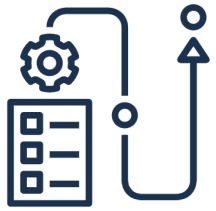
2° Investing Initiative

PACTA for Banks Training Webinar III

Analysis and Visualisation

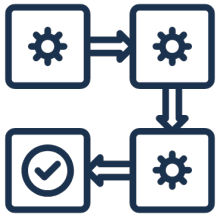
June, 2022

Agenda



Methodology recap

Matching process recap

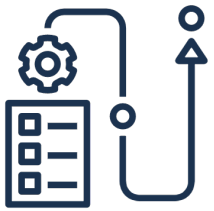


Analysis Workflow

Visualization

Final comments

Methodology *Recap*



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Methodology Recap

Corporate lending portfolios

Alignment of loan books is benchmarked against **climate change scenarios** and the **market**

Loans are mapped to the **physical assets** in **the real economy** and their corresponding **production values**

Climate Change Scenarios

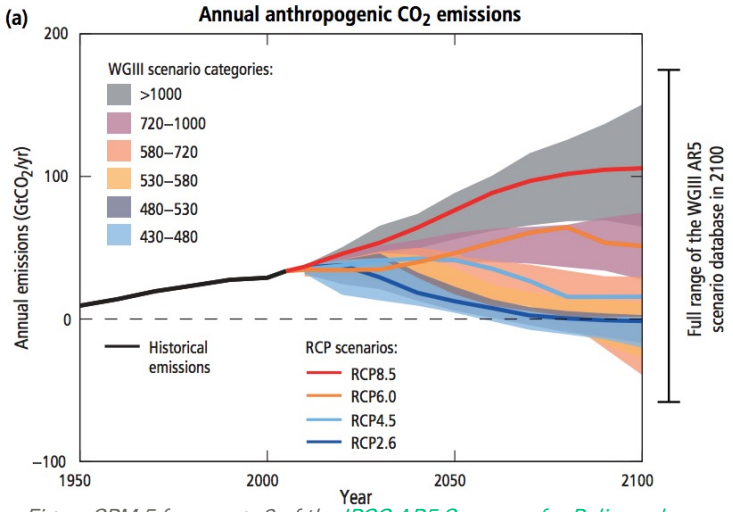
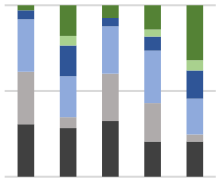
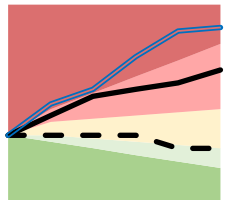


Figure SPM.5 from page 9 of the IPCC AR5 Summary for Policymakers:

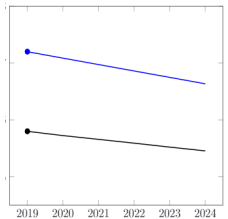
Metrics



- Technology mix



- Volume trajectory



- Emission Intensity

Physical Assets in the Real Economy

The Matching Process *Recap*

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The Matching Process Recap

- Step 1: Importing necessary files
  - Importing loan book
  - Importing Asset-Based Company-Level Data (ABCD)

```
# option 1
your_loanbook <- r2dii.data::loanbook_demo

your_abcd <- r2dii.data::abcd_demo


# option 2
your_loanbook <- readr::read_csv("…enter file path…/lbk.csv)


your_abcd <- readr::read_csv("…enter file path…/abcd.csv)
```

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The Matching Process Recap

- Step 2: Matching

```
# match lbk to abcd
match_file <- r2dii.match::match_name(your_loanbook, your_abcd)
```

  - Optional advanced matching

```
# match lbk to abcd
match_file <- r2dii.match::match_name(your_loanbook, your_abcd, by_sector == TRUE,
    min_score = 0.8, method = "jw", p = 0.1, overwrite = NULL)
```

min_score allows you to set the matching score threshold

method allows you to use different algorithms to determine the score of the matching

by_sector allows you to match any names irrespective of the sector classification

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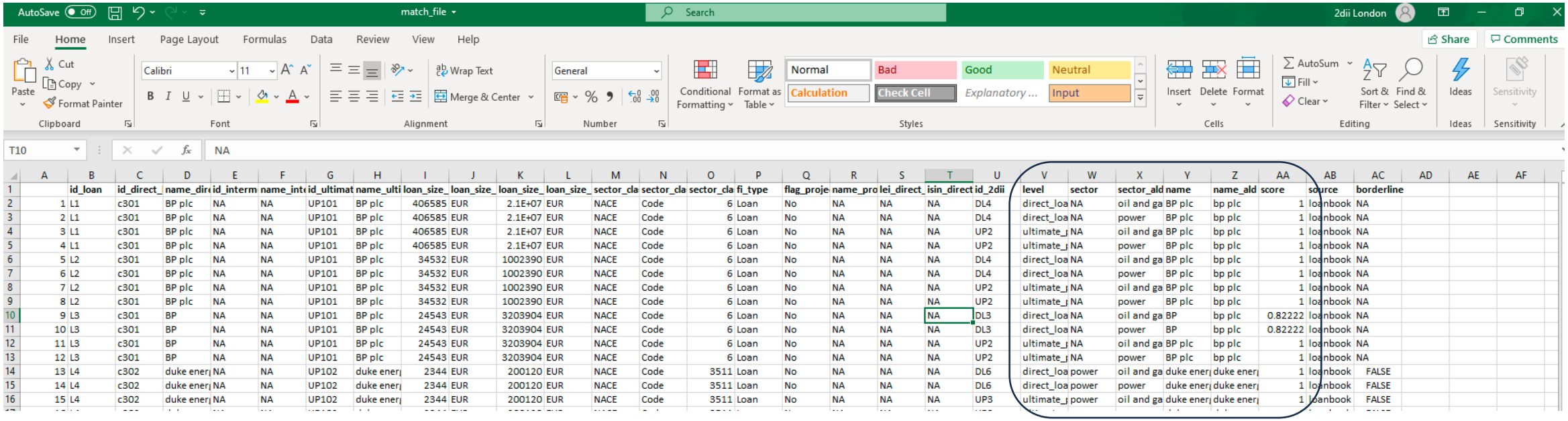
The Matching Process Recap

- Step 3: Manual matching
  - Export the “match_file from R to Excel,
  - Allocate 1 = match, 0 = no match to each loan in the score column

```
# export match_file to excel

write_csv(match_file, “…file path…/match_file.csv
```



	id_loan	id_direct_	name_dir	id_interm	name_int	id_ultimat	name_ulti	loan_size_	loan_size_	loan_size_	loan_size_	sector_cla	sector_cla	sector_cla	fi_type	flag_proje	name_pro	lei_direct_	isin_direct	id_2dii	level	sector	sector_ald	name	name_ald	score	source	borderline
1	L1	c301	BP plc	NA	NA	UP101	BP plc	406585	EUR	2.1E+07	EUR	NACE	Code	6	Loan	No	NA	NA	NA	DL4	direct_loa	NA	oil and ga	BP plc	bp plc	1	loanbook	NA
2	L1	c301	BP plc	NA	NA	UP101	BP plc	406585	EUR	2.1E+07	EUR	NACE	Code	6	Loan	No	NA	NA	NA	DL4	direct_loa	NA	power	BP plc	bp plc	1	loanbook	NA
3	L1	c301	BP plc	NA	NA	UP101	BP plc	406585	EUR	2.1E+07	EUR	NACE	Code	6	Loan	No	NA	NA	NA	UP2	ultimate_	NA	oil and ga	BP plc	bp plc	1	loanbook	NA
4	L1	c301	BP plc	NA	NA	UP101	BP plc	406585	EUR	2.1E+07	EUR	NACE	Code	6	Loan	No	NA	NA	NA	UP2	ultimate_	NA	power	BP plc	bp plc	1	loanbook	NA
5	L2	c301	BP plc	NA	NA	UP101	BP plc	34532	EUR	1002390	EUR	NACE	Code	6	Loan	No	NA	NA	NA	DL4	direct_loa	NA	oil and ga	BP plc	bp plc	1	loanbook	NA
6	L2	c301	BP plc	NA	NA	UP101	BP plc	34532	EUR	1002390	EUR	NACE	Code	6	Loan	No	NA	NA	NA	DL4	direct_loa	NA	power	BP plc	bp plc	1	loanbook	NA
7	L2	c301	BP plc	NA	NA	UP101	BP plc	34532	EUR	1002390	EUR	NACE	Code	6	Loan	No	NA	NA	NA	UP2	ultimate_	NA	oil and ga	BP plc	bp plc	1	loanbook	NA
8	L2	c301	BP plc	NA	NA	UP101	BP plc	34532	EUR	1002390	EUR	NACE	Code	6	Loan	No	NA	NA	NA	UP2	ultimate_	NA	power	BP plc	bp plc	1	loanbook	NA
9	L3	c301	BP	NA	NA	UP101	BP plc	24543	EUR	3203904	EUR	NACE	Code	6	Loan	No	NA	NA	NA	DL3	direct_loa	NA	oil and ga	BP	bp plc	0.82222	loanbook	NA
10	L3	c301	BP	NA	NA	UP101	BP plc	24543	EUR	3203904	EUR	NACE	Code	6	Loan	No	NA	NA	NA	DL3	direct_loa	NA	power	BP	bp plc	0.82222	loanbook	NA
11	L3	c301	BP	NA	NA	UP101	BP plc	24543	EUR	3203904	EUR	NACE	Code	6	Loan	No	NA	NA	NA	UP2	ultimate_	NA	oil and ga	BP plc	bp plc	1	loanbook	NA
12	L3	c301	BP	NA	NA	UP101	BP plc	24543	EUR	3203904	EUR	NACE	Code	6	Loan	No	NA	NA	NA	UP2	ultimate_	NA	power	BP plc	bp plc	1	loanbook	NA
13	L4	c302	duke ener	NA	NA	UP102	duke ener	2344	EUR	200120	EUR	NACE	Code	3511	Loan	No	NA	NA	NA	DL6	direct_loa	power	oil and ga	duke ener	duke ener	1	loanbook	FALSE
14	L4	c302	duke ener	NA	NA	UP102	duke ener	2344	EUR	200120	EUR	NACE	Code	3511	Loan	No	NA	NA	NA	DL6	direct_loa	power	power	duke ener	duke ener	1	loanbook	FALSE
15	L4	c302	duke ener	NA	NA	UP102	duke ener	2344	EUR	200120	EUR	NACE	Code	3511	Loan	No	NA	NA	NA	UP3	ultimate_	power	oil and ga	duke ener	duke ener	1	loanbook	FALSE

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The Matching Process Recap

- Step 4 (optional): Overwrite file
- Step 5: Prioritize matches
  - Read the “matched_file” file back into R

```
matched_file_ready <- readr::read_csv("…enter file path…/matched_file_ready.csv)
```

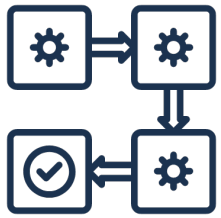
  - The prioritize function selects the best match for the loan at the Direct Loan Taker level, when found. Otherwise the Ultimate Parent is used.

```
loanbook_demo_ready <- r2dii.match::prioritize(matched_file_ready)
```

  - If instead, you would like the production values of the Ultimate Parent:

```
loanbook_demo_ready <- r2dii.match::prioritize(matched_file_ready, priority = rev)
```

Analysis Workflow



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Analysis Workflow

- Step 1: Importing and loading necessary files and tables
  - Importing scenarios
  - Loading regions

```
# scenario data for fossil fuel, power and automotive sectors
scenario_isf_nz <-
    read_csv("…file path…/ISF-NZ-2020-Fossil-Fule-Power.csv")

scenario_nz_iea <-
    read_csv("…file path…/NZ-IEA-2021-Fossil-Fuel-Power-Auto.csv")

scenario_weo_2019 <-
    read_csv("…file_path…/WEO-2019-ETP-2017-Fossil-Fuel-Power-Auto.csv")

scenario_weo_2020 <-
    read_csv("…file path…/WEO-2020-Fossil-Fuel-Power.csv")
```

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Analysis Workflow

- Step 1: Importing and loading necessary files and tables
  - Importing scenarios
  - Loading regions

```
# scenario data for cement, steel and aviation sectors

scenario_etp_2017_co2 <-

    read_csv("…file path…/ETP-2017-CO2-Intensity-for-Steel-Cement.csv")

scenario_isf_nz_co2 <-

    read_csv("…file path…/ISF-NZ-2020-CO2-Intensity-for-Steel-Cement-and-
Aviation.csv")


# regions

regions <- r2dii.data::region_isos
```

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Analysis Workflow

- Step 2: Calculate targets

Attributing macro carbon budgets to micro-economic actors

- Step 2.1.: Market share approach
  - The target set out by the scenario will be met collectively, with all the players responsible for their market share within the sector
  - Market share is calculated as the companies' share of the sector's total production in a given technology

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Analysis Workflow

- Step 2: Calculate targets
- Step 2.1.: Market share approach
  - At portfolio level:

```
market_share_targets_portfolio <- lbk_ready %>% target_market_share(
    abcd = abcd, scenario = scenario, region_isos = regions)
```

  - Optional to use credit_limit

```
market_share_targets_portfolio <- lbk_ready %>% target_market_share(
    abcd = abcd, scenario = scenario, region_isos = regions, use_credit_limit = TRUE,
    weight_production = TRUE)
```

Production is weighted by relative loan-size

Use loan_size_credit_limit instead of loan_size_outstanding

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Analysis Workflow

- Step 2: Calculate targets
- Step 2.1.: Market share approach
  - At company level:

```
market_share_targets_portfolio_company <- lbk_ready %>% target_market_share(
    abcd = abcd, scenario = scenario, region_isos = regions, by_company = TRUE,
    weight_production = FALSE)
```

How the results should look like:

sector	technology	year	region	scenario_source	metric	production	technology_share
power	coalcap	2020	global	demo_2020	projected	22283.679	0.12873655
power	coalcap	2020	global	demo_2020	corporate_economy	3581944.526	0.37427497
power	coalcap	2020	global	demo_2020	target_cps	22283.679	0.38410394
power	coalcap	2020	global	demo_2020	target_sds	22283.679	0.38410394
power	coalcap	2020	global	demo_2020	target_sps	22283.679	0.38410394
power	coalcap	2021	global	demo_2020	projected	22461.950	0.12875337
power	coalcap	2021	global	demo_2020	corporate_economy	3582775.094	0.36982845
power	coalcap	2021	global	demo_2020	target_cps	21999.210	0.37576589
power	coalcap	2021	global	demo_2020	target_sds	21709.413	0.36991330
power	coalcap	2021	global	demo_2020	target_sps	21894.950	0.37380315
power	coalcap	2022	global	demo_2020	projected	22640.220	0.12877104
power	coalcap	2022	global	demo_2020	corporate_economy	3583605.662	0.36914436
power	coalcap	2022	global	demo_2020	target_cps	21714.742	0.36757753
power	coalcap	2022	global	demo_2020	target_sds	21135.148	0.35604449
power	coalcap	2022	global	demo_2020	target_sps	21506.220	0.36369703
power	coalcap	2023	global	demo_2020	projected	22818.491	0.12878954
power	coalcap	2023	global	demo_2020	corporate_economy	3584436.230	0.36459286
power	coalcap	2023	global	demo_2020	target_cps	21430.274	0.35953487
power	coalcap	2023	global	demo_2020	target_sds	20560.883	0.34248669
power	coalcap	2023	global	demo_2020	target_sps	21117.491	0.35378012
power	coalcap	2024	global	demo_2020	projected	22996.762	0.12880884
power	coalcap	2024	global	demo_2020	corporate_economy	3585266.798	0.36442687
power	coalcap	2024	global	demo_2020	target_cps	21145.806	0.35163405
power	coalcap	2024	global	demo_2020	target_sds	19986.617	0.32922955
power	coalcap	2024	global	demo_2020	target_sps	20728.762	0.34404715
power	coalcap	2025	global	demo_2020	projected	20340.087	0.11722732
power	coalcap	2025	global	demo_2020	corporate_economy	3586097.366	0.37383549
power	coalcap	2025	global	demo_2020	target_cps	20861.337	0.34387135
power	coalcap	2025	global	demo_2020	target_sds	19412.352	0.31626318
power	coalcap	2025	global	demo_2020	target_sps	20340.033	0.33449305
power	coalcap	2026	global	demo_2020	projected	20486.606	0.11724816

sectors: power, oil and gas, automotive

technologies: vary depending on the sector

year: 2020 - 2040

region: vary depending on the scenario used

scenario_source: vary depending on the scenario used

metrics: projected, targets, and corporate_economy

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Analysis Workflow

- Step 2: Calculate targets

  Attributing macro carbon budgets to micro-economic actors

- Step 2.2.: Sectoral decarbonisation approach

  - All portfolio intensity targets will converge to equal the sector intensity target at the end of the date prescribed by the scenario

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Analysis Workflow

- Step 2: Calculate targets
- Step 2.2.: Sectoral decarbonisation approach
  - At portfolio level:

```
sda_targets_portfolio <- lbk_ready %>% target_sda(
    abcd = abcd, co2_intensity_scenario = scenario, region_isos = regions)
```

  - Optional to use credit_limit

```
sda_targets_portfolio <- lbk_ready %>% target_sda(
    abcd = abcd, co2_intensity_scenario = scenario, region_isos = regions,
    use_credit_limit = TRUE)
```

Use loan_size_credit_limit
instead of loan_size_outstanding

How the results should look like:

sector	year	emission_factor_metric	emission_factor_value
cement	2020	projected	0.66431197
cement	2020	corporate_economy	0.66929376
cement	2020	target_demo	0.66431197
cement	2020	adjusted_scenario_demo	0.66141222
cement	2021	projected	0.66522074
cement	2021	corporate_economy	0.67027667
cement	2021	target_demo	0.60732952
cement	2021	adjusted_scenario_demo	0.60471975
cement	2022	projected	0.66612950
cement	2022	corporate_economy	0.67122370
cement	2022	target_demo	0.55034707
cement	2022	adjusted_scenario_demo	0.54802727
cement	2023	projected	0.66703827
cement	2023	corporate_economy	0.67213482
cement	2023	target_demo	0.49336461
cement	2023	adjusted_scenario_demo	0.49133479
cement	2024	projected	0.66794704
cement	2024	corporate_economy	0.67300999
cement	2024	target_demo	0.43638216
cement	2024	adjusted_scenario_demo	0.43464232
cement	2025	projected	0.66885581
cement	2025	corporate_economy	0.67384917
cement	2025	target_demo	0.37939971
cement	2025	adjusted_scenario_demo	0.37794984

sectors:
cement, steel
and aviation

year:
2020 – 2025 are used,
2013 – 2050 is extra

emission_factor_metric:
projected,
corporate_economy,
target_**b2ds**,
adjusted_scenario_**b2ds**

Visualisation

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Visualisation

- Set up
  - Installing packages

```
# installation
install.packages("r2dii.plot") / library("r2dii.plot")


# other packages that go well with r2dii.plot
install.packages(ggplot2) / library(ggplot2)
install.packages(dplyr) / library(dplyr)
```

  - Making sure your data has a similar structure to that of the demo datasets

```
loanbook <- loanbook_demo
abcd <- abcd_demo
scenario <- co2_intensity_scenario_demo
region <- region_isos_demo
```

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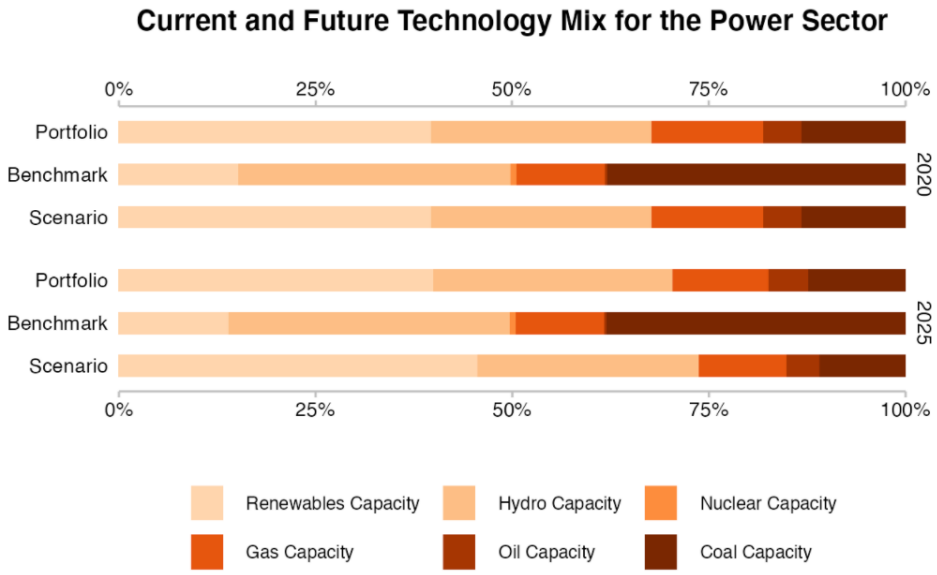
Visualisation

- Sector level technology mix

```
market_share_targets_portfolio %>%
    subset(
      sector == "power" &
      region == "global" &
      scenario_source == "scenario_source" &
      metric %in%
        c("projected", "corporate_economy", "target_sds")
    ) %>%
    qplot_techmix()
```



- Various sectors
- Various regions

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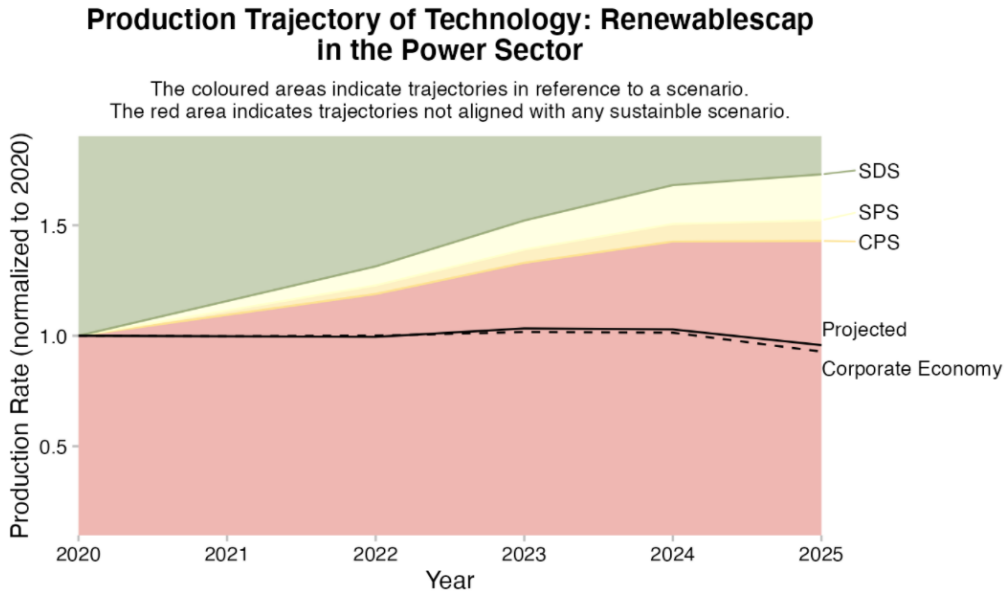
Visualisation

- Technology level volume trajectory

```
market_share_targets_portfolio %>%
    subset(
      technology == "renewablescap" &
      region == "global" &
      scenario_source == "scenario_source"
    ) %>%
    qplot_trajectory()
```



- Various technologies
- Various regions

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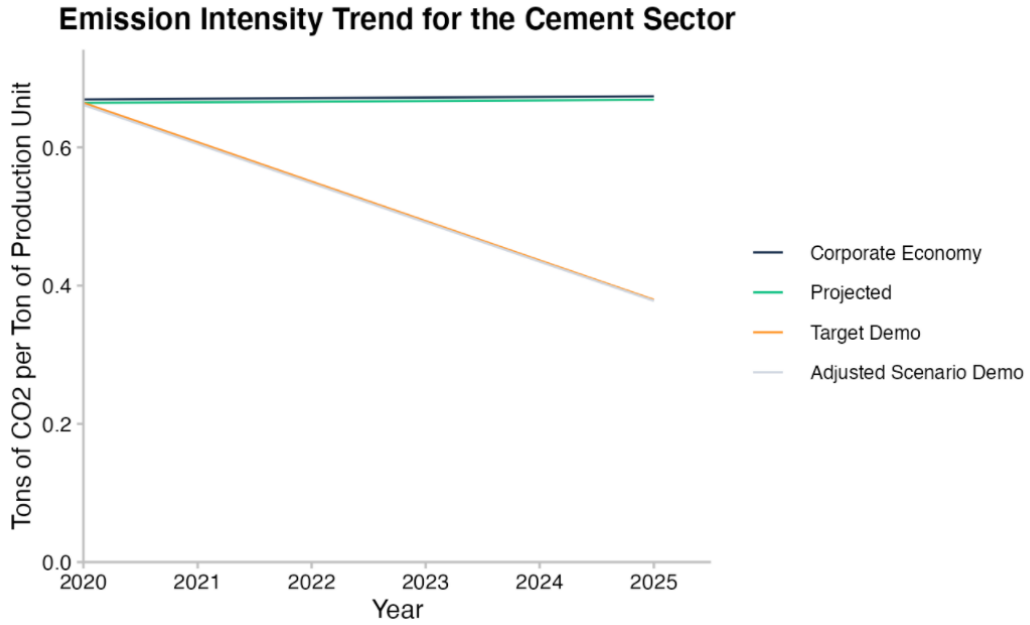
Visualisation

- SDA target

```
sda_targets_portfolio %>%
   subset(
      sector == ”cement" &
      region == "global” &
      scenario_source == "scenario_source”
    ) %>%
    qplot_emission_intensity()
```



- Various sectors

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Visualisation

- Sector level technology mix by company

```
results_yukon <- market_share_targets_portfolio_company %>%
    filter(name_abcd == "yukon development corp”)


results_yukon %>%
    subset(
      sector == "power" &
      region == "global" &
      scenario_source == " scenario_source" &
      metric %in%
        c("projected", "corporate_economy", "target_sds")
    ) %>%
    qplot_techmix()
```

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Visualisation

- Technology level volume trajectory by company

```
results_yukon <- market_share_targets_portfolio_company %>%
    filter(name_abcd == "yukon development corp”)


results_yukon %>%
    subset(
      technology == "renewablescap" &
      region == "global” &
      scenario_source == " scenario_source”
    ) %>%
    qplot_trajectory()
```

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More on Visualisation

Plots can be customised in three ways:

1. Use parameters of plot_*() function
2. Modify the input data
3. Use “ggplot2” functions.

Some typical options are:

- Change the time span.
- Add custom labels by modifying the column ‘metric’ and technology of the results data.
- Add a title and a subtitle.
- Change x and y axis labels.
- Customize the colours and legend labels with ggplot2::scale_colour_manual() or r2dii.plot::scale_*() functions

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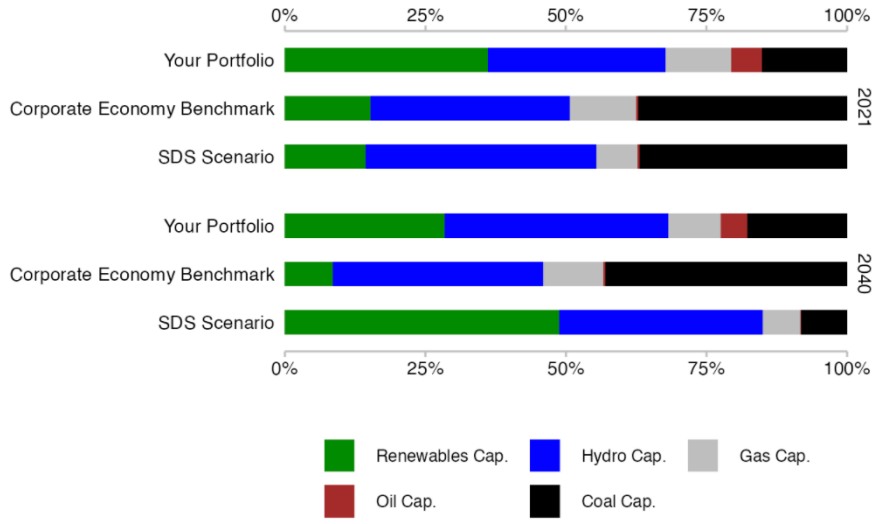
More on Visualisation

- Sector level technology mix

```
data <- market_share %>%
  filter(
    metric %in% c("projected", "corporate_economy", "target_sds"),
    sector == "power",
    region == "global",
    year >= 2021,
    year <= 2040) %>% # custom time range
  mutate(
    label = case_when(
      metric == "projected" ~ "Your Portfolio",
      metric == "corporate_economy" ~ "Corporate Economy Benchmark",
      metric == "target_sds" ~ "SDS Scenario"))


plot_techmix(data) +
  scale_fill_manual(
    values = c("black", "brown", "grey", "yellow", "blue", "green4"),
    labels = paste(c("Coal", "Oil", "Gas", "Nuclear", "Hydro", "Renewables"), "Cap."))
```



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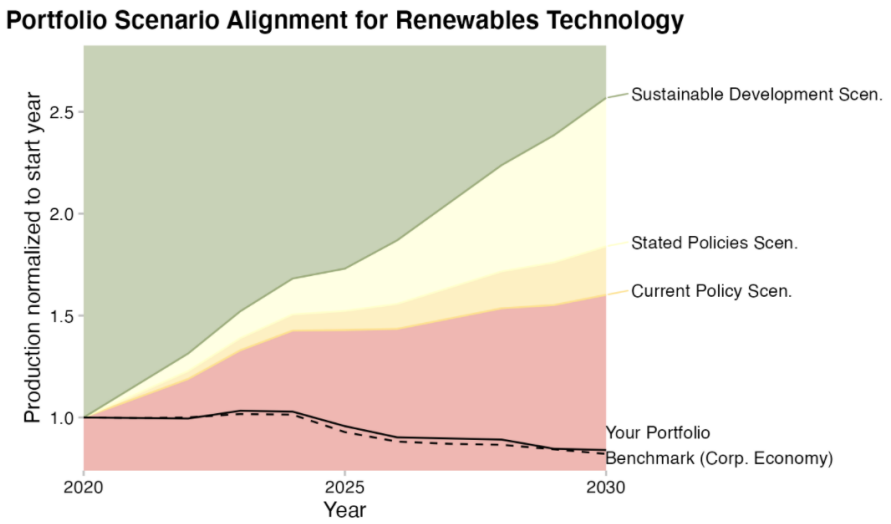
More on Visualisation

- Technology level volume trajectory

```
data <- matched %>%
  target_market_share(ald, scenario = scenario_demo_2020, region_isos = region) %>%
  filter(
    technology == "renewablescap",
    region == "global",
    year <= 2030) %>%
  mutate(
    label = case_when(
      metric == "projected" ~ "Your Portfolio",
      metric == "corporate_economy" ~ "Benchmark (Corp. Economy)",
      metric == "target_sds" ~ "Sustainable Development Scen.",
      metric == "target_sps" ~ "Stated Policies Scen.",
      metric == "target_cps" ~ "Current Policy Scen.",
      TRUE ~ metric))
plot_trajectory(data) +
  scale_x_continuous(n.breaks = 3) +
  labs(
    title = "Portfolio Scenario Alignment for Renewables Technology",
    x = "Year",
    y = "Production normalized to start year") +
  theme(plot.margin = unit(c(0.5, 6, 0.5, 1), "cm"))
```



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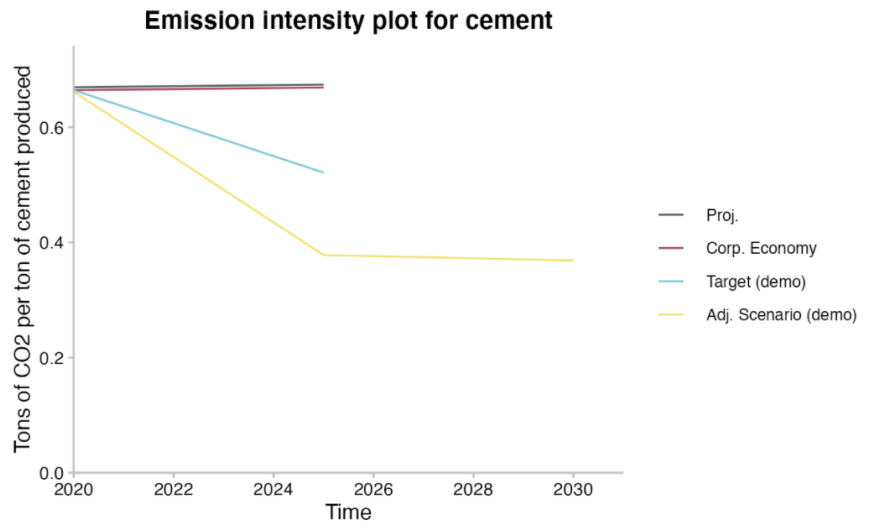
More on Visualisation

- SDA target

```
data <- sda %>%
  filter(
    sector == "cement",
    year <= 2030)


plot_emission_intensity(data) +
  labs(
    title = "Emission intensity plot for cement",
    x = "Time",
    y = "Tons of CO2 per ton of cement produced") +
  scale_color_manual(
    values = c("#4a5e54", "#a63d57", "#78c4d6", "#f2e06e"),
    labels = c("Proj.", "Corp. Economy", "Target (demo)", "Adj. Scenario (demo)"))
```



Final comments

Final comments

- This Webinar is the final on a series of three published webinars for the implementation of PACTA for Banks.

- All relevant PACTA for Banks information is published in the Capital Transition Monitor website:
  - https://www.transitionmonitor.com/pacta-for-banks-2020/

- Documentation of the packages funtionalities is also available online.

- If you have any questions, please do not hesitate to contact us by writing an email to any of these emails:
  - banks@2degrees-investing.org
  - contact@2degress-investing.org

Thank you for your attention.