of NDCs
- Paris compatible scenarios with NDCs, where countries follow a pathway similar to a full implementation of the targets and strategies included in the current NDCs until 2030, while they accelerate action after 2030
- Paris compatible scenarios with technological and behavioural disruptions
- 1.5°C compatible scenarios, where countries implement very deep decarbonisation strategies, that brings them on a pathway towards the 1.5°C-related benchmarks

The data sources used for compiling the database are the following:

- Deep Decarbonisation Pathways Project (DDPP) - http://deepdecarbonization.org/
- MILES project - http://www.iddri.org/Projets/MILES-(Modelling-and-Informing-Low-Emission-Strategies)
- AR5 IPCC database (AR5 Scenario Database hosted by IIASA) - https://tntcat.iiasa.ac.at/AR5DB/dsd?Action=htmlpage&page=about
- SIAMESE Database, hosted by Climate Analytics
- IEA ETP 2017 - https://www.iea.org/etp2017/
- National scenarios developed under COP21 RIPPLES project

## 3. Data template

To allow comparability and consistency across scenarios coming from different sources, an excel-based data template has been created by IDDRI, with support from CNRS, CA and the other partners involved in WP2. The data template covers around 100 variables, of which 57 are mandatory. The data template covers economy-wide information on GDP, population, and emission trajectories as well as more granular data for 4 main sectors of the economy, namely power sector, industry, buildings (private and commercial) and transport. There is no data coverage for LULUFC, unless differently stated. For the above sectors, the database covers information on sectoral emissions, energy production and consumption, fuel mix and activity levels. The data are reported on a 10 years basis from 2010 to 2050. It must be noted that not all variables listed in the data template are reported for all scenarios. In some

cases, e.g. for the scenarios coming from the IPCC database, some data are missing, especially when looking at the activity levels. The data template used for this deliverable is reported in the Annex.

## 4. Methodology

Inclusion of global scenarios in the database

Even though the PA refers to only one long-term goal ("Holding the increase in the global average temperature to well below 2°C above pre-industrial levels and pursuing efforts to limit the temperature increase to 1.5°C (…)") its interpretation is not unambiguous. For example, the IEA ETP 2017 recently released a "beyond 2C" scenario which is consistent with a long-term temperature goal of 1.75°C warming with a 50% probability. The IEA does not clarify if this scenario will lead to a temporary overshoot of the 2°C goal before 2100.

Keeping in mind the lack of consistency between pathways in the literature and the PA temperature and emissions goals, the database prioritises only pathways that lead to at least 66% chance of staying below 2°C throughout the whole century and a 50% chance staying below 1.5°C by 2100, in line with best available science. Nevertheless, an exception is made for IEA ETP 2017 because it contains more details, sectorally disaggregated, and is technology explicit. The inclusion of this scenario allows for COP21 RIPPLES analysis to provide more meaningful insights on how to realistically enhance the NDC level of ambition and policies in the EU in line with the PA and currently expected technological developments.

The AR5 IPCC database contains the scenarios published under the 5th Assessment Report of WG3 of the IPCC. The database comprises of 1184 scenarios based on 31 models. However, we found that only five pathways are compatible with a 1.5°C temperature increase, based on only two models: GCAM and IMAGE. We also found that IPCC models are able to cover roughly 20% of the data template of the COP21 RIPPLES project. In particular, data are lacking for the so-called "activity indicators" at the sectorial level (e.g. "floor area for residential units").

Regarding the regional coverage, IPCC data is mostly available at the global level and for five IPCC regions (OECD90, Latin America, Asia, Middle East and North Africa, Reforming Economies). A few model runs also provide data at the country level, namely for the USA, EU27, China, India, Indonesia, Japan, and Korea. Data at the country level, are not directly available from the AR5 IPCC database, but can be accessed from their specific "model comparison projects" websites (e.g. Asian Modeling Exercise database).

Inclusion of national scenarios in the database

As stated in section 2 of this report, scenarios have been collected according to their compliance to specific climate targets and other assumptions characterizing the narratives. Concerning the climate targets, one of the challenges of this deliverable has been to develop a method for defining national scenarios produced within the COP21 RIPPLES project that are compatible with global level climate targets, i.e. well below 2°C and 1.5°C. It was decided to avoid a burden sharing approach and rather identify the necessary conditions to respect the well-below 2°C/1.5°C targets. Instead, for each narrative, we identified a representative (or marker) scenario that can be interpreted as a representative case to

illustrate a particular narrative on the basis of a few features. In practice, this translates in the following approach:

1. Given that the existing DDPP national scenarios are altogether compatible with the 2°C target, we used some aggregate trends emerging from the DDPP analysis in order to characterise our new "Paris compatible scenarios with early action". Indeed, although the national contexts are different, we know that the DDPP countries experience some common trends, as following:

   - Decoupling of emissions from economic growth (CI of GDP reduced by at least 80% in 2050 relative to 2010)
   - Average energy intensity of GDP reduced by 65% in 2050 wrt 2010
   - Share of electricity in final energy consumption equal to more than 40% in 2050
   - Emission intensity of electricity below 50 gCO2/kwh in 2050 IPCC (AR5 WG3)

   Following this approach, the country teams choose the marker country scenario for the "Paris compatible scenarios with early action" based on the above characteristics.

2. The "Paris compatible scenarios with early action" scenarios have been then taken as a reference for the identification of ranges of Paris-compatible country's cumulative emissions up to 2050. This information has been used as a reference for the "Paris compatible scenarios with NDCs" scenarios.
3. In order to identify the country scenarios falling in the 1.5C storyline, as a rule of thumb we used the indicators above, with values between 25% to 50% more ambitious, which seems in line with the IPCC estimates.

## 5. Content of the database

The excel-based database contains a total of 89 scenarios. A total of 51 come from global teams and models, and the remaining 38 are sourced from in-country teams. 15 national scenarios have been newly generated by COP21 RIPPLES partners in the context of the project. Each tab represents an individual scenario, and they are colour code as follows:

- Red: Paris compatible scenarios with early action
- Blue: Paris compatible scenarios following global NDC pathway
- Orange:

Paris compatible scenarios with technological and behavioural disruptions

- Green: 1.5C- compatible scenarios (and proxies)

Scenarios developed by global teams/models are labelled with an initial letter 'G', whereas an 'N' is used for in-country modeling.

The tables below summarise the scenarios included in the database for each of the four categories.

## 5.1. Paris compatible scenarios with early action

In-country teams - National and global models (#23 scenarios)

| Tab name | Country | Model name | Scenario | Institution |
|---|---|---|---|---|
| N-AUS-3 | Australia | CSIRO Energy Sector Model (ESM) | DDPP 3 | ClimateWorks Australia, Australian National University |
| N-BRA-2 | Brazil | IMACLIM-BR CGE model | DDPP 2 | CentroClima/ COPPE/UFRJ |
| N-CAN-1 | Canada | CIMS | DDPP 1 | Carbon Management Canada |
| N-CHN MILES ERI 2 | China | IPAC-AIM/Technology | MILES 2°C | Energy Research Institute |
| N-CHN | China | SACC | Scenario Peak 2030 | Tsinghua University, NCSC |
| N-FRA-1 | France | Imaclim-R France | DDPP 1 | EDDEN, CIRED |
| N-FRA RIP-1 | France | POLES (01) /GAEL | Scenario 1 RIPPLES, no breakthrough | CNRS |
| N-DEU-3 | Germany | External sources | DDPP 3 | Wuppertal Institute |
| N-DEU-RIP-1 | Germany | External sources | Scenario 1 RIPPLES, early decarb | Wuppertal Institute |
| N-GBR-1 | UK | UK TIMES | DDPP 1 | UCL |
| N-GBR-RIP-3 | UK | UK TIMES | Scenario 3 RIPPLES: 9Gt Low CCS & DR | UCL |
| N-ITA-3 | Italy | TIMES Italy, GDyn-E, ICES | DDPP 3 | ENEA, FEEM |
| N-ITA-RIP-1 | Italy - | TIMES Italy | Scenario 1 RIPPLES, Early action 90 | ENEA |
| N-POL-RIP-1 | Poland | MEWA | Scenario 1 RIPPLES, no tech | WiseEuropa |
| N-IND-2 | India | SLIM | DDPP 2 | IIMA |
| N-IND-MILES | India | SLIM | MILES | IIMA |
| N-IDN-1 | Indonesia | DDPP Calculator | DDPP 1 | ITB, CCROM |
| N-USA-2 | USA | PATHWAYS, GCAM | DDPP 2 | E3 |
| N-MEX-1 | Mexico | Dashboard, emissions calculator | DDPP 1 | Tempus Analytica |

| | | | | |
|---|---|---|---|---|
| N-JPN-2 | Japan | AIM/Enduse, AIM CGE | DDPP 2 | NIES, IGES |
| N-KOR-2 | Korea | DDPP Calculator | DDPP 2 | Korea University |
| N-RUS-1 | Russia | RU-TIMES | DDPP 1 | RANEPA |
| N-ZAF PAMS8 | South Africa | SATIM CGE e-SAGE | PAMS ALL RIPPLES 8 | Energy Research Centre, University of Cape Town |

Global teams and models (#19 scenarios)

| Tab name | Model name | Scenario1 | Country coverage | Institution |
|---|---|---|---|---|
| G-WRLD-SSP2 | IMAGE | SSP2-26 (1) | World | PBL |
| G-*country*-GCAM-LIM RP450 | GCAM 3.1 | LIMITS-RefPol-450 (country and world) (6) | China, EU, India, Japan, USA and World | PNNL |
| G-*country*-MESSAGE-LIMRP450 | MESSAGE V.4 | LIMITS-RefPol-450 (country and world) (5) | China, EU, India, USA and World | IIASA |
| G-*country*-REMIND-LIMRP450 | REMIND 1.5 | LIMITS-RefPol-450 (country and world) (7) | China, EU, India, Japan, Russia, USA and World | PIK |

## 5.2. Paris compatible scenarios following global NDC pathway

In-country teams – National and global models (#8 scenarios)

| Tab name | Country | Model name | Scenario | Institution |
|---|---|---|---|---|
| N-CHN-MILES NN | China | PACE | MILES New Normal, Fu Sha (NDC RU) | Renmin University, NCSC |
| N-CHN-MILES ERI NDC | China | IPAC-AIM/Technology | MILES NDC 2°C ELEC | Energy Research Institute |
| N-ITA RIP NDC90 | Italy | TIMES Italy | Scenario 2, RIPPLES NDC 90% | ENEA |
| N-FRA RIP-2 | France | POLES (1)/GAEL | Scenario 2 RIPPLES | CNRS |
| N-POL RIP-2 | Poland | MEWA | Scenario 2 RIPPLES, tech_post_2030 | WiseEuropa |
| N-EU-MILES | EU | PRIMES | MILES EU NDC | ICCS |
| N-JPN-MILES NDC | Japan | DNE21+ V.MILES | MILES With INDCs Case1 | RITE |
| N-ZAF PAMS10 | South Africa | SATIM CGE e-SAGE | PAMS ALL RIPPLES 10 | Energy Research Center, University of Cape Town |

Global teams and models (#6 scenarios)

| Tab name | Model name | Scenario | Country coverage | Institution |
|---|---|---|---|---|
| G-*country*-GCAM3-2030 500 | GCAM 3.1 | LIMITS-RefPol2030-500 (6) * | China, EU, India, Japan, USA and World | PNNL |

* 50% probability of staying below 2°C throughout the whole century

[1] Between brackets: number of scenarios included in the RIPPLES database

## 5.3. Paris compatible scenarios with technological and behavioural disruptions

In-country teams – National and global models (#1 scenario)

| Tab name | Country | Model name | Scenario | Institution |
|---|---|---|---|---|
| N-GBR-RIP-2 | UK | UK TIMES | Scenario 2 RIPPLES: 9Gt High All | UCL |

Global teams and models (#6 scenarios)

| Tab name | Model name | Scenario | Country coverage | Institution |
|---|---|---|---|---|
| G-EMF27-450 IMACLIM LowEI | IMACLIM v1.1 | IMACLIM v1.1EMF27-450-LowEI (1) | world | CIRED |
| G-EMF27-450 MERGE LowEI | MERGE | MERGE_EMF27EMF27-450-LowEI (1) | world | EPRI |
| G-EMF27-450 POLES LowEI | POLES | POLES EMF27EMF27-450-LowEI (1) | world | CNRS |
| G-EMF27-450 REMIND LowEI | REMIND 1.5 | REMIND 1.5EMF27-450-LowEI (1) | world | PIK |
| G-EMF27-450 GCAM3.0 EERE | GCAM 3.0 | GCAM 3.0EMF27-450-EERE (1) | world | PNNL |
| G-EMF27-450 REMIND EERE | REMIND 1.5 | REMIND 1.5EMF27-450-EERE (1) | world | PIK |

## 5.4. 1.5C- compatible scenarios (and proxies)

In-country teams – National and global models (#6 scenarios)

| Tab name | Country | Model name | Scenario | Institution |
|---|---|---|---|---|
| N-BRA 1.5 | Brazil | IMACLIM | New Brazil 1.5 C (IES Brasil 2050 Project) | CentroClima/ COPPE/UFRJ |
| N-DEU 1.5 | Germany | External sources | Scenario RIPPLES, DEU below 2C | Wuppertal Institute |
| N-POL 1.5 | Poland | MEWA | Scenario RIPPLES, PL tech early action | WiseEuropa |
| N-GBP 1.5 | UK | UK TIMES | Scenario 3 RIPPLES, UK 4GT High All | UCL |
| N-CHN 1.5 | China | SACC | Scenario Peak 2025 | Tsinghua University, NCSC |
| N-FRA 1.5 | France | POLES | RIPPLES | CNRS |

Global teams and models (#20 scenarios)

| Tab name | Model name | Scenario | Country coverage | Institution |
|---|---|---|---|---|
| G-IPCC 1.5 Conv | GCAM 3.0 | IPCC EMF27-450-Conv (1) | world | PNNL |
| G-IPCC 1.5 LimBio | GCAM 3.0 | IPCC EMF27-450-LimBio (1) | world | PNNL |
| G-IPCC 1.5 NoCCS | GCAM 3.0 | IPCC EMF27-450-NoCCS (1) | world | PNNL |
| G-country-IEA | IEA/ETP | IEA/ETP 2017 Bynd 2°C** (9) | USA, South Africa, Russia, Mexico, India, EU, China, Brazil & world | IEA |
| G-*country*-IMAGE 1.5 | IMAGE 2.4 | IMAGE2.4AME 2.6 W/m2 OS (8) | China, EU, India, Indonesia, Japan, Korea, USA and world | PBL |

** 1.75°C pathway

# ANNEX: COP21 RIPPLES data template for Task 2.1

**RIPPLES: Dashboard for task 2.1 and 2.3**

Color Key:

| |
|---|
| Data absolutely needed |
| Data needed if available |

| | | 2000 | 2010 | 2020 | 2030 | 2040 | 2050 |
|---|---|---|---|---|---|---|---|
| **Aggregate Inputs** | | | | | | | |
| Population | Millions | | | | | | |
| GDP | B$2005PPP | | | | | | |
| GDP | B$2005MER | | | | | | |
| Total CO2 emissions | MtCO2 | | | | | | |
| **Residential & service inputs** | | | | | | | |
| **Residential inputs** | | | | | | | |
| Floor area, residential units | Msqm | | | | | | |
| Residential final energy consumption | Mtoe | | | | | | |
| Residential total non-electricity CO2 emissions | MtCO2 | | | | | | |
| Residential total CO2 emissions | MtCO2 | | | | | | |
| Residential final electricity | TWh | | | | | | |
| Residential non-electricity FEC | Mtoe | | | | | | |
| Residential district heating | Mtoe | | | | | | |
| Residential solar thermal | Mtoe | | | | | | |
| Residential pipeline gas | Mtoe | | | | | | |
| Residential liquid fossil fuels | Mtoe | | | | | | |
| Residential coal and coal gas | Mtoe | | | | | | |
| Residential solid biomass | Mtoe | | | | | | |
| **Service inputs** | | | | | | | |
| Floor area, commercial units | Msqm | | | | | | |
| Service Value added | B$2005PPP | | | | | | |
| Commercial final energy consumption | Mtoe | | | | | | |
| Commercial total non-electricity CO2 emissions | MtCO2 | | | | | | |
| Commercial total CO2 emissions | MtCO2 | | | | | | |
| Commercial final electricity | TWh | | | | | | |
| Comemrcial non-electricity FEC | Mtoe | | | | | | |
| Comemrcial district heating | Mtoe | | | | | | |
| Commercial solar thermal | Mtoe | | | | | | |
| Commercial pipeline gas | Mtoe | | | | | | |
| Commercial liquid fossil fuels | Mtoe | | | | | | |
| Commercial coal and coal gas | Mtoe | | | | | | |
| Commercial solid biomass | Mtoe | | | | | | |
| **Transport inputs** | | | | | | | |
| **Passenger transport inputs** | | | | | | | |
| Total passenger kilometers traveled (PKT) | Gpkm | | | | | | |
| Passenger kilometers - Cars | Gpkm | | | | | | |
| Passenger kilometers - Road collective transports | Gpkm | | | | | | |
| Passenger kilometers - Air | Gpkm | | | | | | |
| Passenger kilometers - non motorized transports | Gpkm | | | | | | |
| Passenger transport final energy consumption | Mtoe | | | | | | |
| Passenger non-electricity CO2 emissions | MtCO2 | | | | | | |
| Passenger total CO2 emissions | MtCO2 | | | | | | |
| Passenger final electricity | TWh | | | | | | |
| Passenger non-electricity FEC | Mtoe | | | | | | |
| Passenger biofuels | Mtoe | | | | | | |
| Passenger liquid fossil fuel | Mtoe | | | | | | |
| Passenger natural gas | Mtoe | | | | | | |
| Passenger hydrogen | Mtoe | | | | | | |
| **Freight transport inputs** | | | | | | | |
| Freight movement | Gt-km | | | | | | |
| Freight movement - Road | Gt-km | | | | | | |
| Freight movement - Rail | Gt-km | | | | | | |
| Freight movement - Air | Gt-km | | | | | | |
| Freight transport final energy consumption | Mtoe | | | | | | |
| Freight non-electricity CO2 emissions | MtCO2 | | | | | | |
| Freight total CO2 emissions | MtCO2 | | | | | | |
| Freight final electricity | TWh | | | | | | |
| Freight non-electricity FEC | Mtoe | | | | | | |
| Freight biofuels | Mtoe | | | | | | |
| Freight liquid fossil fuel | Mtoe | | | | | | |
| Freight natural gas | Mtoe | | | | | | |
| Freight hydrogen | Mtoe | | | | | | |

| | |
|---|---|
| **Industry inputs** | |
| **Industry total inputs** | |
| **Industry value added** | **B 2005$PPP** |
| **Industry final energy consumption** | **Mtoe** |
| **Industry non-electricity CO2 emissions** | **MtCO2** |
| **Industry fugitive and process emissions** | **MtCO2** |
| **Industry total CO2 emissions** | **MtCO2** |
| **Industry final electricity** | **TWh** |
| **Industry non-electricity FEC** | **Mtoe** |
| **Industry steam** | **Mtoe** |
| **Industry coal** | **Mtoe** |
| **Industry coal w/ccs** | **Mtoe** |
| **Industry pipeline gas** | **Mtoe** |
| **Industry pipeline gas w/ccs** | **Mtoe** |
| **Industry liquid fossil fuels and other** | **Mtoe** |
| **Industry solid biomass** | **Mtoe** |
| **Industry biofuels** | **Mtoe** |
| **Industry sub-sectors inputs** | |
| **Cement or NMM value added** | **B 2005$PPP** |
| **Cement or NMM production** | **Mt** |
| **Cement or NMM final energy consumption** | **Mtoe** |
| **Cement or NMM non-electricity energy-related CO2 emissions** | **MtCO2** |
| **Cement or NMM final electricity** | **TWh** |
| **Iron & Steel value added** | **B 2005$PPP** |
| **Iron & Steel production** | **Mt** |
| **Iron & Steel final energy consumption** | **Mtoe** |
| **Iron & Steel non-electricity energy-related CO2 emissions** | **MtCO2** |
| **Iron & Steel final electricity** | **TWh** |
| **Mining value added** | **B 2005$PPP** |
| **Mining production** | **Mt** |
| **Mining final energy consumption** | **Mtoe** |
| **Mining non-electricity energy-related CO2 emissions** | **MtCO2** |
| **Mining final electricity** | **TWh** |
| **Non-Ferrous metals value added** | **B 2005$PPP** |
| **Non-Ferrous metals production** | **Mt** |
| **Non-Ferrous metals final energy consumption** | **Mtoe** |
| **Non-Ferrous metals non-electricity energy-related CO2 emissio** | **MtCO2** |
| **Non-Ferrous metals final electricity** | **TWh** |

| | |
|---|---|
| **Electricity inputs** | |
| **Power generation mix inputs** | |
| **Total power generation (electricity produced)** | **TWh** |
| *Final energy produced from conventional coal* | *TWh* |
| *in which coal with CCS* | *TWh* |
| *Final energy produced from conventional gas* | *TWh* |
| *in which gas with CCS* | *TWh* |
| *Final energy produced from conventional oil* | *TWh* |
| *in which oil with CCS* | *TWh* |
| *Final energy produced from nuclear* | *TWh* |
| *Final energy produced from solar PV* | *TWh* |
| *Final energy produced from CSP* | *TWh* |
| *Final energy produced from wind* | *TWh* |
| *in which wind on-shore* | *TWh* |
| *in which wind off-shore* | *TWh* |
| *Final energy produced from hydro* | *TWh* |
| *Final energy produced from biomass* | *TWh* |
| *Final energy produced from bio-CCS* | *TWh* |
| *Final energy produced from other* | *TWh* |

| | | |
|---|---|---|
| **Power generation sources (energy inputs)** | | |
| **Power generation sources (primary energy inputs)** | **Mtoe** | |
| *Power generation from conventional coal* | **Mtoe** | |
| *in which coal with CCS* | **Mtoe** | |
| *Power generation from conventional gas* | **Mtoe** | |
| *in which gas with CCS* | **Mtoe** | |
| *Power generation from conventional oil* | **Mtoe** | |
| *in which oil with CCS* | **Mtoe** | |
| *Power generation from nuclear* | **Mtoe** | |
| *Power generation from solar PV* | **Mtoe** | |
| *Power generation from CSP* | **Mtoe** | |
| *Power generation from wind* | **Mtoe** | |
| *in which wind on-shore* | **Mtoe** | |
| *in which wind off-shore* | **Mtoe** | |
| *Power generation from hydro* | **Mtoe** | |
| *Power generation from biomass* | **Mtoe** | |
| *Power generation from other* | **Mtoe** | |
| **Power generation CO2 emissions** | | |
| **Total CO2 emissions from power generation** | **MtCO2** | |
| *CO2 emissions from conventional coal* | *MtCO2* | |
| *in which coal with CCS* | *MtCO2* | |
| *CO2 emissions from conventional gas* | *MtCO2* | |
| *in which gas with CCS* | *MtCO2* | |
| *CO2 emissions from conventional oil* | *MtCO2* | |
| *in which oil with CCS* | *MtCO2* | |
| *CO2 emissions from others* | *MtCO2* | |

| | | |
|---|---|---|
| **Biogas penetration** | | |
| **Share of biogas in pipeline gas** | **%** | |