



CARBON RISK REAL ESTATE MONITOR

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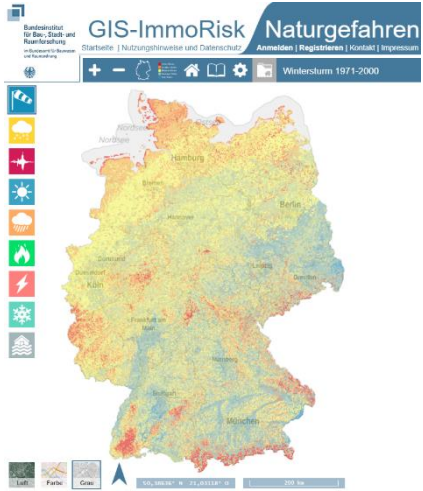
HEAD OF RESEARCH | IIÖ INSTITUTE FOR REAL ESTATE ECONOMICS

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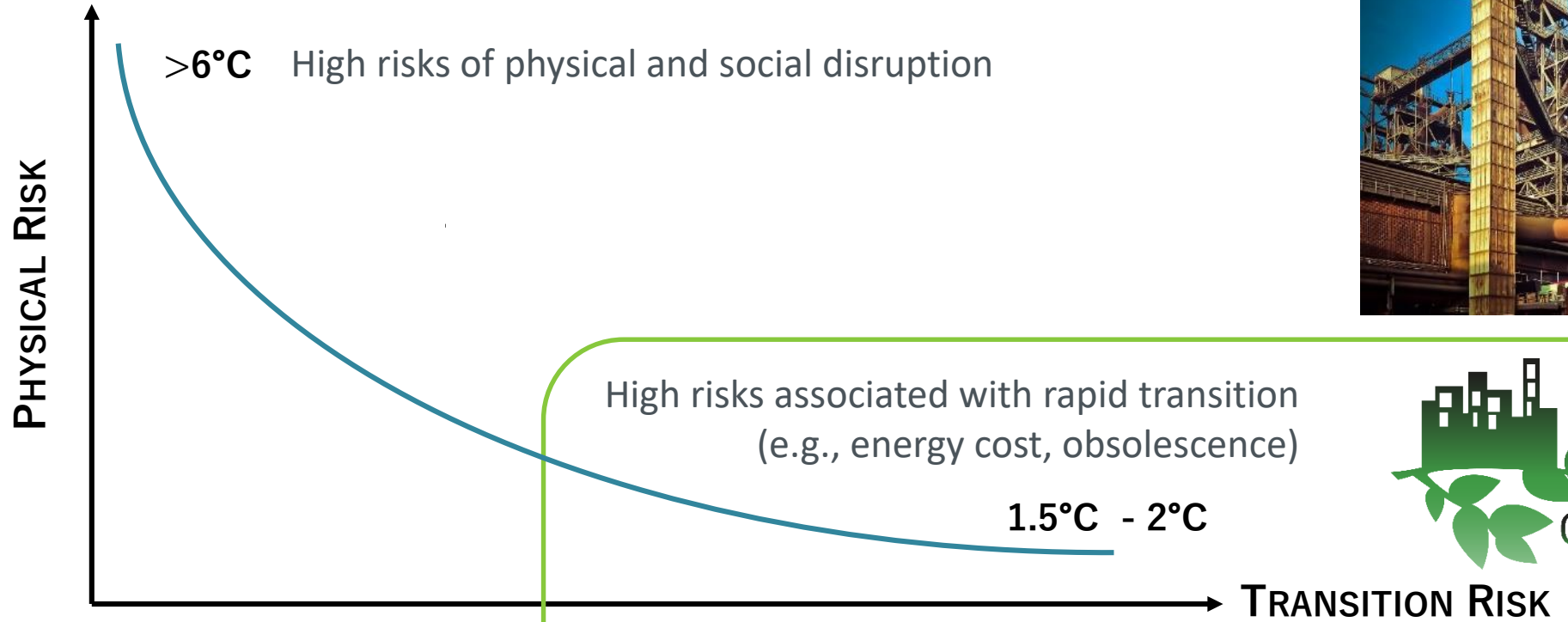
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PHYSICAL RISK + TRANSITION RISK



“STRANDED ASSETS are properties that will be exposed to the risk of early economic obsolescence due to climate change because they will not meet future regulatory efficiency standards or market expectations.” (CRREM, 2019)

Source: TCFD Technical Supplement, 2017

Climate science: Climate impact and carbon emission budgets/pathways compatible with limiting global warming to $x.x^{\circ}\text{C}$



Politics: Commitment to limit global warming to 2°C or better 1.5°C



New mandatory and voluntary requirements to (sustainable) finance & carbon risk



CARBON RISK REAL ESTATE MONITOR

CRREM pathways

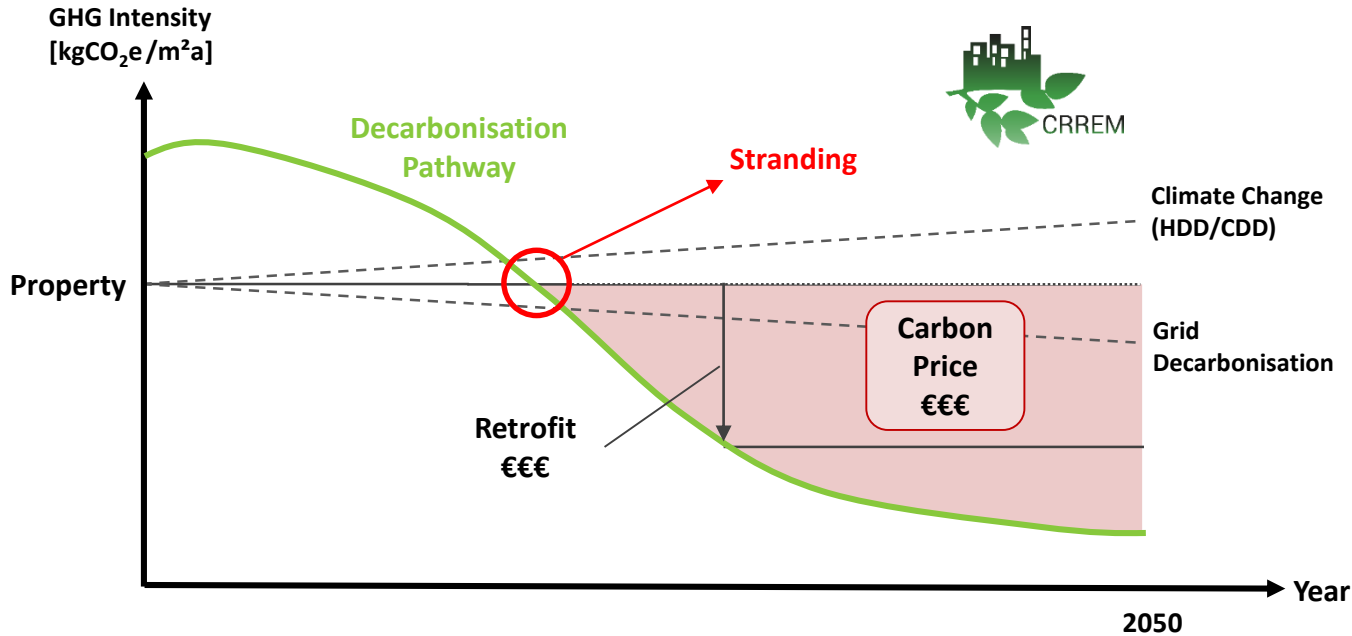
- Paris-aligned decarbonisation & energy reduction pathways
- Per country and building type

CRREM Tool

- Assess the carbon and energy performance of buildings and portfolios
- Benchmark against CRREM pathways and peers
- Derive indicators for risk management, reporting, disclosure

CARBON RISK ASSESSMENT & MANAGEMENT BASED ON QUANTITATIVE PERFORMANCE DATA AND TARGET SETTING

CRREM STRANDING DIAGRAM



DECARBONISATION PATHWAYS

Aligned with 1.5°C and 2°C global warming, country- and building type specific

+

BUILDING'S CARBON PERFORMANCE

Energy consumption, carbon emission factors, grid decarbonisation), changed heating and cooling demand, normalisation

=

CARBON RISK ANALYSIS

Year of stranding, excess emissions, carbon costs, energy costs, benchmarking

CRREM DOWNSCALING: FROM GLOBAL EMISSIONS TO CARBON INTENSITY PATHWAYS

DOWNSCALING

Global GHG budget and emissions pathway (consistent with a certain amount of global warming)



EU emission pathway (convergence of per capita emissions until 2050)



EU commercial real estate (CRE) sector



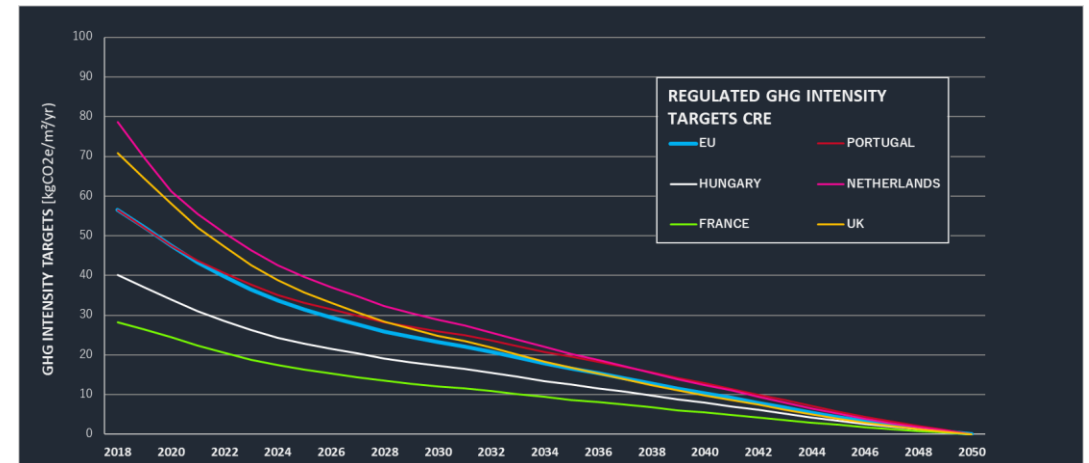
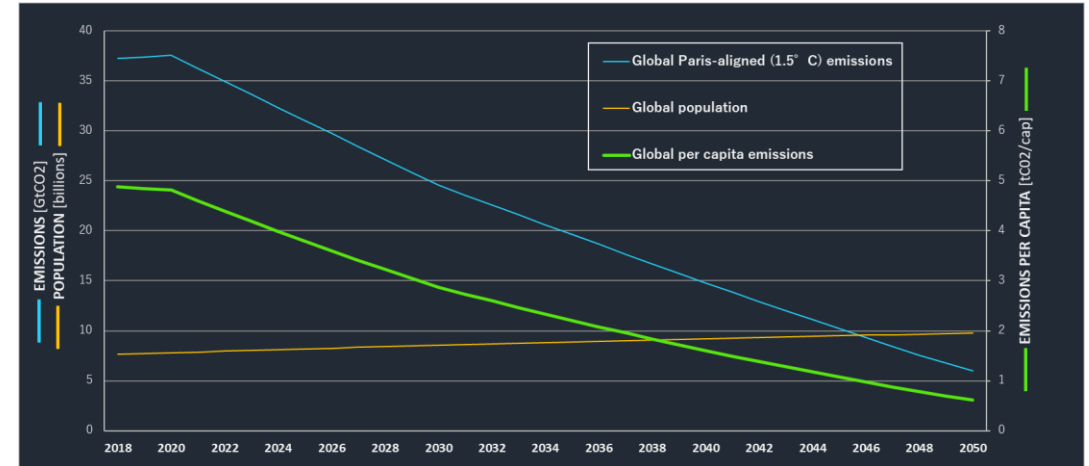
Country-specific targets (convergence of GHG intensity)



Sector-specific GHG targets for each country



Energy reduction pathway

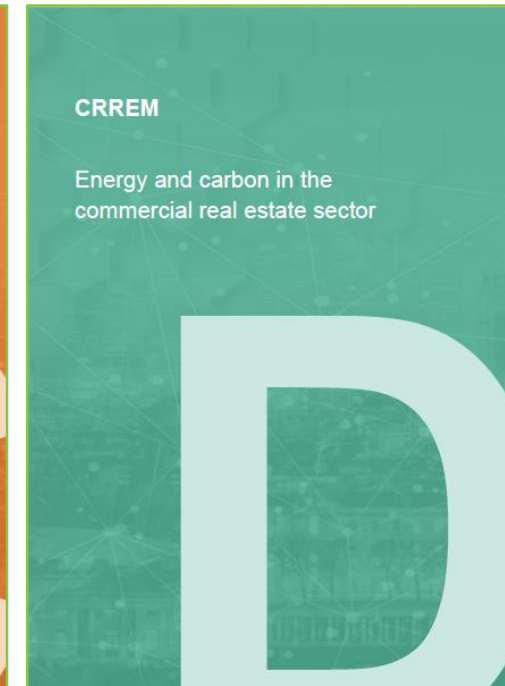
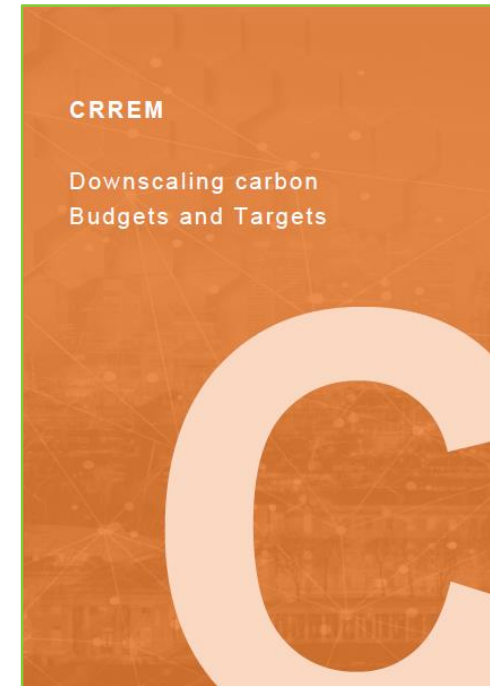
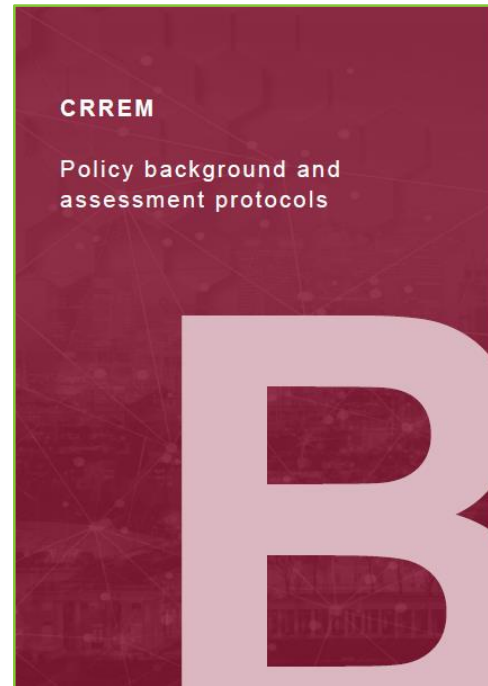
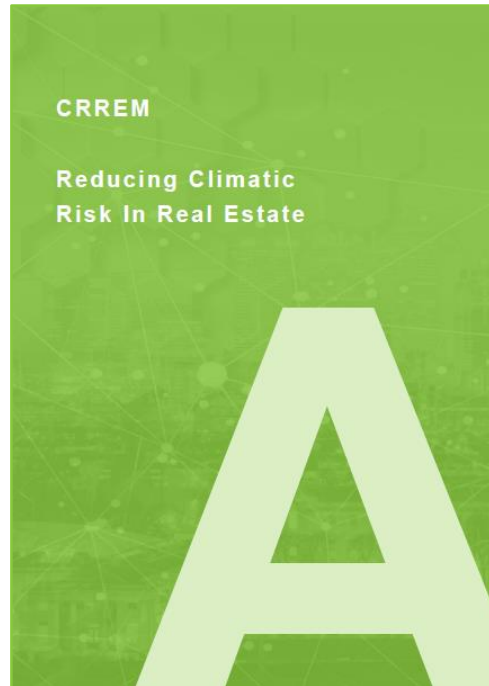


STRANDING RISKS & CARBON

available on
www.CRREM.eu

Science-based decarbonising of the EU commercial real estate sector

available on
www.CRREM.eu

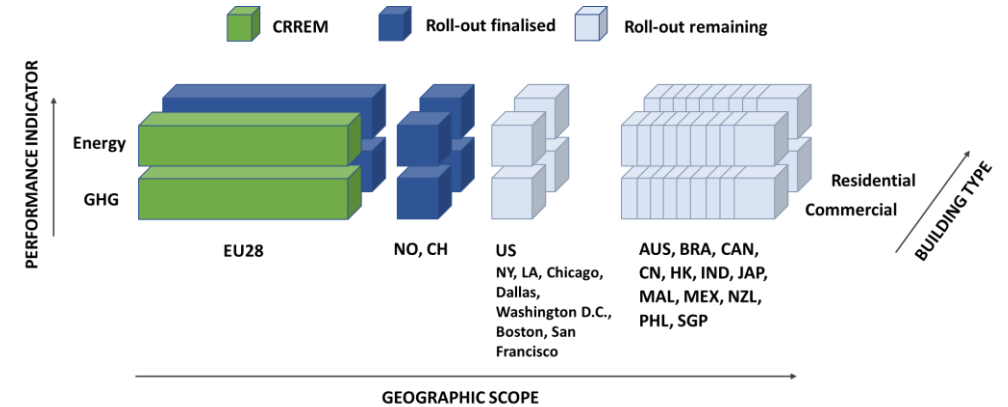


STATUS QUO:

- PILOT TESTING WITH MEMBERS OF CRREM EUROPEAN INVESTOR COMMITTEE (FURTHER PILOT TESTERS ON REQUEST): 01/2020
- INCORPORATION OF EIC PILOT TEST FEEDBACK: 02/2020
- FINAL TESTING WITH FURTHER TESTERS: 03/2020
- PUBLICATION OF PATHWAYS AND TOOL ON www.crrem.eu: 04/2020

RECENT EXTENSION OF SCOPE THANKS TO FUNDING BY 3 MAJOR GLOBAL INVESTORS

- PATHWAYS FOR RESIDENTIAL BUILDINGS AND FURTHER COUNTRIES BEYOND THE EU28
- PUBLIC CONSULTATION: 02/2020
- PUBLICATION OF PATHWAYS: 04/2020

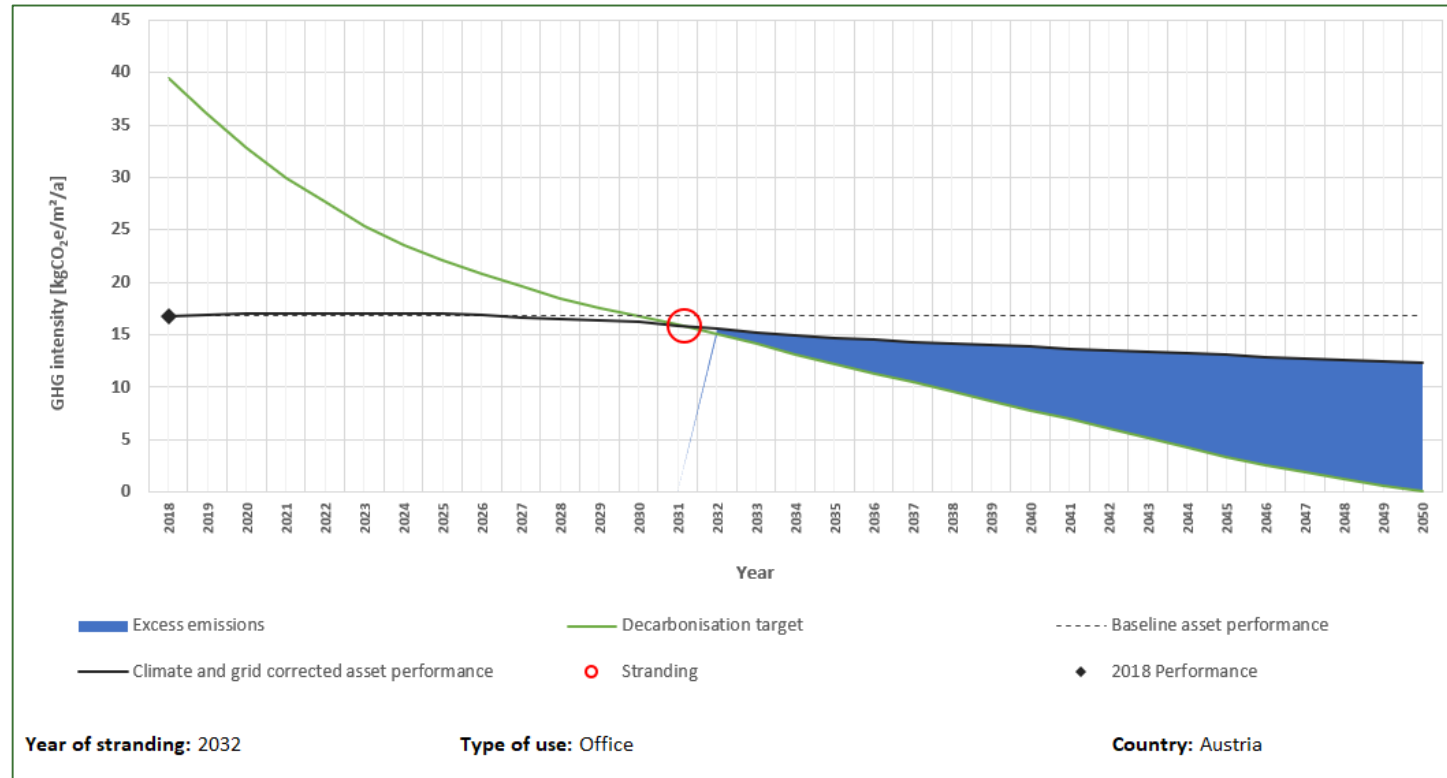


INTENDEND EXTENSION OF SCOPE:

- FURTHER REGIONAL EXTENSION OF PATHWAYS (WITH REGIONAL INITIATIVES)
- PATHWAYS FOR FURTHER PROPERTY TYPES (E.G. INFRASTRUCTURE)
- EXTENSION OF CRREM TOOL BEYOND EU COMMERCIAL REAL ESTATE
- REFINEMENT OF CRREM TOOL FUNCTIONALITY (ABATEMENT COSTS, EMBODIED CARBON, ONLINE TOOL...)

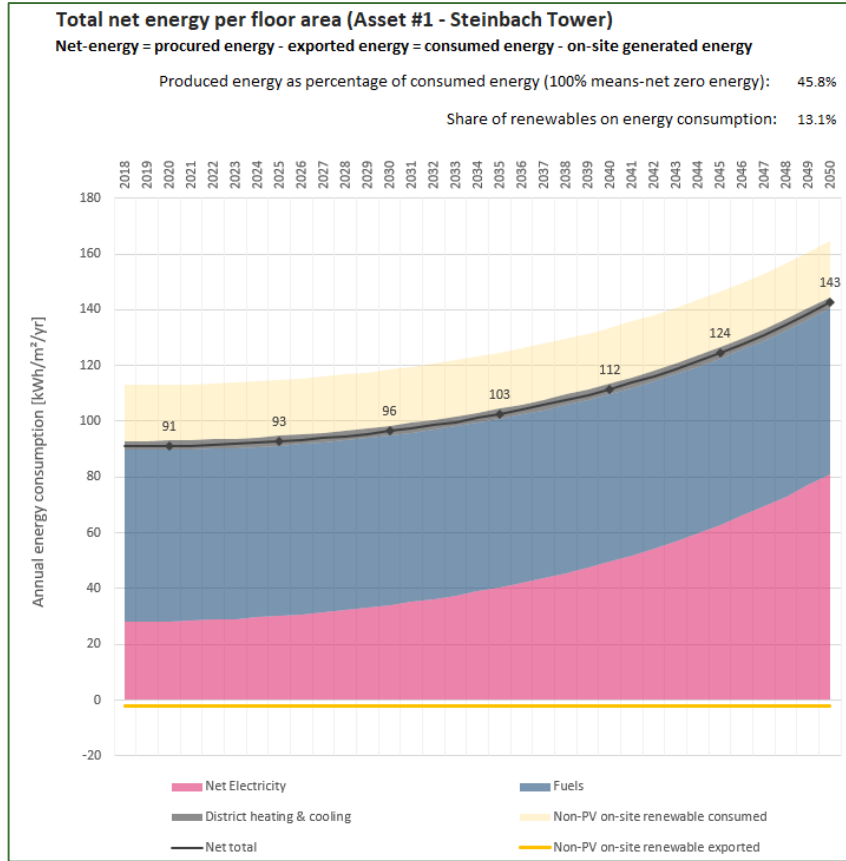
QUANTITATIVE CARBON PERFORMANCE AND RISK INDICATORS: ASSET LEVEL

CRREM TOOL STRANDING DIAGRAM

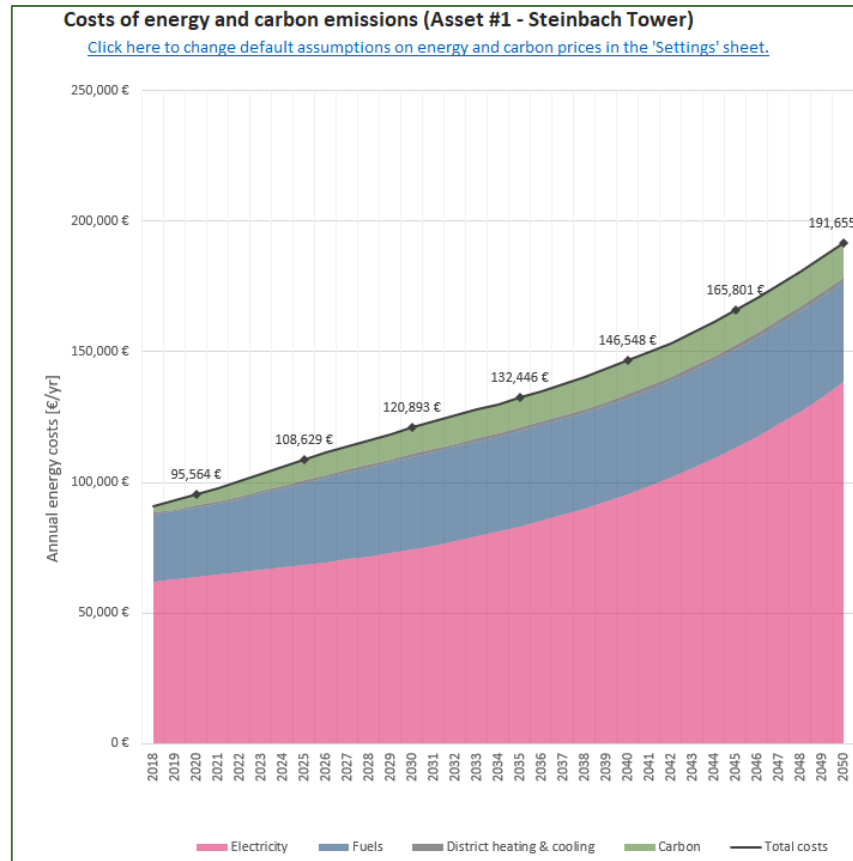


QUANTITATIVE CARBON PERFORMANCE AND RISK INDICATORS: ASSET LEVEL

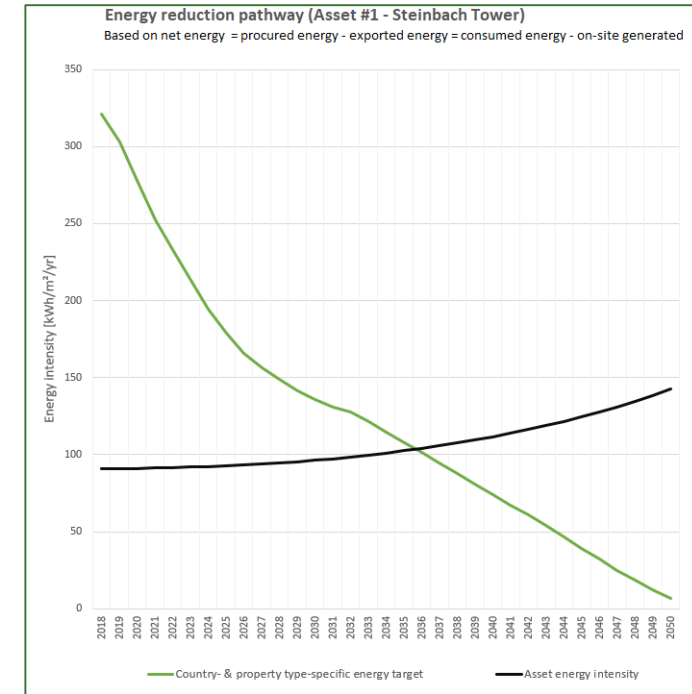
ENERGY CONSUMPTION



COSTS OF ENERGY AND CARBON



ENERGY REDUCTION PATHWAYS



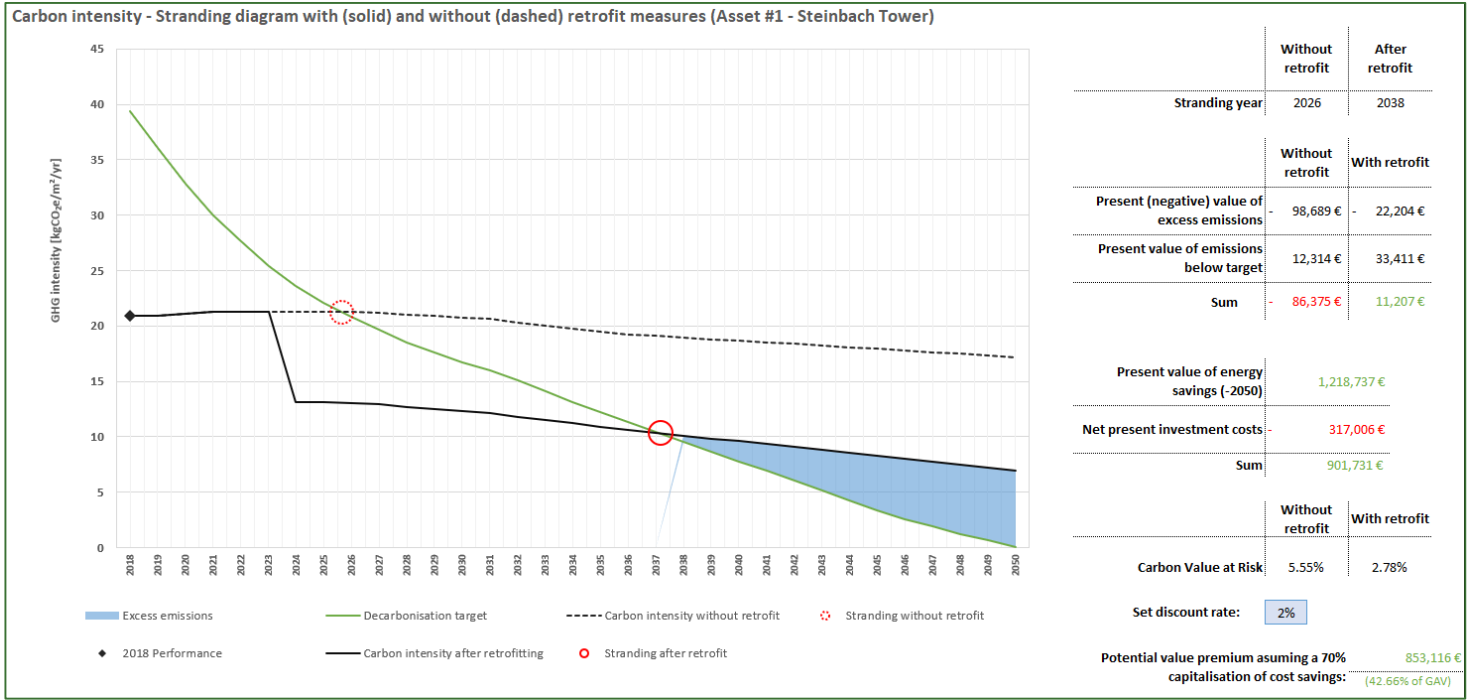
Energy targets based on country-specific sector-wide emission factor reflecting energy mix and evolving grid decarbonisation

Based on (optionally) normalised baseline consumption and projected data considering changed heating and cooling demand

Based on energy and carbon price projections (IEA, EU etc.)

QUANTITATIVE CARBON PERFORMANCE AND RISK INDICATORS: ASSET LEVEL

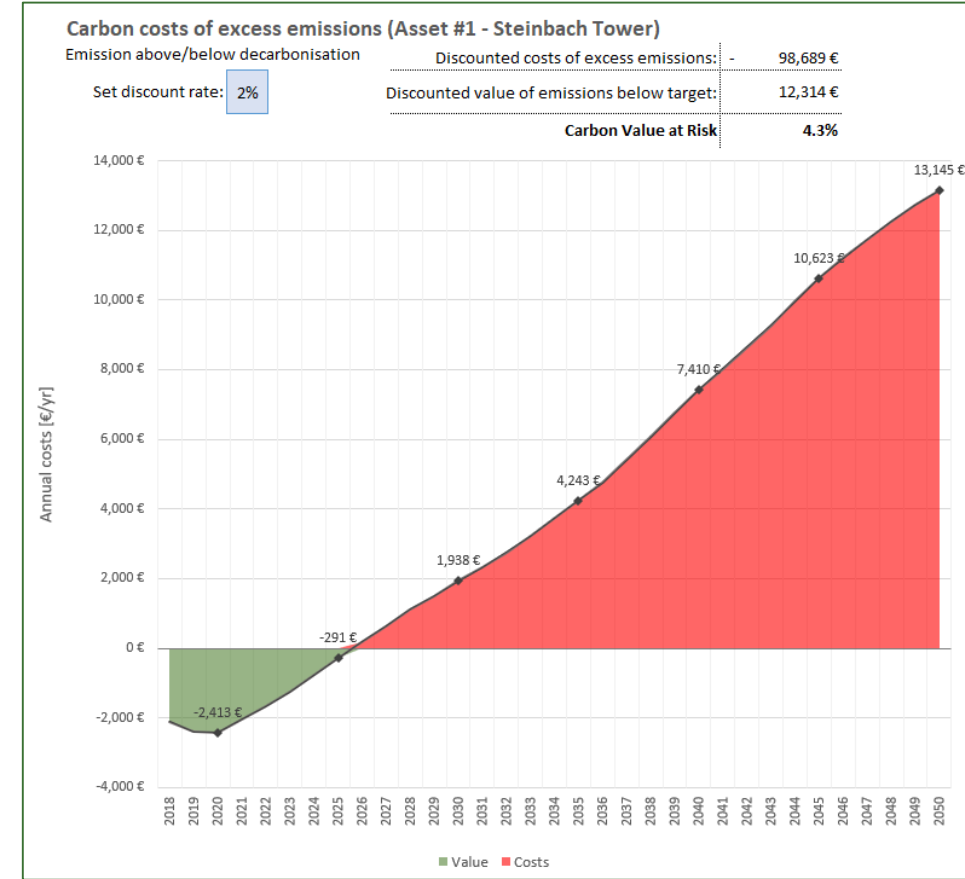
EFFECT OF POTENTIAL RETROFIT MEASURES



Based on marginal abatement costs curves.

Model the effect of retrofit measures on key carbon risk indicators.

COSTS OF EXCESS EMISSIONS ABOVE TARGET



Analogous to the NY City model with penalties for each ton of emission above emission limit (and possibility of trading emission credits)

QUANTITATIVE CARBON PERFORMANCE AND RISK INDICATORS: PORTFOLIO LEVEL

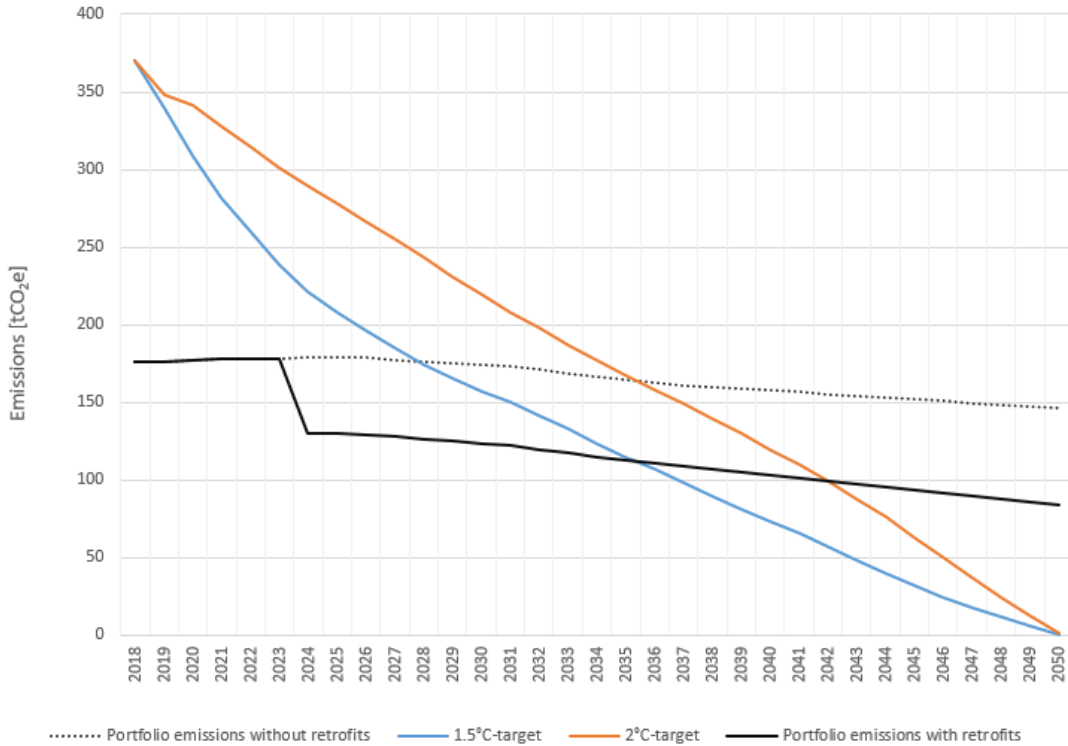
AGGREGATED RESULTS. TOTAL PORTFOLIO OR FILTERED BY COUNTRY, PROPERTY TYPE OR ENTITY/FUND

| PORTFOLIO SUMMARY | | Set filter: | | Country: | All | Property type: | All | Entity/Fund: | All | | | | | | | |
|--|-----------------------|-------------|--|-------------|---|----------------|---|---|---|------------|--|-------------|------------------------------------|------------|--|------------|
| Asset ID (click on an Asset ID to enter updated data) | Year of Stranding | | Cumulative excess emissions until 2050 | | | | GHG-Intensity 2018 [kgCO ₂ e/m ²] | Cumulative emissions 2018-2050 [tCO ₂ e] | Emission budget 2018-2050 [tCO ₂ e] | | Discounted costs of excess emissions (incl. value of emissions below pathway) (red: costs > value - green: value ≥ costs) | | | | | |
| | 1.5°C-target | 2°C-target | Absolute [kgCO ₂ e] | | Per GFA [kgCO ₂ e/m ²] | | | | (red: budget < cum. emissions - green: budget ≥ cum. Emissions) | | Absolute [€] | | Per floor area [€/m ²] | | Per gross asset value ('Carbon value at Risk') | |
| | | | 1.5°C-target | 2°C-target | 1.5°C-target | 2°C-target | | | 1.5°C-target | 2°C-target | 1.5°C-target | 2°C-target | 1.5°C-target | 2°C-target | 1.5°C-target | 2°C-target |
| | Set discount rate: 3% | | | | | | | | | | | | | | | |
| 1 | 2026 | 2033 | 1,410,805 | 853,749 | 235 | 142 | 21 | 3,890 | 3,136 | 4,071 | 66,240 | 16,527 | 11 | 3 | 3.31% | 0.83% |
| 2 | 2028 | 2035 | 292,514 | 178,050 | 293 | 178 | 27 | 850 | 728 | 945 | 12,733 | 1,195 | 13 | 1 | 0.21% | 0.02% |
| 3 | 2037 | 2043 | 149,762 | 86,042 | 75 | 43 | 12 | 721 | 1,045 | 1,357 | - 7,171 | - 23,742 | - 4 | - 12 | -0.15% | -0.50% |
| 4 | 2021 | 2024 | 512,858 | 369,650 | 1,026 | 739 | 72 | 1,004 | 560 | 717 | 27,951 | 19,616 | 56 | 39 | 0.59% | 0.41% |
| 5 | 2023 | 2028 | 183,260 | 82,112 | 611 | 274 | 74 | 545 | 420 | 544 | 9,541 | 2,958 | 32 | 10 | 0.95% | 0.30% |
| 6 | 2040 | 2045 | 5,891,230 | 2,974,680 | 211 | 107 | 59 | 44,288 | 79,637 | 102,685 | - 1,076,197 | - 2,296,356 | - 39 | - 82 | -3.07% | -6.56% |
| 7 | 2024 | 2031 | 4,187,293 | 2,528,000 | 279 | 169 | 28 | 11,111 | 7,986 | 10,448 | 221,188 | 89,809 | 15 | 6 | 0.88% | 0.36% |
| 8 | 2041 | 2046 | 2,693,614 | 1,269,662 | 180 | 85 | 71 | 27,379 | 55,498 | 71,560 | - 931,895 | - 1,782,207 | - 62 | - 119 | -2.66% | -5.09% |
| 9 | 2024 | 2033 | 48,326,963 | 19,368,663 | 690 | 277 | 99 | 167,248 | 141,039 | 183,247 | 2,396,455 | 152,413 | 34 | 2 | 0.80% | 0.05% |
| 10 | 2021 | 2024 | 115,558,931 | 58,334,187 | 1,651 | 833 | 184 | 299,712 | 203,795 | 264,782 | 6,286,461 | 3,043,930 | 90 | 43 | 2.10% | 1.01% |
| 11 | 2024 | 2033 | 48,326,963 | 19,368,663 | 690 | 277 | 99 | 167,248 | 141,039 | 183,247 | 2,396,455 | 152,413 | 34 | 2 | 0.80% | 0.05% |
| Σ | | | 227,534,192 | 105,413,458 | 819 | 380 | 108 | 723,996 | 634,883 | 823,603 | 9,401,760 | - 623,445 | 34 | - 2 | 0.93% | -0.06% |

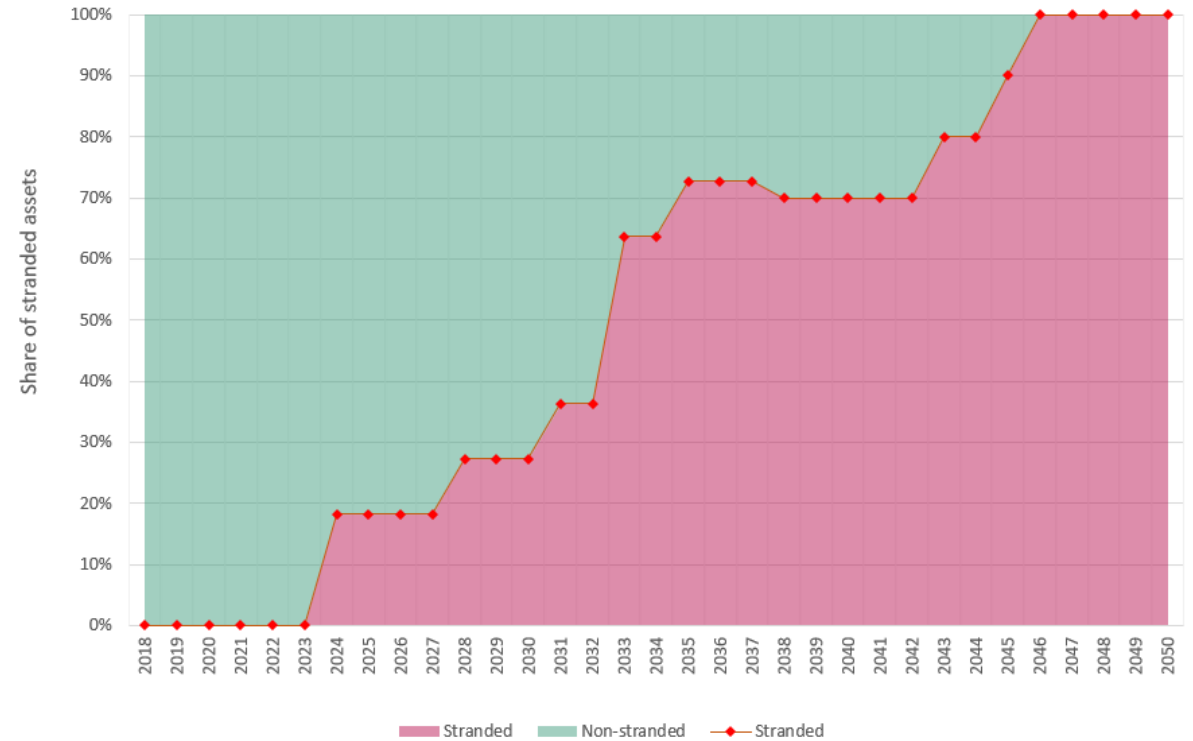
QUANTITATIVE CARBON PERFORMANCE AND RISK INDICATORS: PORTFOLIO LEVEL

ALIGN YOUR PORTFOLIO WITH PARIS DECARBONISATION TARGETS

EMISSIONS OF PORTFOLIO VS. EMISSIONS ACCORDING TO DECARBONISATION PATHWAY



SHARE OF STRANDED ASSETS OVER TIME



Shares based on number of buildings, floor area or asset value.

Simulate effect of selling building x in year y (here: 2038)



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WWW.CRREM.EU

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