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Abstract

Physical climate risks, particularly heat stress and water-related hazards, are intensifying and bear directly on organisations whose service delivery is bound to specific buildings and vulnerable populations. Dutch long-term care (LTC) organisations are a clear case: care is location-bound, residents cannot easily be relocated, and providers carry substantial real-estate exposure. Yet objective exposure does not translate into organisational recognition. This thesis examines to what extent objective physical climate risk exposure, real-estate portfolio characteristics, financial capacity and institutional sustainability commitments are associated with climate-related disclosure among Dutch LTC organisations. Physical climate exposure was measured at the level of 10,299 individual care locations using the Klimaateffectatlas and the DGBC ordinal scoring framework, then aggregated to the organisational level. The dependent variable, disclosure level, was coded from annual reports using AI assistance. The hypotheses were tested using ordered logistic regression on a final complete-case sample of 289 organisations. The central finding is that exposure and disclosure are decoupled: neither heat nor water exposure predicts disclosure, only 6.5% of organisations explicitly recognise physical climate risk, and roughly half the sample combines above-median exposure with little or no disclosure. Disclosure is instead associated with organisational size and with the depreciation status of the real-estate portfolio, while financial capacity and formal sustainability commitments show no association. The thesis therefore documents an exposure-disclosure gap in Dutch LTC: physical climate risk is widespread, but formal recognition in annual reporting is shaped more by organisational reporting capacity than by objective exposure.

Keywords: physical climate risk; climate-related disclosure; long-term care; real estate; ordered logistic regression.

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Table of Contents

List of Figures

List of Tables

1. Introduction

Climate change is no longer solely an environmental concern, but it has become a material risk for organisations worldwide. Physical climate risks, such as heat stress, extreme precipitation and flooding, directly affect buildings, accessibility, operational continuity and the wellbeing of the people who depend on those services (IPCC, 2021; TCFD, 2017).

The healthcare sector is particularly vulnerable to physical climate risks. Healthcare institutions are dependent on real estate, infrastructure and reliable energy systems, which makes them sensitive to the disruptions caused by extreme weather events. Healthcare institutions provide services to vulnerable population groups, namely the elderly and the ill. As a result, physical climate risk does not only impact operations, but it also poses a threat to the continuity of care for those populations. For instance, heatwaves are associated with increased morbidity and mortality rates, particularly among vulnerable groups, which adds further pressure on healthcare systems (IPCC, 2022; WHO, 2021). At the same time, extreme precipitation and flooding can damage or disrupt infrastructure, reduce accessibility to the organisation for employees as well as patients and interfere with critical services such as electricity, which are necessary for the continuity of care. During the 2021 flooding in Limburg (province in the Netherlands), healthcare provider Sevagram in Valkenburg, Limburg, reported an estimated €42.5 million in damage. One facility, housing eighty-four residents, was considered lost and required rebuilding, while residents were temporarily relocated (NOS, 2021). Together, this creates a dual challenge in which both the capacity to provide care may be constrained and at the same time demand for care increases (Valente et al., 2025).

Within this context, this study examines how Dutch long-term care (LTC) organisations operating under the Wlz (Wet langdurige zorg, long term care act) recognise and disclose physical climate risks. These organisations form a relevant setting because care delivery is often location bound and is provided in specific buildings, at specific addresses, with specific exposure to local climate hazards (Dosa et al., 2011; Hua et al., 2022). For this reason, this study adopts a location-level approach. Physical climate exposure is measured at the level of individual care locations. These location-level scores are then aggregated to the organisational level because the dependent variable, climate related disclosure, is observed in annual reports written on the organisational level. In total, the analysis covers 10,299 care locations in the descriptive statistics and almost 300 LTC organisations in the regression models.

However, exposure to physical climate risk alone is unlikely to determine how organisations recognise and respond to these risks. Organisations that face comparable physical climate risks may differ in the way they recognise and disclose those risks. This suggests that organisational response depends not only on exposure but also on organisational characteristics. Financial capacity could determine whether the organisation is able to invest in adaptation measures. Governance related factors may influence whether physical climate risks are integrated into operations (Berkhout et al., 2006; Engle, 2011). Therefore, disclosure is not treated as a measure of actual preparedness but as an indicator of recognition: whether physical climate risks are acknowledged and integrated in annual reports.

The descriptive analysis in this thesis points to a gap between exposure and disclosure. Dutch LTC organisations are widely exposed to physical climate risks, but explicit physical climate risk disclosure remains rare. Most organisations report on generic sustainability themes such as energy usage, waste management, CO_2 reduction or environmental policies. A minority explicitly mentions physical climate risks such as heat stress, flooding, or extreme precipitation. Climate-related reporting in the sector is still mainly oriented toward mitigation rather than toward adaptation to physical climate risks (TwynstraGudde, 2025).

Three strands of literature touch on this without addressing it directly. Climate health research shows that physical climate risk poses a risk to healthcare infrastructure and vulnerable populations. However, they do not study whether organisations formally report on these risks (Dosa et al., 2011; Gasparrini et al., 2015; Hua et al., 2022). Organisational adaptation research explains why organisations facing similar exposure respond differently, but this is not applied to LTC (Berkhout et al., 2006; Engle, 2011). Climate disclosure research examines the determinants of corporate climate reporting in primarily listed, for profit firms operating under mandatory disclosure regimes (Alam & Costa, 2025; Cahan et al., 2015; Hummel & Schlick, 2016). None of these studies examine whether objective physical climate risk exposure, measured at the location-level, is reflected in annual report disclosure by publicly funded, real estate dependent LTC organisations.

This leads to the following research question:

To what extent are objective physical climate risk exposure, real estate portfolio characteristics, financial capacity and institutional sustainability commitments associated with climate related disclosure among Dutch long-term care organisations?

This study aims to contribute to the existing literature in three ways. First, it shifts attention from generic sustainability disclosure to physical climate risk disclosure, which remains underexplored in healthcare real estate. Second, it introduces a location-level measurement of physical climate risk exposure and links it to organisational level annual reporting. Third, it examines whether organisational characteristics (real estate characteristics, financial capacity, institutional commitments) help explain why some organisations disclose physical climate risk while others do not.

The remainder of the thesis is structured as follows: Chapter 2 develops the theoretical framework and derives the hypotheses. Chapter 3 explains the research design, data sources, variable construction and the empirical models. Chapter 4 presents the descriptive analysis, including the distribution of physical climate exposure, disclosure levels and the mismatch between the two. Chapter 5 reports the main regressions. Chapter 6 discusses the findings, implications and limitations. Chapter 7 concludes.

2. Literature review

This chapter sets the theoretical framework and provides an overview of the existing literature. Every section of this chapter motivates one element of the model: section 2.1 the exposure variables, section 2.2 the location-level relevance of those variables for LTC real estate, section 2.3 the translation gap that motivates the inclusion of organisational characteristics, sections 2.4 – 2.6 the three organisational mechanisms (real estate characteristics, financial capacity, institutional commitments) and section 2.7 the research gap and lists the hypotheses of this study

2.1 Physical climate exposure

Physical climate risks arise directly from changes in the climate system and differ from transition risk associated with decarbonisation (IPCC, 2021; TCFD, 2017)[1]. For fixed real-estate assets in the Dutch LTC sector, two physical hazards are particularly relevant: heat stress, which is driven by rising baseline temperatures and intensified heatwaves (IPCC, 2021; KNMI, 2023; RIVM, n.d.). Water related risk is driven, among other factors, by pluvial flooding from short duration high intensity rainfall and coastal flooding (KNMI, 2023; Planbureau voor de Leefomgeving, 2024; Deltares, 2025). Heat and water are therefore the two physical climate exposure dimensions used in this thesis.

2.2 Heat and water exposure in long-term care real estate

LTC organisations are exposed to climate hazards primarily through their buildings because care delivery is location-bound and residents cannot be relocated easily (Dosa et al., 2011; Hua et al., 2022). Heat exposure has well documented, direct effects on LTC residents. The delivery of care can be disrupted by extreme weather events (Valente et al., 2025). Elevated temperatures raise morbidity and mortality rates among the elderly (Gasparrini et al., 2015; Huynen et al., 2001; Vicedo-Cabrera et al., 2021). Evidence from the Netherlands shows that although heat related mortality risk has declined since the introduction of the national heat plan, elevated temperatures remain associated with increased mortality (Klompmaker & Hagens, 2025). The intensity of these effects is mediated by the built environment: indoor temperatures depend on building characteristics, and many Dutch buildings overheat because they were not built for the higher temperatures now occurring (RIVM, n.d.; Van Loenhout et al., 2016). Heat exposure measured at the building location is therefore a meaningful proxy for the risk that LTC residents experience.

Water exposure affects LTC facilities through damage to building systems and loss of accessibility. International evidence shows higher mortality and hospitalisation among nursing home residents exposed to flooding (Hua et al., 2022; Ashe et al., 2025) and that floods materialise primarily through failures in basement located backup generators, electrical systems

[1] Physical risk is further classified into acute risks (extreme events such as heatwaves, floods, storms) and chronic risks (gradual shifts in baseline temperature, precipitation patterns, sea level). The distinction matters for hazard characterisation but not for the empirical model, which uses the DGBC composite scoring. On the increasing frequency of compound hazards, see Zscheischler et al. (2018) and IPCC (2022).

and access routes (Abebe et al., 2025). The 2021 Limburg flooding (NOS, 2021) showed that Dutch LTC facilities can be directly affected by water related damage, showing that flood risk can materialise through both real estate damage and care continuity.

2.3 The translation from exposure to disclosure

Organisational adaptation under uncertainty rarely takes the form of deliberate strategic redesign, it emerges from routinised problem solving in which long horizon risks are crowded out by current day operational pressures (Berkhout et al., 2006). Adaptive capacity is not reducible to financial resources, but it also requires governance routines, expertise and information systems that convert resources into actions (Engle, 2011; Thomas et al., 2018). In listed, for-profit firms, exposure and disclosure are more tightly linked because material exposure attracts investor scrutiny, regulatory disclosure mandates and capital market legitimacy pressures. Therefore, firms with higher exposure tend to disclose more (Cahan et al., 2015; Hummel & Schlick, 2016). In organisational fields where regulatory pressure around physical climate risk disclosure is limited and professional norms are still emerging, disclosure may be shaped more by legitimacy considerations than by underlying performance (DiMaggio & Powell, 1983; Hummel & Schlick, 2016; Crossley et al., 2021). Sector level evidence confirms this pattern in Dutch healthcare: climate adaptation is not yet embedded in organisations and responses are predominantly reactive rather than proactive (TwynstraGudde, 2025).

The implication for the model is twofold. First, objective exposure is unlikely to predict disclosure on its own. Second, organisational characteristics (real estate characteristics, financial capacity, institutional commitments) determine whether exposure becomes relevant and should therefore be the informative predictors. The remainder of this chapter motivates these characteristics. Disclosure is interpreted throughout as a formal recognition in reporting, not as a measure of preparedness; the symbolic versus substantive distinction (Crossley et al., 2021; Ferraro et al., 2026; Meyer & Rowan, 1977) makes this caveat necessary for any disclosure-based outcome.

2.4 Real estate portfolio characteristics

Climate hazards materially affect property valuation, capital allocation and asset management (Azzone et al., 2025; Carlin et al., 2023; OECD, 2025). Dutch real-estate evidence supports the idea that physical climate risk can become financially material through the asset base. Eichholtz et al. (2026) show that flood-exposed homes in the Netherlands sell at a discount, which indicates that physical climate exposure is at least partly capitalised into property values. Eichholtz et al. (2026) concerns residential housing rather than healthcare real estate, but the mechanism is relevant for LTC organisations because physical climate exposure may affect not only operations but also the long-term value and risk profile of the real-estate portfolio. For LTC organisations that own their buildings, climate and asset risk are therefore closely connected. Three elements of the real estate portfolio plausibly translate this materiality into disclosure: the depreciation status of the asset base, the ownership share and the total fixed assets divided by annual revenue.

The depreciation status is captured by the book-to-acquisition ratio; a higher ratio denotes a less depreciated asset base, while a lower ratio denotes a more depreciated one. In this study, the ratio is interpreted as a proxy for recent capital engagement rather than as a direct measure of building vulnerability. This interpretation is consistent with the literature, which shows that climate related risk affects buildings through capital expenditure, retrofitting needs, energy performance and asset values (Carlin et al., 2023; OECD, 2025). Organisations with less depreciated portfolios are more likely to have made recent investment decisions and more likely to have applied the current sustainability and building performance requirements. In the Netherlands, new developments have had to comply with the Bijna Energieneutrale Gebouwen [Nearly Zero-Energy Buildings] (BENG) requirements since 2021 (Rijksdienst voor Ondernemend Nederland [RVO], 2026). BENG is assessed on three energy performance indicators and is therefore not a measure of physical climate adaptation. A higher book-to-acquisition ratio may therefore capture not only a less depreciated asset base, but also more recent engagement with regulation regarding building sustainability. A positive association is therefore expected between the book-to-acquisition ratio and disclosure level.

Ownership structure captures whether climate related financial consequences sit on the balance sheet of the organisation or are externalised to the landlord. Commercial real estate literature shows that the landlord-tenant split incentives lead to misaligned investment in resilience and that recognition of climate risks tend to follow ownership rather than occupancy (DLA Piper, 2024; OECD, 2025). Therefore, a higher ownership ratio is predicted to be associated with a higher disclosure level. Ownership also correlates with organisational scale and historic investment strategy (OECD, 2025), which is why organisational revenue is included as a control in the empirical model. A third element of real-estate structure that may matter for disclosure is the relative scale of the real estate base compared to the revenue of the organisation.

Captured by a real-estate intensity proxy: acquisition value of fixed assets divided by the operating revenue. A higher value means that the operation of an organisation rests on a proportionally larger (in monetary value) real estate base. So, a given physical climate shock is financially more material to the operation, such organisations should therefore have a stronger incentive to recognise and disclose physical climate risk.

2.5 Financial capacity

Reporting climate risk is a resource using activity because the risk needs to be identified first and then needs to be assessed. Financial slack resource literature predicts that financially stronger organisations have more managerial attention, more developed reporting infrastructure and greater strategic planning capacity (Cyert & March, 1963; Symeou et al., 2019). The empirical record on this prediction is mixed. Recent evidence suggests that financial slack is necessary but not sufficient for environmental disclosure: outcomes depend more on managerial commitment and strategic orientation than on the availability of resources themselves (Kim et al., 2019; Sekimoto & Amran, 2025; Vitale et al., 2023). Solvency ratio and the earnings before interest, depreciation and amortisation (EBITDA) margin therefore enter the model. Of the two variables, solvency is the more defensible moderator because it reflects long-run resilience, which matches the horizon over which physical climate risk materialises.

The Dutch LTC sector adds an institutional constraint to the equation. Revenues are largely fixed through the Wlz. Real estate and inventory funding runs through the Normatieve Huisvestingscomponent [Normative Housing Component] and Normatieve Inventariscomponent [Normative Inventory Component] (NHC and NIC, respectively), which leaves organisations with investment responsibility but limited freedom to expand revenues (Nederlandse Zorgautoriteit, 2022)[2]. In financially constrained organisations, day to day operational pressure may crowd out long horizon risks regardless of exposure (Berkhout et al., 2006).

2.6 Institutional sustainability commitments

Two prominent sustainability commitments are the norm in the Dutch healthcare sector: Green Deal Duurzame Zorg 3.0 [Green Deal Sustainable Healthcare 3.0] (Green Deal) and

[2] The NHC and NIC determine the level of capital that LTC organisations can recover for real estate and inventory through Wlz rates. Together with the structurally modest surplus margins that result, the framework leaves organisations with full real-estate investment responsibility but limited discretionary financial slack.

Milieuthermometer Zorg [Healthcare Environmental Thermometer] (MTZ).[3] Both are interpretable through institutional theory as responses to normative and mimetic pressure (DiMaggio & Powell, 1983; Hummel & Schlick, 2016). The standard prediction is that committed organisations have more developed reporting routines and therefore disclose more across sustainability themes, including physical climate risk.

This prediction is complicated by two things. First, voluntary commitments are frequently decoupled from real performance and function primarily as legitimacy signals (Crossley et al., 2021; Ferraro et al., 2026; Hummel & Schlick, 2016; Meyer & Rowan, 1977). Second, both the Green Deal and MTZ are framed around mitigation, targeting CO_2, energy usage, circularity and pharmaceutical residues. This reflects the broader healthcare sustainability landscape, which is historically dominated by a focus on carbon footprints, rather than on physical climate risk adaptation (Karliner et al., 2019; Romanello et al., 2022). The WHO (2020) climate resilience health care facilities guidance explicitly aims to correct this imbalance by mainstreaming adaptation alongside mitigation; however, the broader focus on mitigation remains. If these commitments capture mitigation rather than recognition, their association with physical climate disclosure may be weak or null even where the underlying disclosure channels are well developed.

2.7 Research gap and hypotheses

As mentioned in Chapter 1, existing literature has not examined whether objective physical climate exposure, measured at the location-level, is reflected in annual report disclosure by publicly funded LTC organisations. The previous sections have developed the theoretical mechanisms that explain why this gap may exist and which organisational factors are expected to explain it. Figure 1 summarises the conceptual framework. The conceptual model treats objective exposure as the risk context and three organisational mechanisms, real estate characteristics, financial capacity and institutional sustainability commitments, as the filters through which exposure becomes disclosure.

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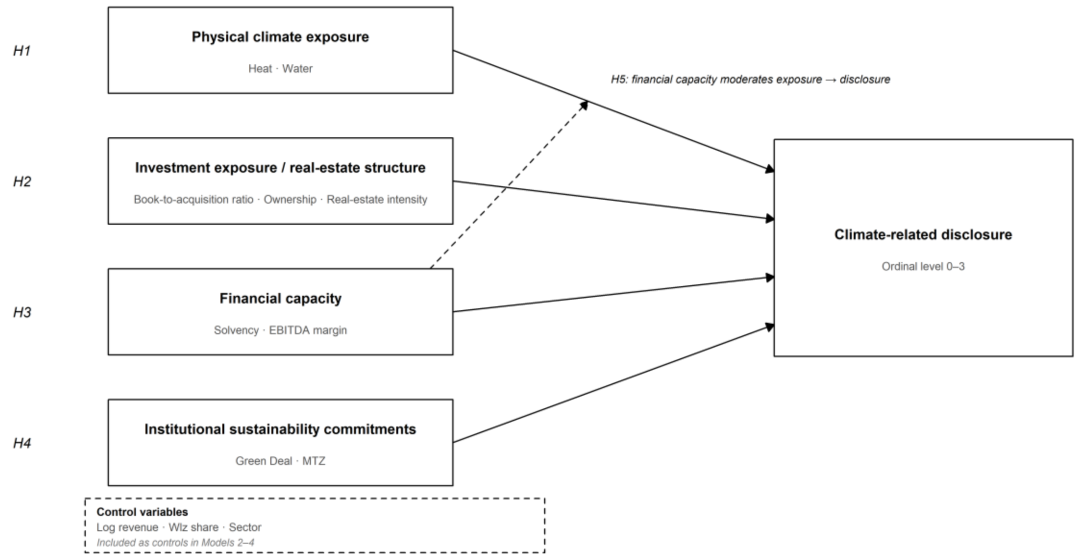
[3] The Green Deal is a voluntary sectoral covenant covering CO_2, circular healthcare, pharmaceutical residues in water and a healthy living environment. The MTZ is an environmental management certification with a bronze, silver and gold level, requiring documented environmental management systems and periodic audits (Green Deal Duurzame Zorg 3.0, n.d.; *MilieuThermometer Zorg*, 2026)

Figure 1

Conceptual framework



H1: Higher levels of objective physical climate exposure are associated with a greater likelihood of being in a higher climate-related disclosure category.
H2: Real estate portfolio characteristics are associated with a greater likelihood of being in a higher climate-related disclosure category.
H3: Greater financial capacity is associated with a greater likelihood of being in a higher climate-related disclosure category.
H4: Stronger institutional sustainability commitments are associated with a greater likelihood of being in a higher climate-related disclosure category.
H5: Financial capacity positively moderates the relationship between objective physical climate exposure and climate-related disclosure.

Three indicators are tested in H2: the book-to-acquisition ratio, the ownership ratio and real estate intensity. A positive association is expected for all three indicators. The theoretical ambiguity of H4 arises from symbolic decoupling and the mitigation orientated sustainability initiatives, as discussed in section 2.6. Because annual reports are observed at the organisational level while physical climate risk exposure is measured at the location-level, the empirical analysis tests these hypotheses after aggregating the exposure to organisational level. Chapter 3 explains this aggregation, the construction of the data set and the models used to test the hypotheses.

3. Methods

3.1 Research design

This thesis adopted a quantitative cross-sectional research design to study whether objective physical climate risk exposure and organisational characteristics are associated with climate related disclosure among Dutch LTC organisations. Climate exposure is observed at the locational-level and subsequently aggregated to the organisational level. This has been done because disclosure is observed in organisational level annual reports rather than at individual locations. The analysis identifies associations rather than causal effects. Climate exposure indicators are treated as exogenous to the organisation because they are based on geographic location rather than organisational behaviour. Financial indicators are from the year 2023, while disclosure was coded from annual reports from the year 2024. This time lag improves interpretability and reduces, but does not eliminate, simultaneity concerns.

The dependent variable is climate related disclosure. It should not be interpreted as a direct measure of actual climate adaptation or preparedness. Rather, it captures to which extent climate risks are formally recognised or integrated in annual reporting. Disclosure and actual preparedness may therefore diverge; a point returned to in section 6.6.

3.2 Data sources

The analysis combines annual-report coding, financial data, location-level climate exposure indicators, organisation-level location information and institutional sustainability data, as elaborated on below. The final analysis dataset was constructed by merging the following sources on the organisation identifier fldZorginstelling.

- Annual reports. Disclosure is coded from Dutch LTC annual reports relating to fiscal year 2024 and published in 2025. The coding procedure identifies generic sustainability disclosure, explicit physical climate risk recognition, disclosure in formal risk sections and concrete adaptation actions, alongside seven supplementary indicators that are reported descriptively in Chapter 4 but do not feed into the main disclosure level outcome.
- Financial and organisational data. Financial data is obtained from the Zorgrating database, accessed through Finance Ideas. The 2023 data is used for solvency, EBITDA margin, book-to-acquisition ratio, total fixed assets, operating revenues, Wlz funding share and sector classification.

- Climate exposure data. Physical climate exposure was derived from the KlimaateffectAtlas (n.d.) at the level of individual care locations. The raw atlas indicators were classified into qualitative exposure classes by Finance Ideas, following the framework of the Dutch Green Building Council (DGBC, 2022). The locational-level data set contains, for each of the 10,299 care locations, a qualitative class per climate theme: (geen [none], zeer laag [very low], laag [low], middel [medium], hoog [high], zeer hoog [very high] , or onbekend [unknown]) for water and (geen, laag, middel en hoog) for heat. This location-level dataset was linked to Zorgrating financial variables supplied by Finance Ideas. All subsequent steps, the conversion of these qualitative classes into numeric scale and the aggregation from the individual to the organisational level, were conducted in this study.
- Location data. Care-location data were linked to the climate indicators at the location-level and then aggregated to the organisation level using the construction described in 3.4.3.
- Institutional sustainability data. Formal sustainability commitment was measured through Green Deal participation and MTZ certification information.

3.3 Sample and data collection

The starting point of this study was the Zorgrating database of 702 healthcare institutions. The focus of this study was on organisations operating under the Wlz, operationalised as the verpleeging verzorging thuiszorg [nursing, care and home care] (VVT) and gehandicaptenzorg [disability care] (GHZ) sectors. The climate and financial aggregation file contained 319 organisations with linked financials and climate data. There was also a file on the location-level with climate data, spanning 10,299 unique locations.

The disclosure-coding file contained 301 coding rows, of which 297 contained a valid Zorgrating internal identifier. Because three organisations appear more than once in the coding file, duplicate coding rows were aggregated to the organisational level using the maximum value for disclosure-related binary indicators and certification scores. This produced 293 unique coded organisation IDs, all of which were present in the climate/finance data sheet and therefore formed a valid disclosure sample used in the descriptive data chapter. The regression models were estimated on a complete case sample of 289 organisations. Four organisations were excluded because they had missing values on the book-to-acquisition ratio, the solvency ratio or the EBITDA margin. The breakdown of the sample funnel is reported in Table 1. All main models and sensitivity analyses use the same complete-case sample so that model fit statistics, likelihood-ratio tests and coefficient patterns were comparable across specifications.

Table 1

Overview of the sample construction

Stage	Number of organisations
Zorgrating healthcare organisations	702
Climate/finance organisations after sector selection and linkage	319
Disclosure coding rows	301
Coding rows with valid fldZorginstelling	297
Uniquely coded and matched organisation IDs after duplicate aggregation	293
Complete-case regression sample	289

3.4 Variable construction

3.4.1 Dependent variable: climate related disclosure

The dependent variable, disclosure level, is an ordered four category measure constructed from coded annual reports. The coding procedure records eleven indicators per organisation, of which four fed the main outcome and seven served as supplementary descriptive indicators reported in Chapter 4. The four primary indicators were:

PHYSICAL_RISK_MENTION: explicit mention of the physical climate risks, such as heat stress, flooding or extreme precipitation, in relation to the organisation.

RISK_IN_RISK_SECTION: physical climate risk disclosure in the formal risk section of the annual report.

ADAPTATION_ACTION: concrete measures in addressing physical climate risks, such as heat protocols, cooling measures, building adjustments or other adaptation measures.

GENERIC_SUSTAINABILITY: sustainability disclosure without a direct physical climate risk link, such as CO_2 reduction, waste management, energy efficiency.

These indicators were combined into an ordinal disclosure score using a hierarchical rule, see Table 2. If ADAPTATION_ACTION equalled 1, the relevant organisation was coded as level 3. If no adaptation action was coded but either PHYSICAL_RISK_MENTION or RISK_IN_RISK_SECTION equalled 1, the relevant organisation was coded as level 2. If only GENERIC_SUSTAINABILITY was coded as 1, the relevant organisation was coded as level 1. If none of the indicators were present the organisation was coded as level 0.

Table 2

Coding hierarchy for climate related disclosure level

Level	Label	Definition
0	No disclosure	No climate, sustainability or physical climate-risk disclosure identified.
1	Generic sustainability	Sustainability disclosure is present, but without an explicit physical climate-risk link.
2	Physical risk recognised	Physical climate risk is explicitly mentioned or appears in the formal risk section, but without concrete adaptation action.
3	Physical climate adaptation disclosed	Concrete adaptation action addressing physical climate risk is disclosed

In addition to the four primary indicators, seven supplementary indicators were coded for each annual report: HEAT_MENTIONED and WATER_MENTIONED (explicit hazard naming), TCFD_CSRD_MENTIONED (reference to international climate-disclosure frameworks), CLIMATE_STRATEGY_OR_POLICY (existence of a formal climate adaptation strategy, policy or roadmap), REAL_ESTATE_LINK (climate themes explicitly linked to the organisation's buildings, locations or real estate), HEALTH_CARE_CONTINUITY_LINK (climate risk linked to residents, employees or continuity of care) and INSURABILITY_OR_DAMAGE_COSTS (climate-related insurance, damage or premium discussion). These indicators were not used as predictors or outcomes in the regression analysis but are reported descriptively in section 4.4 to characterise the landscape of climate-related disclosure in the sector.

3.4.2 AI-assisted coding procedure

Annual reports were coded using a Python protocol implemented in Google Colab. The Python code for the coding pipeline was partly developed with the assistance of generative AI, after which the researcher reviewed and tested the script. First, the organisation's name and document type were extracted from the cover pages and matched to the fIDZorginstelling identifier through fuzzy string matching. Second, the reports were divided into page chunks and JSON formatted codes were returned for each of the eleven indicators, including binary classification (0/1), page numbers and quotes. Chunk level outputs of each report were merged at the organisation level by taking the maximum value of each binary indicator.

The coding model was Claude Sonnet 4.6 from Anthropic (2026), accessed through the Anthropic API. As the model could not read scanned PDFs, these were manually coded by the researcher. The coding pipeline was tested during development on ten annual reports to confirm that the protocol returned valid JSON outputs and that the output was consistent with the content of the relevant annual report. No formal inter-rater reliability assessment was carried out. The AI classifications were not validated against manual coding on a sub sample of the final dataset. Full technical details of the coding pipeline, including chunk size, maximum-pages cap, the fuzzy-matching threshold, the lookup table of organisation names and the complete execution script are reported in Appendix A.

3.4.3 Climate exposure

Climate exposure was measured using location-level Klimaateffectatlas (n.d.) data from 2024 scored according to the DGBC (2022) climate risk categories. As noted in section 3.2, the location-level scoring was carried out by Finance Ideas prior to data delivery. The two aggregation steps described below, taking a per location maximum across the water indicators and averaging per location heat scores across each organisation were done in R. The analysis focuses on two exposure dimensions: heat stress and water related risk.

Heat exposure is measured using heat_mean_score, defined as the average heat stress score across all locations from an organisation. This indicator is based on the Klimaateffectatlas 2050 warm-nights heat-stress projection. Because only one heat indicator is available, the aggregation is a simple mean across locations.

Water exposure is measured using water_maxloc_mean_score. This variable is constructed into two steps because there are four separate (in this database) water-related sub-indicators at the location-level: extreme precipitation, groundwater nuisance, flood probability and maximum flood depth. First, for each location the maximum score across these four sub indicators is taken, capturing the most severe water hazard at that location. Second, these per location maximum scores are averaged across the organisation. Heat and water are aggregated asymmetrically. Heat as the mean of one indicator, water as the mean of a per location worst case across four indicators. For the descriptive mismatch analysis in section 4.6, a combined exposure score is constructed as the mean of the heat and water exposure scores per organisation. Organisations were split at the sample median into high and low exposure groups. This combined score is used for descriptive purposes. The regression models use heat and water exposure as separate predictors.

The DGBC framework does not prescribe how scores should be combined across climate themes. Therefore, the combined score is a result of the researcher's own aggregation choice.[4]

3.4.4 Real estate portfolio characteristics

Real estate portfolio characteristics were measured using real estate variables from the 2023 Zorgrating data. The first was the fldBoekAanschafratio, which captured the ratio of book value to acquisition value of fixed assets. In Dutch LTC organisations, fixed assets consist predominantly of real estate; equipment and other non-real estate assets are negligible in relative terms given the residential care model and the NHC/NIC financing structure. The ratio was therefore used as a proxy for the depreciation status of the real estate portfolio, it did not observe building age or the physical condition directly. In the analysis, higher values were treated as an indicator of more recent capital engagement. The second variable was the ownership structure proxy. This proxy captured the relative reliance on owned versus leased or rented real estate. It was constructed as:

$$\frac{(depreciation\ on\ fixed\ assets + financial\ expenses)}{(depreciation\ on\ fixed\ assets\ +\ financial\ expenses\ +\ rent\ and\ leasing\ costs)}$$

Depreciation and financial expenses proxy the cost of owned assets, while rent and leasing costs proxy the cost of rented or leased assets. Higher values indicated stronger reliance on owned real estate, while lower values indicated greater use of rented or leased assets. This measure was used as a proxy for capital lock in and direct exposure to asset level climate risk. The ratio was constructed from financial-statement line items and therefore approximates ownership through the relative magnitude of depreciation, financial expenses and rent and lease costs; it does not observe legal ownership of individual properties directly.

The third variable is real estate intensity, which is a proxy and constructed as:

$$Total\ acquisition\ value\ of\ fixed\ assets\ /\ revenue$$

[4] Water and heat are scored on the six-point DGBC ordinal ladder (geen = 0, zeer laag = 1, laag = 2, middel = 3, hoog = 4, zeer hoog = 5). Because the DGBC warm-nights classification distinguishes only Geen, Laag, Middel and Hoog, heat takes the values {0, 2, 3, 4}; the value 1 (zeer laag) does not occur for heat, whereas water uses the full 0–5 range.

The numerator, fIdAanschafwaardeTotaal, was the total acquisition value of fixed assets. For Dutch LTC organisations, fixed assets mainly consist of real estate, so the ratio was interpreted as a proxy for the relative scale of the real estate asset base relative to the annual revenue. This was a proxy rather than a direct measure, the variable did not separate real estate from other fixed assets, although in the Dutch LTC sector this component is small. Unlike book value, acquisition value is unaffected by the accrued depreciation and therefore reflects the original scale of the real estate investment regardless of age. A higher value of the proxy indicated a larger real estate base relative to the organisations operating scale. It complements the book-to-acquisition and ownership ratio proxy by adding a profit and loss statement dimension to the real estate characteristics.

3.4.5 Financial capacity

Financial capacity was measured using two variables from the 2023 Zorgrating data. Solvency ratio (fldSolveRatio) captures long term balance sheet resilience and the ability to absorb shocks. EBITDA margin (fldEbitdaMarge) captures operational profitability and short-term financial performance. Financial variables were lagged by one year relative to the annual reports (2024) to ensure that financial conditions precede organisational responses and thus reduced simultaneity concerns.

3.4.6 Institutional sustainability commitment

Institutional sustainability commitment was measured using two indicators. Green Deal participation was coded as a dummy variable equal to 1 if the organisation participates in the Green Deal and 0 otherwise. MTZ certification was coded as an ordinal three-level scale: 0 = no certification (combining "Geen" [none] and "Niet gevonden" [not found] in the source data), 1 = bronze and 2 = silver. Gold certification was defined in the MTZ scheme but was not observed in the sample. The MTZ score was standardised alongside the other continuous predictors in the regression models, although it took only three distinct values; the standardisation was applied for comparability with the other predictors and did not change the rank order of the variable.

3.4.7 Control variables

The models included three control variables. Organisational size was measured as the natural logarithm of total operating revenues (fIdBedrijfsOpbrengsten). The funding structure was measured using the Wlz share of organisational revenue. Sector was included as a categorical variable with VVT as the reference category and GHZ as the comparison category.
Continuous predictors were standardised using z-scores before modelling. Coefficients for these variables therefore represented the change in the log-odds of being in a higher disclosure

category associated with a one-standard-deviation increase in the predictor. Green Deal participation and sector were not standardised because they are categorical variables.

3.5 Empirical model

The ordered logistic regression model was used to examine how Dutch LTC organisations respond to physical climate risk, the dependent variable is disclosure level. The models were designed to assess whether organisational response is driven by climate exposure, real estate characteristics, financial capacity or institutional commitment. The models build upon each other. In total four models were analysed. From model 2 onwards, control variables were included to account for organisational characteristics. All models were estimated on the complete data sample of 289 organisations in R. All continuous predictors were standardised so that coefficients reflect the change in log-odds of being in a higher disclosure level category associated with a one-standard-deviation increase in the predictor. Model fit was assessed using AIC, BIC, McFadden pseudo-R^2 and likelihood-ratio tests for nested models.[5] Confidence intervals were based on the Wald approximation. The proportional-odds assumption was assessed using a Brant test on model 3 and is reported in section 5.5.

3.5.1 Ordered logistic specification

The ordered logistic regression specification models are cumulative log-odds of being in or below a given disclosure level:

$$Log\left[\frac{P(Y_i > j)}{P(Y_i \leq j)}\right] = a_j - Xi\beta, \qquad j = 0,1,2$$

As can be seen above, Yi is DISCLOSURE LEVEL for organisation i, a_j are the three category thresholds between the four disclosure levels and $Xi\beta$ is the linear predictor. The negative sign on $Xi\beta$ follows the convention used in R’s polr() function and means that a positive coefficient indicates a higher likelihood of being in a higher disclosure category. For each of the four models below, the linear predictor $Xi\beta$ is specified as follows.

[5] The full model fit statistics are reported in Appendix B.

Model 1: Climate exposure and disclosure

The first model examined whether organisations that are more exposed to physical climate risk are more likely to disclose climate-related information in their annual reports:

$$X_{i\beta} = \beta 1\ Heat_i + \beta 2\ water_i \qquad (1)$$

This model tested whether higher levels of objective climate exposure are associated with higher disclosure. A positive β1 or β2 coefficient would indicate that as climate exposure increases, the organisation is more likely to be in a higher disclosure category. The model tested the following hypothesis:

H1: Higher levels of climate exposure are associated with a greater likelihood of being in a higher disclosure category.

Model 2: Adding real estate portfolio characteristics and financial capacity

Model 2 built on Model 1 by adding real estate characteristics and financial capacity:

$$X_{i\beta} = \beta 0 + \beta 1\ heat_i + \beta 2\ water_i + \beta 3\ bookratio_i + \beta 4\ ownership_i + \beta 5\ re\_intensity_i + \beta 6\ solvency_i + \beta 7\ ebitda_i + \beta 8\ controls_i \qquad (2)$$

This model tested whether disclosure is not only influenced by climate risk exposure but also by the extent of assets at risk and the financial capacity of the organisation to respond. A positive β3, β4 and β5coefficient would indicate that the real estate characteristics are associated with a higher disclosure category. A positive β6 and β7 coefficient would indicate that financially stronger organisations are more likely to have a higher disclosure level. The model tested the following hypotheses:

H2: Real estate characteristics are associated with a greater likelihood of being in a higher disclosure category.

H3: Greater financial capacity is associated with a greater likelihood of being in a higher disclosure category.

Model 3: Adding institutional commitment

Adding institutional sustainability commitment variables:

$$X_{i\beta} = \beta 0 \; + \; \beta 1 \, heat_i \; + \; \beta 2 \, water_i \; + \; \beta 3 \, bookratio_i + \; \beta 4 \, ownership_i \; + \; \beta 5 \, re\_intensity_i \; + \; \beta 6 \, solvency_i + \; \beta 7 \, ebitda_i + \beta 8 \, greendeal_i + \beta 9 \, MTZ_i + \beta 10 \, controls_i \qquad (3)$$

Model 3 tested whether participation in formal sustainability programmes is associated with higher levels of disclosure. A positive β8 would indicate that Green Deal participation is associated with a higher disclosure level. A positive β9 would indicate that a higher MTZ certification level is associated with higher disclosure. The model tested the following hypothesis:

H4: Stronger institutional sustainability commitments are associated with a greater likelihood of being in a higher disclosure category.

Model 4: Moderation by financial capacity

To assess whether financial capacity moderates the relationship between climate exposure and disclosure, Model 4 added interaction terms between climate exposure and solvency:

$$X_{i\beta} = \beta 0 \; + \; \beta 1 \, heat_i \; + \; \beta 2 \, water_i + \; \beta 3 \, book_{ratio_i} + \; \beta 4 \, ownership_i \; + \; \beta 5 \, re\_intensity_i \; + \; \beta 6 \, solvency_i \; + \; \beta 7 \, ebitda_i \; + \; \beta 8 \, green\_deal_i \; + \; \beta 9 \, mtz_i \; + \; \beta 10 \, (heat \; \times \; solvency)_i \; + \; \beta 11 \, (water \; \times \; solvency)_i \; + \; \beta 12 \, controls_i \qquad (4)$$

Solvency was selected as the moderator because it reflects long-term financial resilience, which is more closely aligned with the theoretical mechanism of H5 than short-run profitability. EBITDA margin is retained as a main-effect control. This model tests whether financially stronger organisations respond differently to equivalent levels of physical climate risk in terms of disclosure. A positive β10 or β11 would indicate that financial capacity strengthens the relationship between climate exposure and the probability of a higher disclosure level. The model tested the following hypothesis:

H5: Financial capacity positively moderates the relationship between climate exposure and disclosure level.

To aid interpretation, predicted probabilities were computed from Model 3 by varying each predictor of interest between one standard deviation below and above the sample mean, holding all other predictors at their means. Two sensitivity analyses assessed robustness: Sensitivity A collapses disclosure 2 and 3 into one physical-disclosure category (three-category ordered outcome), and Sensitivity B estimated a binary logit in which physical disclosure equals 1 if disclosure level ≥ 2.[6]

4. Data

Chapter 4 presents the descriptive foundation of the empirical analysis. Sections 4.1 describes the sample, unit of analysis and the data linkage. In section 4.2 the geographic distribution of physical climate exposure is presented. Section 4.3 presents the distribution of climate related disclosure and the topics on which organisations report. Section 4.4 the relationship between exposure and disclosure is visually examined. Section 4.5 shows the distribution of the real estate characteristics variables across disclosure levels. Section 4.6 presents the mismatch between exposure and disclosure and 4.7 the predictor correlations.

4.1 Sample, unit of analysis and data linkage

Climate risk was measured at the care location-level. The climate and location data contained 10,299 care locations. The locations were linked to physical climate risk indicators and then aggregated to the organisational level, because the disclosure outcome was measured in organisational level annual reports rather than at individual buildings. Descriptive analyses are done on the 293-organisation sample. The final complete case regression subset contains 289 organisations.

The data structure combined locational-level climate exposure with organisational-level financial data and annual reports disclosure coding. For each organisation, location-level climate risk scores were summarised into average exposure measures. This aggregation was necessary because annual reports are written at the organisational level and discuss climate risk in corresponding terms. At the same time, the location-level origin of the climate data remains

[6] Sensitivity analysis A & B are reported in Appendix C

important; the maps and exposure measures in section 4.3 show that objective physical risk was spatially distributed across LTC real estate portfolios, even though the final exposure variables were aggregated to the organisational level.

Table 3 reports the sectoral composition and the distribution of the number of care location per organisation. 73.7% of the sample is VVT and 26.3% is GHZ. The number of care locations per organisation displayed heterogeneity, ranging from a single location to portfolios with more than one thousand locations. The mean of 34 locations obscures a strongly rightward skewed distribution in which the typical organisation operates a relatively small portfolio while a small number of large concerns drive the upper tail. This was consequential for the analysis. Organisations with extensive portfolios could face a wider geographical spread of climate exposure and may therefore experience more diversified, but also more physical risk than smaller LTC. Portfolio scale was accordingly retained as a control variable in the regression specifications, measured through the log of operating revenues.

Table 3

Sample description

Variable	N	Total (N = 293)
Sector	293	
VVT		216 (73.7%)
GHZ		77 (26.3%)
Number of locations	293	34 (86)

Table 4 reports the descriptive statistics of the variables used in the regression analysis, which used the N = 289 sample. The mean heat exposure was 2.29 (SD = .67) with a max of 3.5 on the 0-4 DGBC (2022) scale. The mean water exposure was 3.24 (SD = 1.03) with a max of 5 on the 0-5 DGBC (2022) scale. The mean book-to-acquisition ratio was .53 (SD = .14), this implies that on average the depreciated value of assets represents slightly more than half of the acquisition value. The mean ownership ratio was .59 (SD = .28). There was substantial variation: some organisations rely exclusively on owned real estate while others operate through leases. Real estate intensity had a mean of 1.096 (SD = 1.59), which implies that on average the acquisition value of fixed assets exceeds annual operating revenue.

Table 4

Descriptive statistics of regression variables

Variable	N	Mean	SD	Min	Max
Heat exposure	289	2.294	0.665	0.000	3.500
Water exposure	289	3.241	1.027	0.000	5.000
Book/acquisition ratio	289	0.525	0.137	0.129	0.925
Ownership ratio	289	0.593	0.281	0.020	1.000
Real estate intensity	289	1.096	1.592	0.002	18.952
Solvency ratio	289	0.460	0.162	−0.277	0.841
EBITDA margin	289	0.097	0.042	−0.066	0.245
MTZ score	289	0.301	0.631	0.000	2.000
Green Deal (0/1)	289	0.367	0.483	0.000	1.000
Operating revenues (mln EUR)	289	84.5	108.5	2.4	1,118.8
Wlz share	289	0.870	0.076	0.691	1.000

4.2 Geographic distribution of physical climate risk exposure

Physical climate risk exposure was measured using objective location indicators as described in section 3.4. Both indicators were independent of organisational behaviour and therefore they were treated as exogenous. Each of the 10,299 healthcare locations in the sample were assigned a specific location score, which formed the basis of the organisational level averages used in the regression analysis. Figures 2 and 3 visualise the location level scores across the Netherlands.

Heat exposure (Figure 2) is concentrated in the densely urbanised western and central provinces, where the urban heat-island effect is most pronounced (EPA, 2025). The northern and eastern provinces display lower heat scores. Water-related exposure (Figure 3) presents a different picture: rather than concentrating in regions, elevated scores are spread broadly across the country and relatively few locations fall in the lowest categories. This partly reflects the construction of the water related measure. Figure 3 should therefore be interpreted as the worst-case water hazard per location.

Figure 2

Heat risk level per healthcare location

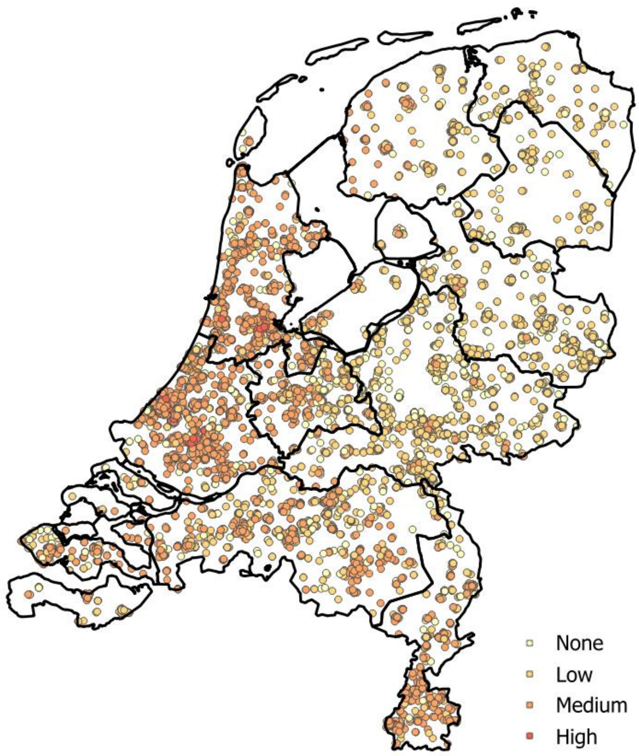


Figure 3

Water risk level per healthcare location

4.3 The distribution of climate related disclosure

It is important to emphasise that the dependent variable, disclosure level, was not a Task Force on Climate-related Financial Disclosures (TCFD) or Corporate Sustainability Reporting Directive (CSRD) compliance score. It measures the extent to which annual reports move from no relevant disclosure to generic sustainability, to physical climate risk recognition and finally to strategic or operational integration of physical climate risk. The levels of disclosure range from no disclosure (level 0), through generic mention of sustainability without explicit physical risk reference (level 1) and moderate disclosure (level 2), to extensive strategic or operational integration (level 3).

Figure 4 reports the distribution of disclosure level across the 293 organisations. The distribution is heavily concentrated in the lower categories. A total of 200 organisations (68.3%) fell into level 1, indicating that they discuss sustainability themes, (e.g. CO_2 reduction, energy transition, or ESG) without any substantive engagement with physical climate hazards. A further 74 organisations (25.3%) reported nothing relevant. Six organisations (2%) reached level 2 and 13 organisations (4.4%) reached level 3. Aggregating the upper two categories, just 19 organisations (6.5% of the sample) explicitly mentioned or integrated physical climate risk in their annual reports.

Figure 4

Distribution of climate-related disclosure levels

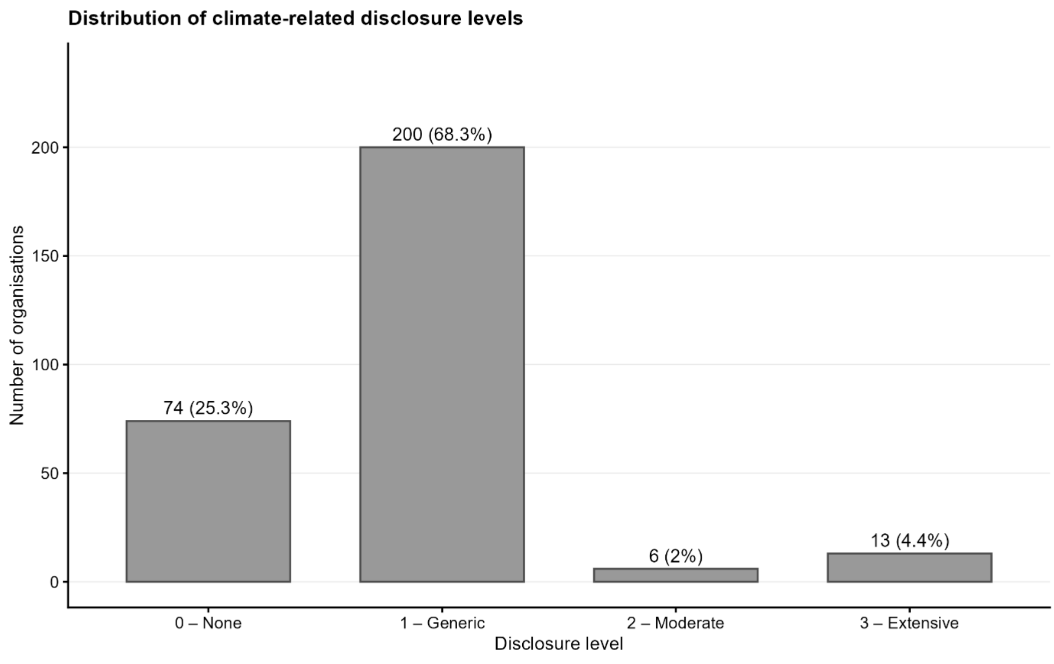
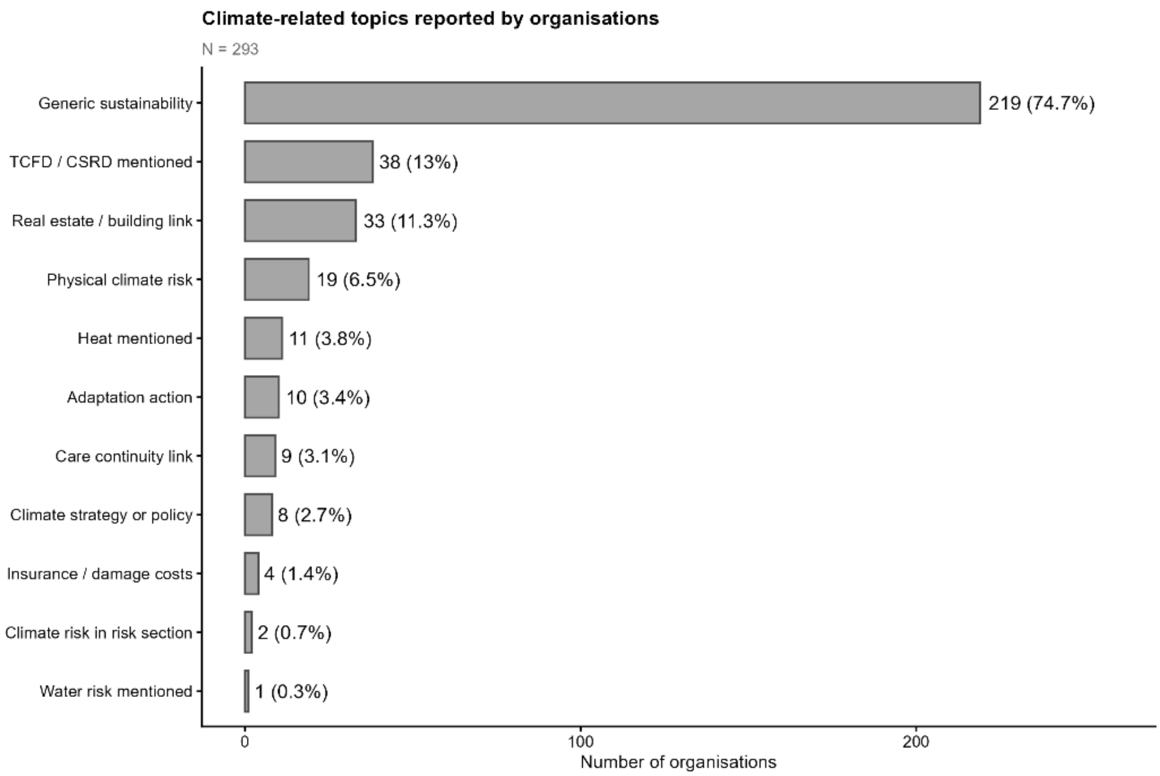


Figure 4 is a central descriptive finding of the Chapter. The pattern is consistent with the institutional account developed by DiMaggio and Powell (1983) and applied to the Dutch healthcare sector by TwynstraGudde (2025). In a sector where coercive pressures around physical climate disclosure remain limited, CSRD applies to a small subset of organisations and Wlz reporting requirements do not mandate physical risk disclosure, normative and mimetic pressures dominate. The dominance of level 1 suggests that organisations participate in a sectoral norm of sustainability reporting without translating that norm into physical risk recognition.

To clarify which disclosure topics are mentioned in the annual reports in this sample, Figure 5 reports the share of organisations that mention each individual topic. Generic sustainability is the most common theme, while explicit references to physical hazards and care continuity links are rare.

Figure 5

Climate related topics reported by organisations



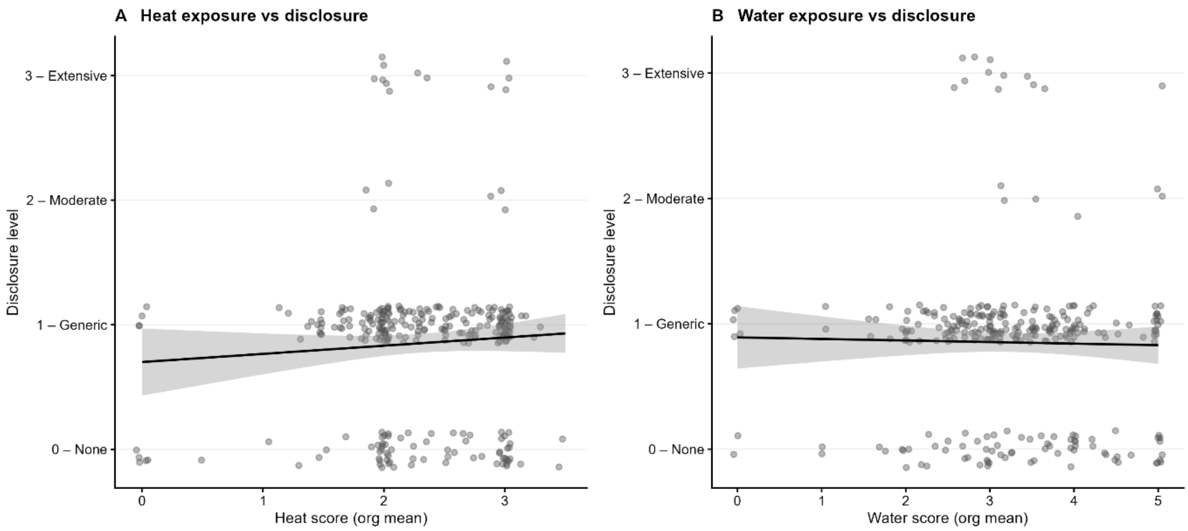
Note. Topics are not mutually exclusive.

4.4 Climate exposure by disclosure level

If physical climate risk exposure mechanically translated into formal disclosure, organisations with higher exposure scores would be expected to disclose more than organisations with lower exposure scores, consistent with H1. Figure 6 plots the organisational level mean heat and water exposure against the four disclosure levels, with a fitted linear trend. Figure 7 presents the corresponding boxplots, which summarise the central tendency and spread within each disclosure level.

Figure 6

Heat exposure vs disclosure & water exposure vs disclosure

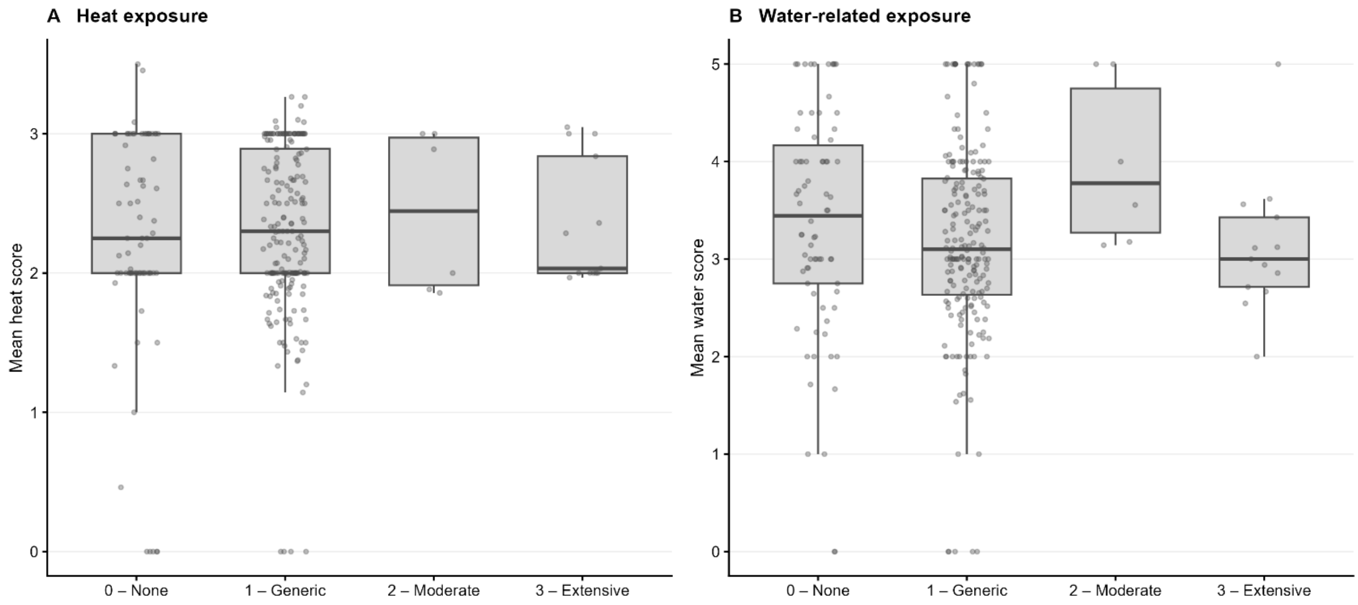


Panel A and Panel B in Figure 6 provide a direct visual inspection whether higher objective exposure corresponds with higher levels of disclosure. The pattern is weak and asymmetric across both hazards. For heat exposure (Panel A), the fitted line is slightly positive, but the points remain widely spread out across the disclosure levels. For water exposure (Panel B) the fitted line has a small downward slope. Most organisations cluster around disclosure level 0 and level 1 across the full exposure range, while organisations with extensive disclosure are few and do not form a clear exposure gradient line.

Figure 7 (Panel A) does not show a clear increase in heat risk across disclosure levels. Median heat risk is broadly similar for organisations across the disclosure levels. Organisations with disclosure level 3 do not appear to have the highest heat risk on average. This suggests that heat exposure alone does not mechanically translate into higher disclosure. Figure 7 (Panel B) shows a somewhat different pattern for water-related risk. Organisations in disclosure level 2 have a higher median water-related risk score compared to the other groups. However, the level 2 group consists of only six organisations, so this is not a reliable pattern. Figure 7 produces a descriptive null result. The regression in Chapter 5 tests the relationship formally.

Figure 7

Heat exposure by disclosure level (A) & water exposure by disclosure level (B)



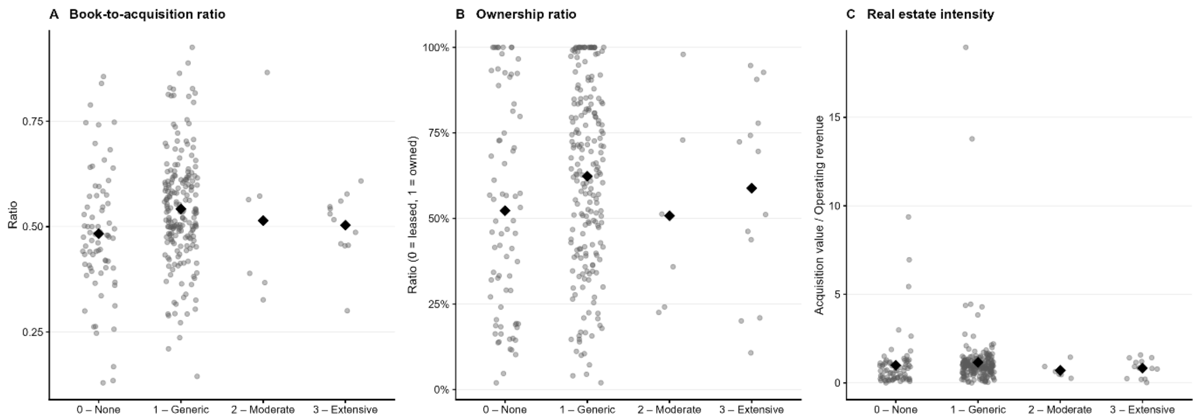
This descriptive null result has two implications. First, it provides preliminary evidence against a straightforward exposure-driven model of disclosure, consistent with the adaptive capacity literature reviewed in section 2.3. Berkhout et al. (2006) and Engle (2011) argue that exposure becomes organisationally important only when filtered through awareness, governance and resources. The absence of a visual exposure disclosure relation is compatible with this filtering account. Second, the pattern motivates the model specification in Chapter 5: rather than testing exposure in isolation, the regression progressively introduces real estate characteristics, financial capacity and institutional commitment to assess if disclosure is associated with these characteristics once objective exposure is held constant.

4.5 Real estate portfolio characteristics

Figure 8 shows three dimensions of the real estate characteristics across disclosure levels, proxied by the book-to-acquisition ratio, the degree of asset ownership captured by the ownership structure proxy and the proxy for real estate intensity.

Figure 8

Book-to-acquisition ratio, ownership ratio and real estate intensity by disclosure level



Panel A presents a visually null result. The mean book-to-acquisition ratio is almost identical across all four disclosure categories, clustering at approximately 0.50 and the point clouds have similar patterns. Organisations with a lower book-to-acquisition ratio are no more likely to formally recognise this in their annual reports than those with higher values. This null pattern is consistent with the argument that physical vulnerability (exposure) alone does not translate into formal recognition without governance and normative pressures (Berkhout et al., 2006; Engle, 2011). Because Figure 8 does not control for other variables, the absence of a visual relation should be interpreted descriptively rather than evidence against a multivariate association.

Panel B shows a more nuanced picture. Organisations with no climate related disclosure have a mean ownership ratio of approximately 53%, while organisations reporting at level 1 show a somewhat higher mean of 62%, the distribution of the point clouds overlap. This difference is consistent with the theoretical expectation that owners, unlike renters, bear direct financial exposure to climate damage and therefore have a greater incentive to formally acknowledge physical risk. However, beyond level 1 the pattern becomes inconclusive: the level

2 group contains only six organisations, producing a confidence interval too wide for meaningful interpretation and the level 3 group mean of approximately 60% falls within the level 1 range. Based on this descriptive evidence, there is no consistent increase of the ownership ratio across the four disclosure levels.

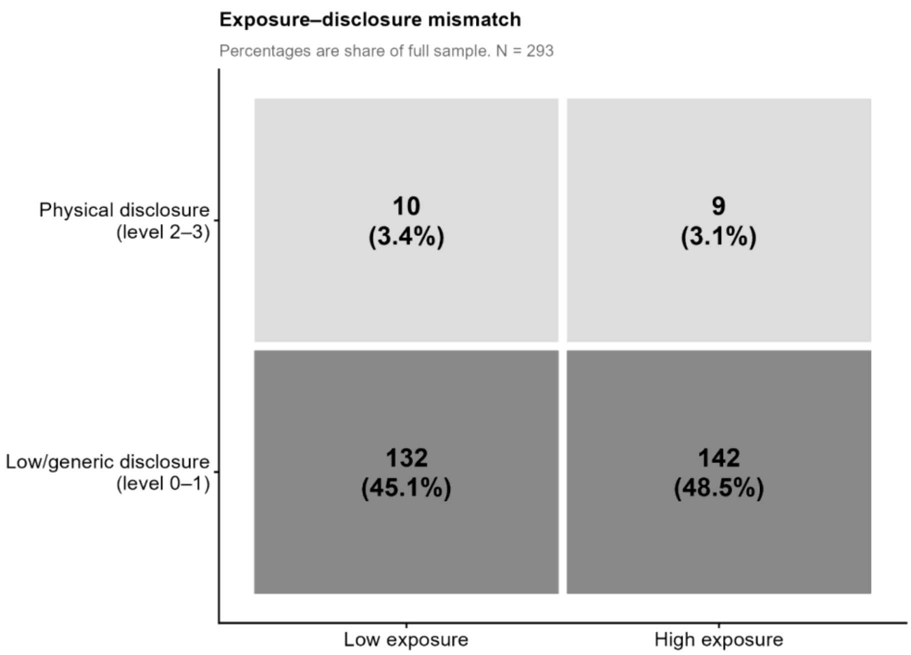
Panel C shows the distribution of real estate intensity across the four disclosure levels. Several organisations carry fixed asset investments worth several times their annual revenue, but most organisations have an acquisition value close to or just above their annual revenue. The mean value across the four disclosure categories is similar and the point clouds overlap. Therefore, it provides no visual support for a systematic relation between the relative materiality of real estate and disclosure behaviour.

4.6 The mismatch between objective exposure and disclosure

The descriptive analysis culminates in a direct comparison between objective exposure and disclosure. To make this comparison intuitive; First, a combined climate exposure score was constructed as described in section 3.4.3 for each organisation. Secondly, organisations were divided into low-disclosure (levels 0-1) and physical disclosure (levels 2-3) groups. The resulting 2x2 classification produced four mutually exclusive categories, shown in Figure 9.

Figure 9

Mismatch between climate exposure and physical climate disclosure



The mismatch in Figure 9 shows that 142 organisations (48.5% of the valid disclosure sample) are classified as high-exposure / low-disclosure. These organisations have an above-median combined climate risk exposure score but remain in disclosure level 0 or 1. By contrast, only nine organisations (3.1%) combine high climate risk exposure with physical climate disclosure. This is the clearest descriptive evidence that objective exposure and disclosure are not automatically aligned. There are 132 low-exposure / low-disclosure organisations (45.1%) and ten (3.4%) low exposure / high physical-disclosure organisations. Physical disclosure therefore remains rare in both risk groups. However, the high-exposure / low-disclosure group is especially important because it shows where disclosure appears most weakly aligned with objective exposure.

This descriptive finding represents the empirical core of this study and clarifies the theoretical question the regressions must address. If exposure does not translate into disclosure, the variation in disclosure must be driven by organisational characteristics that mediate between objective risk and recognition. Chapter 2 identified three mechanisms: financial capacity, real estate characteristics and institutional sustainability commitments. Chapter 5 tests whether these mechanisms explain this exposure-disclosure mismatch.

4.7 Predictor diagnostic and summary

4.7.1 Predictor diagnostic

Before turning to the multivariate analysis, Table 5 reports the Pearson correlations among the standardised continuous predictors. Heat and water are only weakly correlated (r = .2), which supports the decision to model them separately rather than combining them into a combined measure. This is consistent with the geographic patterns described in section 4.3. Similarly, the book-to-acquisition ratio and ownership ratio are weakly correlated (r= .14). The largest correlations are with log revenue and Wlz (r = -.34) share, log revenue and MTZ-score (r = .28) and real estate intensity and ownership ratio (r = .40); all remain well below levels that would indicate multicollinearity outcomes.

Table 5

Pearson correlations among standardised continuous predictors

Variable	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
1. Heat exposure									
2. Water exposure	.20								
3. Book/acquisition ratio	-.15	-.16							
4. Ownership ratio	.05	-.01	.14						
5. Real estate intensity	.02	-.13	.04	.40					
6. Solvency ratio	-.08	-.09	-.04	-.14	.06				
7. EBITDA margin	.07	-.00	.06	-.18	-.10	.19			
8. Log revenue	.13	-.03	-.07	-.02	-.20	-.08	.01		
9. Wlz share	-.23	-.08	.03	.06	.16	-.07	-.01	-.34	
10. MTZ score	.08	.03	.11	.19	.07	.01	.03	.28	-.07

Note. Lower triangle shown; numbers in column headers correspond to the row variables. All variables z standardised. N = 289

4.7.2 Summary

Four descriptive observations emerge from the analysis. First, Dutch LTC organisations were heterogeneously exposed to physical climate risks with heat and water hazards following distinct geographical patterns that reflect well documented mechanisms. Second, climate related disclosure was overwhelmingly generic, sustainability language is common but explicit recognition of physical climate risk appears in only 6.5% of organisations. Third, neither objective climate exposure nor real estate structure produced a clear visual relationship with disclosure: book-to-acquisition ratio displays no pattern across the disclosure levels, ownership structure yields only a limited signal between the no-disclosure and generic mention categories and real estate intensity shows no clear upward pattern across exposure. Fourth, and most consequentially roughly half the sample combined above median physical climate risk with low disclosure. Chapter 5 will test these descriptive results statistically.

5. Results

In this chapter the results of the ordered logistic regression analysis are presented as introduced in section 3.5. The analysis tests the five hypotheses derived from the theoretical framework: whether physical climate risk exposure (H1), real estate characteristics (H2), financial capacity (H3) and institutional commitments (H4) are associated with the likelihood of being in a higher disclosure level and if financial capacity moderates the relationship between climate exposure and disclosure (H5). The models were estimated on the complete case sample of 289 organisations for which all the model variables are observed. The continuous variables were standardised so that coefficients reflect the change in log-odds of being in a higher disclosure category with a one standard deviation increase in the predictor.

5.1 Model 1: Climate exposure and disclosure

Model 1 regressed the four-category disclosure variable on the standardised heat and water exposure scores alone. Neither coefficient was statistically significant. Heat exposure had a positive but insignificant coefficient (b = .169, SE = .125). Water exposure had a negative and insignificant coefficient (b = -.096, SE = .128). The corresponding odds ratios were 1.18 and .91, both close to one.[7] The McFadden pseudo-R^2 of .0044 indicated that heat and water exposure added almost no explanatory power beyond the distribution of disclosure levels. The full model 1 estimates are reported in Table 6.

Hypothesis 1 was not supported with this result. Higher objective physical climate risk exposure is not associated with a greater likelihood of being in a higher disclosure category. The finding is consistent with the evidence shown in section 4.4 and 4.6. Which already indicated that exposure does not visually predict disclosure and that approximately half the sample combines above median climate risk with low disclosure. Model 1 confirmed that this mismatch was statistically robust: without controlling for any other characteristic, exposure did not drive disclosure.

[7] Odds ratios were calculated by exponentiating the ordered logit coefficient. (OR – 1) x 100 gives the percentage change in odds.

5.2 Model 2: Adding real estate characteristics, financial capacity and control variables

In Model 2 real estate characteristics (book-to-acquisition ratio, ownership structure proxy and real estate intensity), financial capacity (solvency and EBITDA margin) and organisational controls (log revenue, Wlz share and sector) were added. The McFadden pseudo-R^2 rose to .1538 which is a substantial improvement from .0044 in Model 1. AIC dropped from 481.43 to 426.68. The strongest predictors in Model 2 were size and the book-to-acquisition ratio (Table 6).

Turning to the individual predictors, from the three real estate characteristics variables only one reached significance. The book-to-acquisition ratio was positive and significantly associated with disclosure ($b = .385$, $SE = .147$, $p < 0.01$). The odds of being in a higher disclosure category was about 47% higher per one SD increase. This provided partial support for H2. Figure 8 Panel A showed no visible relationship between the book-to-acquisition ratio and disclosure. The positive relation emerged in the regression.

The ownership ratio was positive but not significant ($b = .243$, $SE = .153$). The direction was consistent with the prediction from section 2.4; owners, unlike renters, bear the direct financial real estate exposure to climate change, but this effect was not distinguishable from zero in this sample. Real estate intensity was also positive but not significant ($b = .163$, $SE = .143$). From the three real estate characteristics variables, only the book-to-acquisition ratio provided support for H2.

Financial capacity, in contrast, was not significant. Solvency had a small coefficient ($b = .076$, $SE = .148$) and EBITDA margin had a moderate positive coefficient ($b = .198$, $SE = .138$). Both were in the direction of H3, but neither effect was statistically distinguishable from zero. H3, which predicted that financial capacity would be positively associated with disclosure, is therefore not supported.

Log revenue was the strongest predictor in the model ($b = 1.055$, $SE = .173$). A one standard deviation increase in log revenue was associated with nearly a tripling of the odds ($OR = 2.87$) of being in a higher disclosure category. Wlz funding share was not significant and the GHZ sector coefficient was small and not significant. Heat and water exposure also remained not significant in Model 2. The introduction of real estate characteristics, financial capacity and controls did not reveal a suppressed exposure effect.

Table 6

Ordered logistic regression results from Models 1,2,3

	Model 1	**Model 2**	**Model 3**
	Climate only	+ Real estate + Financial	+ Institutional
Heat exposure (z)	0.169	0.049	0.053
	(0.125)	(0.142)	(0.143)
Water exposure (z)	-0.096	0.043	0.025
	(0.128)	(0.142)	(0.143)
Book/acquisition ratio (z)		0.385**	0.355*
		(0.147)	(0.148)
Ownership ratio (z)		0.243	0.221
		(0.153)	(0.154)
Real estate intensity (z)		0.163	0.145
		(0.143)	(0.144)
Solvency ratio (z)		0.076	0.056
		(0.148)	(0.148)
EBITDA margin (z)		0.198	0.200
		(0.138)	(0.138)
Green Deal (0/1)			0.349
			(0.346)
MTZ score (z)			0.052
			(0.161)
Log revenue (z)		1.055***	0.966***
		(0.173)	(0.186)
Wlz share (z)		-0.187	-0.187
		(0.149)	(0.149)
Sector: GHZ		0.148	0.193
		(0.337)	(0.339)

Note. N = 289 for all models. Standard errors in parentheses. * $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$. Reference sector: VVT.

5.3 Model 3: Adding institutional sustainability commitment

In Model 3 Green Deal participation and MTZ certification were added to test H4. The likelihood ratio test against Model 2 was not significant (χ^2 (2) = 1.49, p = .475) and the McFadden pseudo-R^2 increased marginally from .154 to .157. AIC rose slightly from 426.68 to 429.20, which indicated that the additional variables did not improve fit on a per parameter basis. The institutional variables therefore failed to add explanatory power beyond what was captured already in Model 2.

When examining the individual coefficients, neither institutional variable reached significance. Green Deal participation had a positive but insignificant coefficient (b = .349, SE = .346). The MTZ certification score was close to zero and insignificant (b = .052, SE = .161). H4 was therefore not supported, formal sustainability commitments through these two initiatives are not associated with greater physical climate risk disclosure in this sample.

However, this null finding does warrant interpretation. In Chapter 4, it was already noted that the Green Deal and MTZ initiatives primarily focus on CO_2 reduction energy reduction, waste management and broader environmental management, rather than on physical climate hazards specifically. This distinction is confirmed by the regression. Organisations that have formally committed to sustainability through these programmes are no more likely to disclose physical climate risk than comparable organisations that have not. The Green Deal and MTZ coefficients are insignificant.

The book-to-acquisition ratio remained positive and statistically significant in Model 3 (b = .355, SE = .148, $p < .05$). The ownership ratio again is positive, but not significant (b = .221, SE = .154) and real estate intensity is also positive but not significant (b = .145, SE = .144). The null findings for ownership and real estate intensity were consistent across Models 2 and 3. Log revenue also remained the dominant predictor (b = .966, SE = .186, $p < .001$). Climate exposure, financial capacity and the two institutional commitment variables are all insignificant. The full Model 3 estimates are reported in Table 6.

Model 2 had the lowest AIC and BIC values. Model 3 was nevertheless retained as the full theoretical model because it included the institutional commitment variables required to test H4. However, the results showed that the institutional commitment mechanism is not empirically supported. Disclosure in this sample seemed to be mainly associated with organisational scale and, to a lesser extent, the depreciation status of the real estate portfolio, but not with formal participation in sustainability initiatives.

5.3.1 Predicted probabilities

To make the ordered-logit coefficients more interpretable, Table 7 reports the predicted probabilities from Model 3. The significant predictors mainly shifted organisations from no disclosure toward generic sustainability disclosure. They did not create a high predicted probability of physical climate risk disclosure, because disclosure levels 2 and 3 were rare across the sample. For the book-to-acquisition ratio, moving from one SD below the mean to one SD above the mean reduced the probability of no disclosure from 30.9% to 18%, at the same time the probability of extensive disclosure (level 3) increased from 1.4% to 2.8%. Ownership ratio and real estate intensity followed a comparable pattern, but the regression coefficients were not statistically significant, so these scenarios are illustrative.

Table 7

Predicted probabilities of disclosure level (Model 3)

Scenario	Level 0 (%)	Level 1 (%)	Level 2 (%)	Level 3 (%)
Book/acquisition = −1 SD (older)	30.9	67.0	0.8	1.4
Book/acquisition = mean	23.9	73.1	1.1	2.0
Book/acquisition = +1 SD (newer)	18.0	77.7	1.5	2.8
Ownership = −1 SD (leased)	28.1	69.4	0.9	1.6
Ownership = +1 SD (owned)	20.1	76.1	1.3	2.4
Real estate intensity = −1 SD	26.6	70.8	0.9	1.7
Real estate intensity = +1 SD	21.3	75.2	1.2	2.3
Log revenue = −1 SD (smaller)	45.2	53.7	0.4	0.8
Log revenue = +1 SD (larger)	10.7	81.7	2.6	5.0

Note. Predicted probabilities are computed holding all other predictors at their sample means (continuous) or modal value (categorical). Reference: VVT sector, mean values on all other predictors.

The largest difference is associated with organisational size. Moving from one SD below the mean to one SD above the mean of log revenue reduces the predicted probability of no disclosure from 45.2% to 10.7%. While the predicted probability of extensive disclosure (level 3) increases from .8% to 5%. These results confirm that organisational scale is the dominant predictor in Model 3. However, the results should not be interpreted as evidence that larger organisations are more climate adapted, rather it suggests that larger organisations are more likely to formally recognise or report on climate related themes in annual reports.

5.4 Model 4: Moderation by financial capacity

H5 was tested in Model 4 by adding two interaction terms between climate exposure and solvency[8]. Solvency was selected as the moderator because it represents long run financial resilience rather than short run profitability and is therefore closely aligned with the theoretical mechanism of capacity to absorb and respond to climate-related shocks. Two separate interaction terms were estimated: *heat exposure x solvency* and *water exposure x solvency*.

Both interaction terms were not statistically significant. The *heat x solvency* interaction had a positive coefficient ($b = .102$, $SE = .116$) and the water x solvency interaction is negligible ($b = -.003$, $SE = .126$). The likelihood ratio test against Model 3 was not significant (χ^2 (2) = .82, $p = .663$). AIC increased from 429.20 to 432.37, which indicated that the model 4 fit is worse than the model 3 fit. The exposure-disclosure link was not stronger for financially stronger organisations, therefore H5 is not supported.

5.5 Sensitivity checks

Before moving on to the sensitivity checks, the proportional odds assumption of the ordered logit was assessed using a Brant test on Model 3[9]. The omnibus test was marginally significant, (χ^2 (24) = 38.06, $p = .034$). The test did issue a warning that combination of outcome category and predictor value contains no observation. This is a consequence of the small number of organisations in disclosure level 2 ($n = 6$). Therefore, the omnibus statistics should be interpreted with caution. Two sensitivity analyses were conducted to assess the robustness of the main findings, both reproduced the pattern of the results.

The first sensitivity analysis combined disclosure levels 2 and 3 into a single physical disclosure category resulting in a three-category ordered outcome (0,1,2+). This addressed the concern that levels 2 and 3 were thinly populated ($n = 6$, $n = 13$ respectively), which can make the individual threshold estimates unstable. This three-disclosure category model preserved the ordinal structure while consolidating the top end of the scale.

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[8] The full Model 4 results are reported in Appendix D

[9] The Brant test results are reported in Appendix E

Sensitivity A closely mirrored Model 3. The book-to-acquisition ratio remained significant ($b = .355$, $p < .05$), the ownership ratio and real estate intensity remained insignificant. Log revenue remained the strongest predictor ($b = .956$, $p < .001$). The other variables: climate exposure, financial capacity and institutional commitments, remained insignificant. The robustness of the book-to-acquisition ratio finding in sensitivity analysis A provided additional support for the partial H2 result.

Sensitivity B estimated a binary logit in which physical disclosure was coded one for the disclosure levels two or three and zero otherwise. This was a conservative collapse of the outcome and reduced the analysis to whether an organisation discloses physical climate risk at all. In this model, only log revenue remained significant ($b = .86$, $p < .05$). The book-to-acquisition coefficient lost its significance. The reduced explanatory power was expected given the severe imbalance of the binary outcome, with only 19 organisations coded as physical disclosers in the regression sample. The binary logit did not provide additional evidence for the real estate characteristics mechanisms, but it did confirm the dominance of organisational size. Across both sensitivity analyses, size remained the most robust result. The book-to-acquisition effect remained in sensitivity analysis A but not in sensitivity analysis B.

5.6 Summary

Across all models the dominant predictor was organisational size, measured as log revenue. This was not a tested hypothesis, but a control variable and its strong association with disclosure has implications that are discussed in Chapter 6. The combination of supported and unsupported hypotheses indicated that the variation in climate related disclosure in Dutch LTC is not driven by objective exposure, financial capacity or sustainability commitments, but by structural characteristics of the organisation, in particular its size and the depreciation status of its real-estate base.

6. Discussion

6.1 Summary of main findings

This study examined whether objective physical climate risk exposure, real estate characteristics, financial capacity and institutional sustainability commitments are associated with climate related disclosure among Dutch LTC organisations. The analysis leads to three main conclusions. First, objective physical climate exposure does not translate into formal disclosure. Second, disclosure is primarily associated with organisational scale and, to a lesser extent, with the depreciation status of the fixed assets. Third, financial capacity and formal sustainability commitments do not explain physical climate risk disclosure. The hypotheses results are summarised in Table 8.

Table 8

Overview of hypothesis testing

Hypothesis	Result
H1: exposure → disclosure	not supported
H2: real estate characteristics → disclosure	partially supported, only book-to-acquisition ratio is significant
H3: financial capacity → disclosure	not supported
H4: institutional commitment → disclosure	not supported
H5: solvency moderates exposure → disclosure	not supported

6.2 Interpretation of the exposure-disclosure gap

The absence of an exposure effect suggests that physical climate risk is not yet a fully institutionalised reporting object in Dutch LTC. Exposure to physical climate risks does not automatically translate into disclosure in the annual report. This is consistent with the idea that exposure requires organisational translation before it becomes a reporting object: it must be filtered through awareness, governance routines, risk-management systems, reporting capacity, real estate planning (Berkhout et al., 2006; Engle, 2011). Where translating capacity is limited, even substantial physical climate risk exposure, can remain absent from formal disclosure. The mechanisms behind this gap, and how they differ from the drivers for listed firms, are developed in section 6.4.

6.3 Interpretation of organisational predictors

If physical climate exposure does not drive disclosure, the question becomes what does drive it? The regression in this study points to organisational scale as the dominant factor. Log revenue is the strongest predictor across all models and remains significant in both sensitivity checks. Larger organisations are more likely to disclose physical climate risk, consistent with the literature. Larger organisations tend to have more developed reporting routines, dedicated staff and governance structures that make the formal recognition of new risk categories more feasible (Cahan et al., 2015; Hummel & Schlick, 2016).

The second organisational signal comes from the real-estate portfolio. From the three real estate characteristics measures, only the book-to-acquisition ratio is significant, the ownership ratio and real estate intensity are positive but not significant. Organisations with newer or less depreciated fixed asset bases are more likely to disclose. This is best understood as a reporting infrastructure signal rather than as direct evidence that new buildings are safer or more resilient: recent capital engagement is likely to come with more developed real estate reporting and monitoring standards. Because this study has no direct data on building age or physical condition, vulnerability cannot be tested and is therefore not claimed.

Neither financial capacity nor institutional sustainability commitments are associated with disclosure in any specification. Solvency and the EBITDA margin point in the expected direction but are not significant, so there is no evidence that financially stronger organisations disclose more. The theoretical implication is that financial capacity, to the extent that it operates at all, does not amplify the responsiveness of organisations to objective exposure. In combination with the null main effect of solvency in Model 3, this would suggest that financial capacity is not a relevant mechanism for explaining variation in physical climate risk disclosure in this sample. The null result for the Green Deal and MTZ does not mean that they are irrelevant to sustainability behaviour in general: it means that they do not explain physical climate risk disclosure specifically. A plausible reason is that both initiatives are framed around mitigation rather than adaptation, so participation does not translate into the recognition of physical hazards.

6.4 Theoretical implications

The exposure disclosure gap can be examined through three theoretical lenses. The first is adaptive capacity. Berkhout et al. (2006) and Engle (2011) argue that environmental risk becomes organisationally meaningful only when it is filtered through awareness, governance and resources. The finding that exposure leaves no measurable trace in disclosure, while organisational scale dominates, is consistent with this observation: disclosure tracks the capacity to process and report risks rather than the risk itself.

The second lens is institutional pressure. Following DiMaggio and Powell (1983) and Meyer and Rowan (1977), organisations adapt practices that represent legitimacy within their field. In the Dutch LTC sector, coercive pressure to report physical climate risk is currently weak. The frequency of generic sustainability language over physical climate risk exposure-specific recognition suggests that organisations conform to a shared sustainability norm without translating it into physical-risk content. The third lens is symbolic disclosure. The pattern is consistent with evidence that disclosure can reflect legitimacy considerations rather than underlying exposure or performance (Crossley et al., 2021; Hummel & Schlick, 2016). This is the same pattern shown in section 4.3, 68% of organisations sit at generic sustainability language disclosure level 1, while 6.5% recognise any physical climate risk (disclosure level 2 or 3). Organisations signal engagement with sustainability while remaining largely silent on the physical hazards to which their real estate is exposed.

These results stand in contrast with climate disclosure on listed firms. For them, disclosure is frequently linked to material financial exposure, regulatory requirements, investor scrutiny and capital market legitimacy pressure, so that more exposed firms tend to disclose more. In the Dutch LTC setting those pressures are weaker: the organisations are publicly funded rather than capital market financed, the regulatory framework does not (yet) mandate physical risk disclosure and external investor scrutiny is limited. The weakness of these drivers in the sector helps explain why exposure does not translate into disclosure here and why organisational capacity becomes the driving factor instead.

6.5 Practical implications

68% of the organisations report only generic sustainability content (level 1) while disclosing nothing on physical climate risks. Therefore, the presence of generic sustainability language in an annual report cannot be read as evidence that physical climate risk exposure has been recognised. For boards and risk committees this has two implications. First, sustainability language is not a reliable signal of physical climate risk awareness. Second, the absence of any physical risk mention in the risk section does not mean the organisation is unexposed. Silence reflects nonrecognition, not an absence of risk. Embedding physical climate risk into operations, real estate planning, capital investment decisions and risk management routines therefore require steps beyond the current reporting layer.

For regulators and sector bodies, the results suggest that organisational capacity, rather than exposure currently governs which organisations report on physical climate risk. If the policy goal is to make physical climate risks visible across the LTC sector, voluntary frameworks that rely on existing reporting capacity are unlikely, on their own, to close the gap between exposed and reporting organisations. A reporting requirement intended to track exposure will need to be enforced at a level of detail that smaller organisations can also meet.

6.6 Limitations and future research

Several limitations of the research design and data should be noted. First, the cross-sectional design identifies associations rather than causal effects. Financial variables are lagged by one year relative to the disclosure measure to improve interpretability, but this does not establish direct causal direction. It is possible that organisations with more disclosure invest more in reporting capacity over time, reversing the implied directions of some associations. Second, the disclosure measure captures formal recognition in the annual reports rather than actual climate preparedness or adaptation. An organisation may implement adaptation measures without reporting them; the reverse can also be true. The outcome variable therefore reflects reporting behaviour, not resilience. Third, the AI-assisted coding of annual reports introduces measurement uncertainty. During development the pipeline was checked on ten annual reports by manually comparing the AI-assigned scores and quotes against the source documents. This served as a development stage check to refine the coding rules and prompts, rather than as a formal inter reliability test and no agreement statistics were recorded on the final sample. If coding errors are present and are random with respect to organisational characteristics, they would make it harder rather than easier to detect associations, so any positive finds are likely conservative rather than inflated. However, because no formal validation was carried out on the final sample, the possibility that errors are not random cannot be ruled out. Fourth, the cross-location aggregation procedure averages exposure scores across all care locations belonging to an organisation. For the water indicator, the per location maximum across the four sub-indicators is taken first, which preserves the most severe water hazard at each individual site. For both heat and water, however, the second step averages these location-level scores across the portfolio, which can dilute the influence of individual high-risk locations in organisations with large, geographically dispersed portfolios. An organisation, for example with one severely exposed location will receive a moderate mean exposure score, which may understate the true climate-risk relevance of the portfolio. Fifth, the book-to-acquisition ratio is an accounting-based proxy that captures depreciation across all fixed assets rather than real estate exclusively. In Dutch LTC organisations, fixed assets consist predominantly of real estate, so the ratio approximates real estate depreciation status well in this setting. It is, however, sensitive to differences in accounting policies across organisations and to the timing of large capital investments. It should be interpreted as an indicator of recent capital engagement rather than as a precise measure of building age or condition.

Improvement and ideas for further research follow directly from these limitations. A longitudinal design would let future research examine the direction of these associations. It could show whether disclosure responds to climate events, to tightening regulations or to changes in reporting capacity over time, distinctions the cross sectional set up cannot make. Linking disclosure to physical outcomes at location level, through incident or damage reports for instance, would address the limitation that the dependent variable represents disclosure rather than resilience. A formal inter-rater reliability assessment of the AI-assisted coding on the final sample, against independent manual coding, would quantify the measurement uncertainty that this thesis can only acknowledge but not measure. Finally, replicating the design in other publicly funded, real estate dependent sectors would test whether the exposure disclosure gap documented here is specific to Dutch LTC organisations or a characteristic of publicly funded sectors more broadly.

7. Conclusion

This study aimed to examine to what extent objective physical climate risk exposure, real estate portfolio characteristics, financial capacity and institutional sustainability commitments are associated with climate related disclosure among Dutch LTC organisations. The answer is that exposure and disclosure are not related. Explicit recognition of physical climate risk appears in only 6.5% of organisations and neither heat nor water exposure predicts disclosure. Financial capacity and formal sustainability commitments do not explain physical climate risk disclosure. The factors that do predict disclosure are organisational size and the depreciation status of the real estate portfolio.

The contribution of this thesis was to separate generic sustainability disclosure from physical climate-risk disclosure in a publicly funded, real estate dependent sector and to document an exposure-disclosure gap that is governed by organisational capacity and not by the risks the organisations face. In the Dutch LTC sector, formal recognition of physical climate risk appears to be shaped by organisational reporting capacity rather than by exposure itself.

8. References

Abebe, Y. A., Pregnolato, M., & Jonkman, S. N. (2025). Flood impacts on healthcare facilities and disaster preparedness – A systematic review. *International Journal of Disaster Risk Reduction*, *119*, 105340. https://doi.org/10.1016/j.ijdrr.2025.105340

Alam, S. M., & Costa, E. (2025). Climate Change Disclosure: a Conceptual framework and future research avenues. *Corporate Social Responsibility and Environmental Management*, *32*(3), 4019–4034. https://doi.org/10.1002/csr.3168

Anthropic. (2026). *Claude*. https://claude.ai/

Ashe, N., Soroka, O., & Ghosh, A. K. (2025). Long-Term mortality after Hurricane-Related flooding among skilled nursing facility residents with dementia. *Disaster Medicine and Public Health Preparedness*, *19*, e363. https://doi.org/10.1017/dmp.2025.10280

Azzone, M., Ghesini, M., Stocco, D., & Viola, L. (2025). Physical climate risk in asset management. *Corporate Social Responsibility and Environmental Management*, *33*(1), 1077–1094. https://doi.org/10.1002/csr.70215

Berkhout, F., Hertin, J., & Gann, D. M. (2006). Learning to Adapt: Organisational adaptation to climate change impacts. *Climatic Change*, *78*(1), 135–156. https://doi.org/10.1007/s10584-006-9089-3

Cahan, S. F., De Villiers, C., Jeter, D. C., Naiker, V., & Van Staden, C. J. (2015). Are CSR disclosures value relevant? Cross-Country evidence. *European Accounting Review*, *25*(3), 579–611. https://doi.org/10.1080/09638180.2015.1064009

Carlin, D., Arshad, M., Baker, K., & UN envornomen programme financie intiative [unepfi]. (2023). Climate risks in the real estate sector. In *Sectoral Risk Briefings: Insights for Financial Institutions*. https://www.unepfi.org/wordpress/wp-content/uploads/2023/03/Real-Estate-Sector-Risks-Briefing.pdf

Crossley, R. M., Elmagrhi, M. H., & Ntim, C. G. (2021). Sustainability and legitimacy theory: The case of sustainable social and environmental practices of small and medium-sized enterprises. *Business Strategy and the Environment*, *30*(8), 3740–3762. https://doi.org/10.1002/bse.2837

Cyert, R., & March, J. (1963). *A behavioral theory of the firm*. https://vdoc.pub/documents/a-behavioral-theory-of-the-firm-4nk0idvq3s10?__cf_chl_tk=Mn4t1QDhdS6z0R12DAc1ehmRP9ct1YwsSyBdGWiGOg0-1780211777-1.0.1.1-mgLVzU6UETxuy08f9b0bsDmYmz2KBORYbJ6meAWuSZQ

Deltares. (2025). *Landelijk waterbeeld Grootschalige extreme regen*. https://publications.deltares.nl/11211522_001_0004.pdf

DGBC. (2022). *FRAMEWORK FOR CLIMATE ADAPTIVE BUILDINGS*. https://www.dgbc.nl/publicaties/framework-climate-adaptive-buildings/

DiMaggio, P. J., & Powell, W. W. (1983). The Iron Cage revisited: institutional isomorphism and collective rationality in organizational fields. *American Sociological Review*, *48*(2), 147. https://doi.org/10.2307/2095101

DLA Piper. (2024). *"Greening" your leases: the cornerstone of climate resilience and readiness in commercial real estate*. Dlapiper. https://www.dlapiper.com/en-us/insights/publications/2024/08/greening-your-leases-the-cornerstone-of-climate-resilience-and-readiness-in-commercial-real-estate

Dosa, D., Hyer, K., Thomas, K., Swaminathan, S., Feng, Z., Brown, L., & Mor, V. (2011). To evacuate or shelter in place: Implications of universal Hurricane Evacuation policies on nursing home residents. *Journal of the American Medical Directors Association*, *13*(2), 190.e1-190.e7. https://doi.org/10.1016/j.jamda.2011.07.011

Eichholtz, P., Kok, N., & Weenink, P. (2026). Dutch dilemma: Housing prices and flood risk exposure. *Real Estate Economics*. https://doi.org/10.1111/1540-6229.70027

Engle, N. L. (2011). Adaptive capacity and its assessment. *Global Environmental Change*, *21*(2), 647–656. https://doi.org/10.1016/j.gloenvcha.2011.01.019

EPA. (2025, September 2). *What are heat islands? | US EPA*. https://www.epa.gov/heatislands/what-are-heat-islands

Ferraro, L., Rubino, F. E., Arena, C., & Mazzitelli, D. (2026). Substantive or symbolic? Analyzing the quality of impact reports in Italian B-Corps through legitimacy theory. *Corporate Social Responsibility and Environmental Management*. https://doi.org/10.1002/csr.70416

Gasparrini, A., Guo, Y., Hashizume, M., Lavigne, E., Zanobetti, A., Schwartz, J., Tobias, A., Tong, S., Rocklöv, J., Forsberg, B., Leone, M., De Sario, M., Bell, M. L., Guo, Y. L., Wu, C., Kan, H., Yi, S., De Sousa Zanotti Stagliorio Coelho, M., Saldiva, P. H. N., . . . Armstrong, B. (2015). Mortality risk attributable to high and low ambient temperature: a multicountry observational study. *The Lancet*, *386*(9991), 369–375. https://doi.org/10.1016/s0140-6736(14)62114-0

Green Deal Duurzame Zorg 3.0. (n.d.). Green Deal Duurzame Zorg. https://www.greendealduurzamezorg.nl/green-deal-duurzame-zorg/

Hua, C. L., Patel, S., Thomas, K. S., Peterson, L. J., Andel, R., Gordon, L., Jester, D. J., & Dosa, D. M. (2022). The relationship between exposure to Hurricane Harvey and mortality among nursing home residents. *Journal of the American Geriatrics Society*, *71*(3), 888–894. https://doi.org/10.1111/jgs.18143

Hummel, K., & Schlick, C. (2016). The relationship between sustainability performance and sustainability disclosure – Reconciling voluntary disclosure theory and legitimacy theory. *Journal of Accounting and Public Policy*, *35*(5), 455–476. https://doi.org/10.1016/j.jaccpubpol.2016.06.001

Huynen, M. M., Martens, P., Schram, D., Weijenberg, M. P., & Kunst, A. E. (2001). The impact of heat waves and cold spells on mortality rates in the Dutch population. *Environmental Health Perspectives*, *109*(5), 463–470. https://doi.org/10.1289/ehp.01109463

IPCC. (2021). Summary for policymakers [Report]. In *Climate Change 2021: The Physical Science Basis* (pp. 3–32). Cambridge University Press. https://doi.org/10.1017/9781009157896.001

IPCC. (2022). Summary for policymakers. In *Climate Change 2022: Impacts, Adaptation and Vulnerability. Contribution of Working Group II to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change* (pp. 3–33). Cambridge University Press. https://doi.org/10.1017/9781009325844.001

Karliner, J., Slotterback, S., Boyd, R., Ashby, B., & Steele, K. (2019). *HEALTH CARE'S CLIMATE FOOTPRINT*. https://global.noharm.org/resources/health-care-climate-footprint-report

Kim, S., Shin, H., Shin, H., & Park, S. (2019). Organizational Slack, Corporate Social Responsibility, Sustainability, and Integrated Reporting: Evidence from Korea. *Sustainability*, *11*(16), 4445. https://doi.org/10.3390/su11164445

KlimaateffectAtlas. (n.d.). *KlimaateffectAtlas Nederland*. https://www.klimaateffectatlas.nl/nl/

Klompmaker, J. O., & Hagens, W. I. (2025). Temporal changes in the high-temperature–mortality association in the Netherlands and the potential impact of the implementation of the national heat plan. *Environmental Epidemiology*, *9*(5), e424. https://doi.org/10.1097/ee9.0000000000000424

KNMI. (2023). *KNMI'23 klimaat Scenario's*.

Meyer, J. W., & Rowan, B. (1977). Institutionalized organizations: formal structure as myth and ceremony. *American Journal of Sociology*, *83*(2), 340–363. https://www.jstor.org/stable/2778293

Milieuthermometer Zorg. (2026, June 2). MPZ. https://milieuplatformzorg.nl/tools-voor-verduurzaming/milieuthermometer-zorg/

Nederlandse Zorgautoriteit. (2022). Beleidsregel normatieve huisvestingscomponent (nhc) en normatieve inventariscomponent (nic) geestelijke gezondheidszorg, forensische zorg en langdurige zorg - BR/REG-23116. In *Nederlandse Zorgautoriteit*. https://puc.overheid.nl/doc/PUC_716004_22

NOS. (2021, July 23). *Meer dan 40 miljoen euro schade bij zorginstelling Valkenburg*. https://nos.nl/artikel/2390489-meer-dan-40-miljoen-euro-schade-bij-zorginstelling-valkenburg

OECD. (2025). Future-Proofing Real Estate Investment: Place-Based Risks. In *OECD Urban Studies*. OECD Publishing. https://www.oecd.org/content/dam/oecd/en/publications/reports/2025/11/future-proofing-real-estate-investment_f3d78bbb/2dd12063-en.pdf

Planbureau voor de Leefomgeving. (2024). *KLIMAATRISICO'S IN NEDERLAND: De huidige stand van zaken*.

Rijksdienst voor Ondernemend Nederland [RVO]. (2026). *Energieprestatie - BENG*. RVO.nl. https://www.rvo.nl/onderwerpen/wetten-en-regels-gebouwen/beng

RIVM. (n.d.). *GGD-richtlijn medische milieukunde: hitte en gezondheid*. https://www.rivm.nl/ggd-richtlijn-mmk-hitte-gezondheid

Romanello, M., Di Napoli, C., Drummond, P., Green, C., Kennard, H., Lampard, P., Scamman, D., Arnell, N., Ayeb-Karlsson, S., Ford, L. B., Belesova, K., Bowen, K., Cai, W., Callaghan, M., Campbell-Lendrum, D., Chambers, J., Van Daalen, K. R., Dalin, C., Dasandi, N., . . . Costello, A. (2022). The 2022 report of the Lancet Countdown on health and climate change: health at the mercy of fossil fuels. *The Lancet*, *400*(10363), 1619–1654. https://doi.org/10.1016/s0140-6736(22)01540-9

Sekimoto, T., & Amran, A. (2025). Influence of proactive ESG strategies, slack resources, and collective brain on ESG disclosure and firm value in Japanese companies. *Corporate Social Responsibility and Environmental Management*, *32*(3), 4254–4269. https://doi.org/10.1002/csr.3182

Symeou, P. C., Zyglidopoulos, S., & Gardberg, N. A. (2019). Corporate environmental performance: Revisiting the role of organizational slack. *Journal of Business Research*, *96*, 169–182. https://doi.org/10.1016/j.jbusres.2018.11.019

TCFD. (2017). *Recommendations of the Task Force on Climate-related Financial Disclosures*. https://www.fsb-tcfd.org/recommendations/

Thomas, K., Hardy, R. D., Lazrus, H., Mendez, M., Orlove, B., Rivera-Collazo, I., Roberts, J. T., Rockman, M., Warner, B. P., & Winthrop, R. (2018). Explaining differential vulnerability to climate change: A social science review. *Wiley Interdisciplinary Reviews Climate Change*, *10*(2), e565. https://doi.org/10.1002/wcc.565

TwynstraGudde. (2025). *Is de zorg klaar voor het klimaat van vandaag?* https://www.rijksoverheid.nl/documenten/rapporten/2025/06/23/is-de-zorg-klaar-voor-het-klimaat-van-vandaag

Valente, M., Del Prete, C., Facci, G., Musso, F., Cenati, S., Calligaro, S., Ragazzoni, L., & Barone-Adesi, F. (2025). The impacts of extreme weather events on health services and systems: A systematic review of reviews. *Public Health*, *250*, 106049. https://doi.org/10.1016/j.puhe.2025.106049

Van Loenhout, J., Grand, A. L., Duijm, F., Greven, F., Vink, N., Hoek, G., & Zuurbier, M. (2016). The effect of high indoor temperatures on self-perceived health of elderly persons. *Environmental Research*, *146*, 27–34. https://doi.org/10.1016/j.envres.2015.12.012

Vicedo-Cabrera, A. M., Scovronick, N., Sera, F., Royé, D., Schneider, R., Tobias, A., Astrom, C., Guo, Y., Honda, Y., Hondula, D. M., Abrutzky, R., Tong, S., De Sousa Zanotti Stagliorio Coelho, M., Saldiva, P. H. N., Lavigne, E., Correa, P. M., Ortega, N. V., Kan, H., Osorio, S., . . . Gasparrini, A. (2021). The burden of heat-related mortality attributable to recent human-induced climate change. *Nature Climate Change*, *11*(6), 492–500. https://doi.org/10.1038/s41558-021-01058-x

Vitale, G., Cupertino, S., & Taticchi, P. (2023). Analysing the role of available organisational slack resources in affecting environmental performance. A structural equation modelling approach. *Measuring Business Excellence*, *27*(3), 341–363. https://doi.org/10.1108/mbe-09-2022-0110

World Health Organisation [WHO]. (2020, October 12). *WHO guidance for climate resilient and environmentally sustainable health care facilities*. https://www.who.int/publications/i/item/9789240012226

World Health Organisation [WHO]. (2021, November 8). *2021 WHO Health and Climate Change Survey report*. https://www.who.int/publications/i/item/9789240038509

Zscheischler, J., Westra, S., Van Den Hurk, B. J. J. M., Seneviratne, S. I., Ward, P. J., Pitman, A., AghaKouchak, A., Bresch, D. N., Leonard, M., Wahl, T., & Zhang, X. (2018). Future climate risk from compound events. *Nature Climate Change*, *8*(6), 469–477. https://doi.org/10.1038/s41558-018-0156-3

9. Appendices

9.1 Appendix A: Code

```
API_KEY       = “redacted”

REPORTS_FOLDER = "/content/drive/MyDrive/jaarverslagen"
OUTPUT_CSV    = "/content/drive/MyDrive/resultaten_coderingv1.csv"
PROGRESS_FILE  = "/content/drive/MyDrive/coding_progresstest_coderingv1.json"

MAX_PAGES       = 140
PAGES_PER_CHUNK  = 25
NAME_PAGES      = 5
MAX_RETRIES     = 3
MATCH_THRESHOLD  = 75

# ==========================================================
# ORGANISATIE LOOKUP — NIET AANPASSEN
# fldZorginstelling -> officiele naam
# ==========================================================

ORG_LOOKUP = {redacted}


NAME_TO_ID = {v.lower(): k for k, v in ORG_LOOKUP.items()}
NAMES_LIST = list(ORG_LOOKUP.values())

# ==========================================================
# HIERONDER NIETS AANPASSEN
# ==========================================================

import os, json, time, csv, re, datetime
from pathlib import Path
import anthropic
import fitz
import pandas as pd
from rapidfuzz import process, fuzz

CSV_COLUMNS = [
    'filename', 'extracted_org_name', 'matched_org_name', 'fldZorginstelling',
    'match_score', 'document_type', 'coded_at',
    'DISCLOSURE_LEVEL_controle',
    'PHYSICAL_RISK_MENTION', 'PHYSICAL_RISK_PAGE', 'PHYSICAL_RISK_QUOTE',
    'RISK_IN_RISK_SECTION', 'RISK_SECTION_PAGE', 'RISK_SECTION_QUOTE',
    'RISK_SECTION_RISKS_FOUND',
    'ADAPTATION_ACTION', 'ADAPTATION_PAGE', 'ADAPTATION_QUOTE',
    'GENERIC_SUSTAINABILITY', 'GENERIC_PAGE', 'GENERIC_QUOTE',
    'HEAT_MENTIONED', 'HEAT_PAGE', 'HEAT_QUOTE',
    'WATER_MENTIONED', 'WATER_PAGE', 'WATER_QUOTE',
    'TCFD_CSRD_MENTIONED', 'TCFD_CSRD_PAGE', 'TCFD_CSRD_QUOTE',
    'CLIMATE_STRATEGY_OR_POLICY', 'CLIMATE_STRATEGY_PAGE', 'CLIMATE_STRATEGY_QUOTE',
    'REAL_ESTATE_LINK', 'REAL_ESTATE_PAGE', 'REAL_ESTATE_QUOTE',
    'HEALTH_CARE_CONTINUITY_LINK', 'HEALTH_CARE_CONTINUITY_PAGE', 'HEALTH_CARE_CONTINUITY_QUOTE',
    'INSURABILITY_OR_DAMAGE_COSTS', 'INSURABILITY_PAGE', 'INSURABILITY_QUOTE',
    'total_pages', 'pages_coded', 'error'
]

# ── prompts ──────────────────────────────────────────────────────────────

NAME_EXTRACT_PROMPT = """Je leest de eerste pagina's van een Nederlands zorgorganisatie document.
Geef je antwoord ALLEEN als JSON, exact dit formaat, geen uitleg, geen markdown:

{"org_name": "volledige naam", "document_type": "type"}

Voor org_name: de volledige officiele naam inclusief Stichting of B.V. Als niet gevonden: "ONBEKEND".
Voor document_type: kies het meest passende uit:
  jaarverslag, jaarrekening, bestuursverslag, jaardocument, jaarverantwoording, maatschappelijk jaarverslag
  Als geen van deze past, geef een korte omschrijving. Als niet gevonden: "onbekend"."""

SYSTEM_PROMPT = """Je bent een nauwkeurige onderzoeksassistent die jaarverslagen codeert voor een masterthesis over klimaatdisclosure
bij Nederlandse zorgorganisaties.

Je codeert UITSLUITEND op basis van tekst die letterlijk in het document staat.
```

```
Twijfel = 0. CO2/SDG/ESG zonder link aan fysiek klimaatrisico telt NIET voor physical risk.
Algemene klimaatverwijzingen zonder link aan de eigen organisatie tellen NIET.

Geef output ALLEEN als JSON, geen uitleg, geen markdown, geen backticks. Exact dit formaat:

{
  "PHYSICAL_RISK_MENTION": 0, "PHYSICAL_RISK_PAGE": "", "PHYSICAL_RISK_QUOTE": "",
  "RISK_IN_RISK_SECTION": 0, "RISK_SECTION_PAGE": "", "RISK_SECTION_QUOTE": "",
  "RISK_SECTION_RISKS_FOUND": "",
  "ADAPTATION_ACTION": 0, "ADAPTATION_PAGE": "", "ADAPTATION_QUOTE": "",
  "GENERIC_SUSTAINABILITY": 0, "GENERIC_PAGE": "", "GENERIC_QUOTE": "",
  "HEAT_MENTIONED": 0, "HEAT_PAGE": "", "HEAT_QUOTE": "",
  "WATER_MENTIONED": 0, "WATER_PAGE": "", "WATER_QUOTE": "",
  "TCFD_CSRD_MENTIONED": 0, "TCFD_CSRD_PAGE": "", "TCFD_CSRD_QUOTE": "",
  "CLIMATE_STRATEGY_OR_POLICY": 0, "CLIMATE_STRATEGY_PAGE": "", "CLIMATE_STRATEGY_QUOTE": "",
  "REAL_ESTATE_LINK": 0, "REAL_ESTATE_PAGE": "", "REAL_ESTATE_QUOTE": "",
  "HEALTH_CARE_CONTINUITY_LINK": 0, "HEALTH_CARE_CONTINUITY_PAGE": "",
"HEALTH_CARE_CONTINUITY_QUOTE": "",
  "INSURABILITY_OR_DAMAGE_COSTS": 0, "INSURABILITY_PAGE": "", "INSURABILITY_QUOTE": ""
}

VARIABELE DEFINITIES:

PHYSICAL_RISK_MENTION (0/1): Expliciete verwijzing naar fysieke klimaatrisicos gelinkt aan de eigen organisatie. NIET: CO2, ESG,
SDG, energie zonder fysieke klimaatlink.

RISK_IN_RISK_SECTION (0/1): Fysieke klimaatrisicos expliciet vermeld in de formele risicoparagraaf.
  Situatie 1: score=1 -> PAGE+QUOTE van het fysieke klimaatrisico, RISKS_FOUND = opsomming
  Situatie 2: score=0, maar risicoparagraaf WEL aanwezig -> PAGE+QUOTE van wat WEL als risico staat, RISKS_FOUND = opsomming
  Situatie 3: geen risicoparagraaf -> PAGE="", QUOTE="geen risicoparagraaf gevonden", RISKS_FOUND="geen risicoparagraaf gevonden"

ADAPTATION_ACTION (0/1): Concrete maatregelen tegen fysieke klimaatrisicos (hitteplan, koeling, waterafvoer, groendak). NIET: vage
intenties.

GENERIC_SUSTAINABILITY (0/1): Duurzaamheid ZONDER fysieke klimaatlink (CO2, ESG, SDG, energiebesparing).

HEAT_MENTIONED (0/1): Expliciete vermelding van hitte, hittestress, warme nachten gelinkt aan eigen organisatie.

WATER_MENTIONED (0/1): Expliciete vermelding van wateroverlast, overstroming, extreme neerslag gelinkt aan eigen organisatie.

TCFD_CSRD_MENTIONED (0/1): Expliciete verwijzing naar TCFD, CSRD of EU-taxonomie.

CLIMATE_STRATEGY_OR_POLICY (0/1): Expliciete vermelding van een formele klimaatadaptatiestrategie, beleid, routekaart,
vastgoedstrategie of veerkrachtplan gelinkt aan de eigen organisatie. NIET: vage intenties of algemene duurzaamheidsambities.

REAL_ESTATE_LINK (0/1): Klimaat, hitte, water of duurzaamheid expliciet gelinkt aan gebouwen, locaties, vastgoed, huisvesting, onderhoud,
renovatie of nieuwbouw van de eigen organisatie. NIET: algemene verwijzingen zonder link aan eigen vastgoed.

HEALTH_CARE_CONTINUITY_LINK (0/1): Klimaatrisico expliciet gelinkt aan bewoners, clienten, medewerkers, zorgcontinuiteit,
evacuatie, bereikbaarheid, gezondheid of welzijn binnen de eigen organisatie. NIET: algemene verwijzingen naar volksgezondheid.

INSURABILITY_OR_DAMAGE_COSTS (0/1): Expliciete vermelding van verzekering, schade, stormschade, waterschade, extreme
weerschade, verzekeringspremies of onverzekerbare risicos gelinkt aan de eigen organisatie of haar vastgoed. NIET: algemene verwijzingen
zonder klimaatlink.

SCORINGSREGELS: Score=1 -> vul PAGE en QUOTE in (max 2 zinnen, verbatim). Score=0 -> PAGE en QUOTE leeg. Bij twijfel:
score=0."""

# ── helper functions ──────────────────────────────────────────────

def extract_name_and_type(pdf_path, client, max_pages=3):
    """Returns (org_name, document_type) by reading cover pages."""
    try:
        doc = fitz.open(pdf_path)
        text = ""
        for i in range(min(len(doc), max_pages)):
            page_text = doc[i].get_text()
            if page_text.strip():
                text += f"\n[Pagina {i+1}]\n{page_text}"
        doc.close()
        if not text.strip():
            return "GESCAND_PDF", "onbekend"
        response = client.messages.create(
            model="claude-sonnet-4-6",
            max_tokens=150,
```

```
        system=NAME_EXTRACT_PROMPT,
        messages=[{"role": "user", "content": f"Wat is de naam van de organisatie en het type document?\n\n{text[:3000]}"}]
      )
      raw = response.content[0].text.strip()
      raw = re.sub(r"```json|```", "", raw).strip()
      parsed = json.loads(raw)
      org_name = parsed.get("org_name", "ONBEKEND").strip()
      doc_type = parsed.get("document_type", "onbekend").strip()
      return org_name, doc_type
   except Exception as e:
      return f"FOUT: {e}", "onbekend"

def strip_legal_prefixes(name):
   """Remove common Dutch legal prefixes/suffixes before matching."""
   if not isinstance(name, str):
      return name
   prefixes = [
      'stichting ', 'st. ', 'st ', 'coöperatie ', 'cooperatie ',
      'vereniging ', 'stg. ', 'stg ',
   ]
   suffixes = [
      ' b.v.', ' bv', ' groep', ' group', ' zorggroep',
      ' holding', ' n.v.', ' nv',
   ]
   s = name.lower().strip()
   for p in prefixes:
      if s.startswith(p):
         s = s[len(p):]
         break
   for suf in suffixes:
      if s.endswith(suf):
         s = s[:-len(suf)]
         break
   return s.strip()

def match_org_name(extracted_name):
   """Fuzzy match against ORG_LOOKUP. Returns (fld_id, matched_name, score).
   Strips legal prefixes/suffixes before matching to improve accuracy.
   Score is returned as a clean integer 0-100.
   """
   if not extracted_name or extracted_name in ("ONBEKEND", "GESCAND_PDF") or extracted_name.startswith("FOUT"):
      return None, None, 0

   # build stripped versions of query and candidates
   query_stripped = strip_legal_prefixes(extracted_name)
   stripped_list  = [strip_legal_prefixes(n) for n in NAMES_LIST]

   # try matching on stripped name first
   result = process.extractOne(
      query_stripped, stripped_list,
      scorer=fuzz.token_sort_ratio,
      score_cutoff=MATCH_THRESHOLD
   )

   # fallback: try original name against original list
   if result is None:
      result = process.extractOne(
         extracted_name, NAMES_LIST,
         scorer=fuzz.token_sort_ratio,
         score_cutoff=MATCH_THRESHOLD
      )
      if result is None:
         return None, None, 0
      matched_name, score, _ = result
   else:
      _, score, idx = result
      matched_name = NAMES_LIST[idx]

   fld_id = NAME_TO_ID.get(matched_name.lower())
   return fld_id, matched_name, int(round(score))

def extract_pages_from_pdf(pdf_path, max_pages):
   pages = []
   try:
      doc = fitz.open(pdf_path)
```

```
        total = len(doc)
        for i in range(min(total, max_pages)):
            text = doc[i].get_text()
            if text.strip():
                pages.append((i + 1, text))
        doc.close()
        return pages, total
    except Exception as e:
        return [], 0

def pages_to_chunks(pages, pages_per_chunk):
    chunks = []
    for i in range(0, len(pages), pages_per_chunk):
        batch = pages[i:i + pages_per_chunk]
        chunk_text = "\n\n".join(f"[Pagina {num}]\n{text}" for num, text in batch)
        chunks.append(chunk_text)
    return chunks

def call_claude(client, text_chunk, org_name):
    user_message = f"Codeer dit jaarverslag van {org_name} volgens het codeboek.\n\nDOCUMENT TEKST:\n{text_chunk}"
    for attempt in range(1, MAX_RETRIES + 1):
        try:
            response = client.messages.create(
                model="claude-sonnet-4-6",
                max_tokens=2000,
                system=SYSTEM_PROMPT,
                messages=[{"role": "user", "content": user_message}]
            )
            raw = response.content[0].text.strip()
            raw = re.sub(r"```json|```", "", raw).strip()
            return json.loads(raw)
        except json.JSONDecodeError as e:
            if attempt < MAX_RETRIES:
                print(f" [JSON fout, poging {attempt+1}]", end="", flush=True)
                time.sleep(3)
            else:
                raise RuntimeError(f"JSON parse mislukt na {MAX_RETRIES} pogingen: {e}")

def merge_chunk_results(results):
    merged = {
        "PHYSICAL_RISK_MENTION": 0, "PHYSICAL_RISK_PAGE": "", "PHYSICAL_RISK_QUOTE": "",
        "RISK_IN_RISK_SECTION": 0, "RISK_SECTION_PAGE": "", "RISK_SECTION_QUOTE": "",
        "RISK_SECTION_RISKS_FOUND": "",
        "ADAPTATION_ACTION": 0, "ADAPTATION_PAGE": "", "ADAPTATION_QUOTE": "",
        "GENERIC_SUSTAINABILITY": 0, "GENERIC_PAGE": "", "GENERIC_QUOTE": "",
        "HEAT_MENTIONED": 0, "HEAT_PAGE": "", "HEAT_QUOTE": "",
        "WATER_MENTIONED": 0, "WATER_PAGE": "", "WATER_QUOTE": "",
        "TCFD_CSRD_MENTIONED": 0, "TCFD_CSRD_PAGE": "", "TCFD_CSRD_QUOTE": "",
        "CLIMATE_STRATEGY_OR_POLICY": 0, "CLIMATE_STRATEGY_PAGE": "", "CLIMATE_STRATEGY_QUOTE": "",
        "REAL_ESTATE_LINK": 0, "REAL_ESTATE_PAGE": "", "REAL_ESTATE_QUOTE": "",
                    "HEALTH_CARE_CONTINUITY_LINK":   0,   "HEALTH_CARE_CONTINUITY_PAGE":   "",
"HEALTH_CARE_CONTINUITY_QUOTE": "",
        "INSURABILITY_OR_DAMAGE_COSTS": 0, "INSURABILITY_PAGE": "", "INSURABILITY_QUOTE": ""
    }
    risks_found_parts = []
    for r in results:
        rf = r.get("RISK_SECTION_RISKS_FOUND", "")
        if rf and rf not in ["geen risicoparagraaf gevonden", ""]:
            risks_found_parts.append(rf)
        for var, page_key, quote_key in [
            ("PHYSICAL_RISK_MENTION",      "PHYSICAL_RISK_PAGE",          "PHYSICAL_RISK_QUOTE"),
            ("RISK_IN_RISK_SECTION",       "RISK_SECTION_PAGE",           "RISK_SECTION_QUOTE"),
            ("ADAPTATION_ACTION",          "ADAPTATION_PAGE",             "ADAPTATION_QUOTE"),
            ("GENERIC_SUSTAINABILITY",     "GENERIC_PAGE",                "GENERIC_QUOTE"),
            ("HEAT_MENTIONED",             "HEAT_PAGE",                   "HEAT_QUOTE"),
            ("WATER_MENTIONED",            "WATER_PAGE",                  "WATER_QUOTE"),
            ("TCFD_CSRD_MENTIONED",        "TCFD_CSRD_PAGE",              "TCFD_CSRD_QUOTE"),
            ("CLIMATE_STRATEGY_OR_POLICY", "CLIMATE_STRATEGY_PAGE",       "CLIMATE_STRATEGY_QUOTE"),
            ("REAL_ESTATE_LINK",           "REAL_ESTATE_PAGE",            "REAL_ESTATE_QUOTE"),
             ("HEALTH_CARE_CONTINUITY_LINK", "HEALTH_CARE_CONTINUITY_PAGE", "HEALTH_CARE_CONTINUITY_QU
OTE"),
            ("INSURABILITY_OR_DAMAGE_COSTS", "INSURABILITY_PAGE",         "INSURABILITY_QUOTE"),
        ]:
            if r.get(var, 0) == 1 and merged[var] == 0:
                merged[var] = 1
```

```
                merged[page_key] = r.get(page_key, "")
                merged[quote_key] = r.get(quote_key, "")
    if merged["RISK_IN_RISK_SECTION"] == 0:
        for r in results:
            quote = r.get("RISK_SECTION_QUOTE", "")
            page = r.get("RISK_SECTION_PAGE", "")
            if quote and quote not in ["geen risicoparagraaf gevonden", ""]:
                merged["RISK_SECTION_PAGE"] = page
                merged["RISK_SECTION_QUOTE"] = quote
                break
    if risks_found_parts:
        merged["RISK_SECTION_RISKS_FOUND"] = "; ".join(risks_found_parts)
    elif merged["RISK_SECTION_QUOTE"] and merged["RISK_SECTION_QUOTE"] != "geen risicoparagraaf gevonden":
        merged["RISK_SECTION_RISKS_FOUND"] = "risicoparagraaf gevonden, risicos niet samengevat"
    else:
        merged["RISK_SECTION_RISKS_FOUND"] = "geen risicoparagraaf gevonden"
    return merged

def calculate_disclosure_level(result):
    if result["ADAPTATION_ACTION"] == 1: return 3
    if result["PHYSICAL_RISK_MENTION"] == 1 or result["RISK_IN_RISK_SECTION"] == 1: return 2
    if result["GENERIC_SUSTAINABILITY"] == 1: return 1
    return 0

def load_progress():
    if os.path.exists(PROGRESS_FILE):
        with open(PROGRESS_FILE, "r", encoding="utf-8") as f:
            return json.load(f)
    return {}

def save_progress(progress):
    with open(PROGRESS_FILE, "w", encoding="utf-8") as f:
        json.dump(progress, f, ensure_ascii=False, indent=2)

# ── main ──────────────────────────────────────────────────────────────────────

def run():
    if not API_KEY:
        print("FOUT: Vul je API key in bovenaan het script!")
        return

    reports_path = Path(REPORTS_FOLDER)
    if not reports_path.exists():
        print(f"FOUT: Map niet gevonden: {REPORTS_FOLDER}")
        return

    pdf_files = sorted(list(reports_path.glob("*.pdf")))
    if not pdf_files:
        print(f"FOUT: Geen PDFs gevonden in {REPORTS_FOLDER}")
        return

    progress = load_progress()
    already_done = set(progress.keys())
    remaining = [f for f in pdf_files if f.name not in already_done]

    print(f"Totaal PDFs in map: {len(pdf_files)}")
    print(f"Al verwerkt:        {len(already_done)}")
    print(f"Nog te doen:        {len(remaining)}")
    print(f"Output:             {OUTPUT_CSV}")
    print(f"Gestart om:         {datetime.datetime.now().strftime('%H:%M:%S')}\n")

    client = anthropic.Anthropic(api_key=API_KEY)

    csv_exists = os.path.exists(OUTPUT_CSV)
    csv_file = open(OUTPUT_CSV, "a", newline="", encoding="utf-8-sig")
    writer = csv.DictWriter(csv_file, fieldnames=CSV_COLUMNS)
    if not csv_exists:
        writer.writeheader()

    for i, pdf_file in enumerate(remaining, 1):
        print(f"[{i}/{len(remaining)}] {pdf_file.name}")

        try:
            # stap 1: naam + document type
            print(f"  Naam extractie...", end=" ", flush=True)
```

```
extracted_name, document_type = extract_name_and_type(str(pdf_file), client, NAME_PAGES)
print(f"-> '{extracted_name}' [{document_type}]")

# stap 2: match aan fldZorginstelling
fld_id, matched_name, match_score = match_org_name(extracted_name)
if fld_id:
    print(f"  Match: '{matched_name}' (ID={fld_id}, score={match_score})")
else:
    print(f"  Geen match (score onder {MATCH_THRESHOLD}) - opgeslagen zonder ID")

display_name = matched_name or extracted_name

# gescande PDF afhandelen
if extracted_name == "GESCAND_PDF":
    print(f"  Gescande PDF - overgeslagen")
    row = {c: "" for c in CSV_COLUMNS}
    row.update({
        'filename': pdf_file.name,
        'extracted_org_name': 'GESCAND_PDF',
        'matched_org_name': matched_name or "",
        'fldZorginstelling': fld_id or "",
        'match_score': match_score,
        'document_type': document_type,
        'coded_at': datetime.datetime.now().strftime("%Y-%m-%d %H:%M"),
        'error': 'gescande PDF - handmatig coderen'
    })
    writer.writerow(row)
    progress[pdf_file.name] = row
    save_progress(progress)
    csv_file.flush()
    continue

# stap 3: extraheer paginas
pages, total_pages = extract_pages_from_pdf(str(pdf_file), MAX_PAGES)
if not pages:
    row = {c: "" for c in CSV_COLUMNS}
    row.update({
        'filename': pdf_file.name,
        'extracted_org_name': extracted_name,
        'matched_org_name': matched_name or "",
        'fldZorginstelling': fld_id or "",
        'match_score': match_score,
        'document_type': document_type,
        'coded_at': datetime.datetime.now().strftime("%Y-%m-%d %H:%M"),
        'total_pages': total_pages,
        'pages_coded': 0,
        'error': 'geen tekst extraheerbaar'
    })
    writer.writerow(row)
    progress[pdf_file.name] = row
    save_progress(progress)
    csv_file.flush()
    continue

# stap 4: codeer in chunks
pages_coded = len(pages)
chunks = pages_to_chunks(pages, PAGES_PER_CHUNK)
chunk_results = []
rate_limit_hit = False

for ci, chunk in enumerate(chunks):
    print(f"  Chunk {ci+1}/{len(chunks)}...", end=" ", flush=True)
    try:
        result = call_claude(client, chunk, display_name)
        chunk_results.append(result)
        print("klaar")
        time.sleep(3)
    except anthropic.RateLimitError:
        print(f"\n  Rate limit - 120s wachten...")
        time.sleep(120)
        rate_limit_hit = True
        break

if rate_limit_hit:
    print(f"  Overgeslagen - wordt hervat bij volgende run")
```

```
            continue

        if not chunk_results:
            continue

        # stap 5: merge en sla op
        final = merge_chunk_results(chunk_results)
        disclosure_level = calculate_disclosure_level(final)

        row = {
            'filename': pdf_file.name,
            'extracted_org_name': extracted_name,
            'matched_org_name': matched_name or "",
            'fldZorginstelling': fld_id or "",
            'match_score': match_score,
            'document_type': document_type,
            'coded_at': datetime.datetime.now().strftime("%Y-%m-%d %H:%M"),
            'DISCLOSURE_LEVEL_controle': disclosure_level,
            **final,
            'total_pages': total_pages,
            'pages_coded': pages_coded,
            'error': ''
        }
        writer.writerow(row)
        progress[pdf_file.name] = row
        save_progress(progress)
        csv_file.flush()

        print(f"  LEVEL={disclosure_level} | "
              f"HEAT={final['HEAT_MENTIONED']} | "
              f"WATER={final['WATER_MENTIONED']} | "
              f"STRATEGY={final['CLIMATE_STRATEGY_OR_POLICY']} | "
              f"RE={final['REAL_ESTATE_LINK']} | "
              f"ID={fld_id or 'GEEN'} ({match_score})")
        time.sleep(5)

    except Exception as e:
        print(f"  Fout: {e}")
        row = {c: "" for c in CSV_COLUMNS}
        row.update({
            'filename': pdf_file.name,
            'coded_at': datetime.datetime.now().strftime("%Y-%m-%d %H:%M"),
            'error': str(e)
        })
        writer.writerow(row)
        progress[pdf_file.name] = {"error": str(e)}
        save_progress(progress)
        csv_file.flush()

csv_file.close()
print(f"\nKlaar! Resultaten: {OUTPUT_CSV}")
print(f"Klaar om: {datetime.datetime.now().strftime('%H:%M:%S')}")

# ── statistieken ──────────────────────────────────────────────────────────
df = pd.read_csv(OUTPUT_CSV, encoding='utf-8-sig')

ids = df['fldZorginstelling'].astype(str).str.strip()
ids = ids.replace(['', 'nan', 'None', 'NaN'], pd.NA)

print(f"\n=== STATISTIEKEN ===")
print(f"Totaal rijen:                  {len(df)}")
print(f"Met fldZorginstelling ID:      {ids.notna().sum()}")
print(f"Zonder ID (check handmatig):   {ids.isna().sum()}")

if 'document_type' in df.columns:
    print(f"\nDocument type verdeling:")
    print(df['document_type'].fillna('onbekend').value_counts())

if 'DISCLOSURE_LEVEL_controle' in df.columns:
    print(f"\nDisclosure level verdeling:")
    print(df['DISCLOSURE_LEVEL_controle'].value_counts(dropna=False).sort_index())

for var in ['HEAT_MENTIONED', 'WATER_MENTIONED', 'CLIMATE_STRATEGY_OR_POLICY',
            'REAL_ESTATE_LINK', 'HEALTH_CARE_CONTINUITY_LINK', 'INSURABILITY_OR_DAMAGE_COSTS']:
    if var in df.columns:
```

```
        n = pd.to_numeric(df[var], errors='coerce').fillna(0).astype(int).sum()
        print(f"{var}: {n}")

run()
```

9.2 Appendix B: Model fit

Model	Param.	Log-lik.	AIC	BIC	McFadden R^2	LR test vs. previous model
Model 1	5	−235.71	481.43	499.76	0.0044	—
Model 2	13	−200.34	426.68	474.35	0.1538	$\chi^2(8) = 70.74$, $p < .001$
Model 3	15	−199.60	429.20	484.19	0.1569	$\chi^2(2) = 1.49$, $p = .475$
Model 4	17	−199.19	432.37	494.70	0.1587	$\chi^2(2) = 0.82$, $p = .663$

Note. N = 289 for all models. Each model is estimated as an ordered logistic regression on the same complete-case sample. Parameters include regression coefficients and category thresholds. LR tests compare each model with the preceding one. AIC, BIC and McFadden's R^2 are comparable across Models 1–4 because they use the same four-category ordered outcome.

9.3 Appendix C: Sensitivity checks

	Model 3 (preferred)	Sensitivity A (3-cat)	Sensitivity B (binary)
Heat exposure (z)	0.053	0.051	-0.076
	(0.143)	(0.143)	(0.317)
Water exposure (z)	0.025	0.027	0.383
	(0.143)	(0.143)	(0.373)
Book/acquisition ratio (z)	0.355*	0.355*	-0.013
	(0.148)	(0.148)	(0.307)
Ownership ratio (z)	0.221	0.220	0.156
	(0.154)	(0.154)	(0.433)
Real estate intensity (z)	0.145	0.145	-1.270
	(0.144)	(0.144)	(1.379)
Solvency ratio (z)	0.056	0.057	0.235
	(0.148)	(0.148)	(0.296)
EBITDA margin (z)	0.200	0.197	-0.094
	(0.138)	(0.138)	(0.307)
Green Deal (0/1)	0.349	0.340	-0.396
	(0.346)	(0.346)	(0.616)
MTZ score (z)	0.052	0.049	0.136
	(0.161)	(0.160)	(0.258)
Log revenue (z)	0.966***	0.956***	0.860*
	(0.186)	(0.185)	(0.384)
Wlz share (z)	-0.187	-0.187	-0.029
	(0.149)	(0.149)	(0.292)
Sector: GHZ	0.193	0.184	-0.721
	(0.339)	(0.339)	(0.751)
N	289	289	289

*Note. Standard errors in parentheses. * $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$. All continuous predictors standardised (z-scores). Sensitivity A collapses disclosure levels 2 and 3 into a single physical-disclosure category (three-category ordered outcome). Sensitivity B is a binary logit in which physical disclosure equals 1 if the disclosure level is at least 2.*

9.4 Appendix D: Model 4

	Model 3 (preferred)	**Model 4 (moderation)**
Heat exposure (z)	0.053	0.052
	(0.143)	(0.144)
Water exposure (z)	0.025	0.024
	(0.143)	(0.148)
Book/acquisition ratio (z)	0.355*	0.357*
	(0.148)	(0.150)
Ownership ratio (z)	0.221	0.229
	(0.154)	(0.155)
Real estate intensity (z)	0.145	0.139
	(0.144)	(0.146)
Solvency ratio (z)	0.056	0.082
	(0.148)	(0.151)
EBITDA margin (z)	0.200	0.199
	(0.138)	(0.138)
Green Deal (0/1)	0.349	0.327
	(0.346)	(0.347)
MTZ score (z)	0.052	0.055
	(0.161)	(0.161)
Log revenue (z)	0.966***	0.967***
	(0.186)	(0.188)
Wlz share (z)	-0.187	-0.178
	(0.149)	(0.150)
Sector: GHZ	0.193	0.221
	(0.339)	(0.342)
Heat × Solvency		0.102
		(0.116)
Water × Solvency		-0.003
		(0.126)
N	289	289

*Note. Standard errors in parentheses. * $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$. All continuous predictors standardised (z-scores). Model 3 is reproduced for comparison. Model 4 adds the interactions of solvency with heat and water exposure.*

9.5 Appendix E: Model 3 Brant test

Term	χ^2	df	p
Omnibus	**38.06**	**24**	**0.034**
heat_z	0.25	2	0.883
water_z	3.81	2	0.149
Book/acquisition ratio_z	3.48	2	0.175
ownership_z	0.78	2	0.678
re_intensity_z	1.21	2	0.546
solvency_z	1.22	2	0.543
ebitda_z	2.09	2	0.351
green_deal	3.78	2	0.151
mtz_z	0.30	2	0.862
revenue_z	0.28	2	0.870
wlz_z	0.32	2	0.853
sectorGHZ	3.97	2	0.137

Note. H0: the proportional-odds (parallel-lines) assumption holds. A p-value above 0.05 indicates the assumption is not rejected. The omnibus test is marginally significant ($p = 0.034$), but no individual predictor shows a statistically significant violation. The ordered-logit specification is retained and interpreted alongside the sensitivity checks.