

Money without plans: municipal planning capacity as the binding constraint on Europe’s shelter build-out

Evidence from Poland

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Abstract

Poland’s Civil Protection and Civil Defence Act of December 2024 obliges every municipality to plan shelter capacity for a fixed share of its population and has been followed by civil-protection spending on a scale not seen in decades. This paper asks whether the binding constraint on converting that money into protection is still funding, or whether it has become the capacity of 2,477 municipalities to plan. Using only public data, we estimate the statutory requirement for every municipality, model the cost and duration of meeting it, analyse all 351 shelter-related public tenders published nationally since January 2025, simulate the contribution of the new-building rules, and solve a capacitated facility-location problem for one town using official cadastral data. Poland needs 7.85 million places in protective structures and has about 1.43 million (18% of the target; 3.8% of residents). Closing the gap costs a median PLN 112 billion (P10–P90: 72–163 billion); at the 2025–26 funding pace it takes about 37 years. The requirement is dispersed: 56% falls in municipalities of fewer than 50,000 people. Only 158 municipalities (6.4%) appear as buyers in the national tender bulletin, half of all purchases are design documents, and 28% of concluded procedures end without a contract. New housing will add about 2.5 million ad-hoc places by 2035 but no protective-structure places. In the case-study town, meeting the 25% target requires adapting at least nine specific buildings, chosen from 414 cadastral candidates; extrapolated nationally, the programme implies roughly 18,000–90,000 building-level projects, each of which must be identified, assessed, designed, funded, registered and kept under review. Official sources for twelve European countries show no common definition or dataset, reported coverage from under one to over one hundred places per 100 residents, and a shift towards designating existing buildings, a task that falls on municipalities in Lithuania and Czechia, as in Poland, and that Germany is now organising with its states and local authorities. We conclude that the scarce input is continuous, municipal-scale planning, derive six requirements for systems that provide it, and describe one such system.

Keywords: civil protection; shelters; public procurement; facility location; municipal capacity; civil preparedness; Poland; Europe

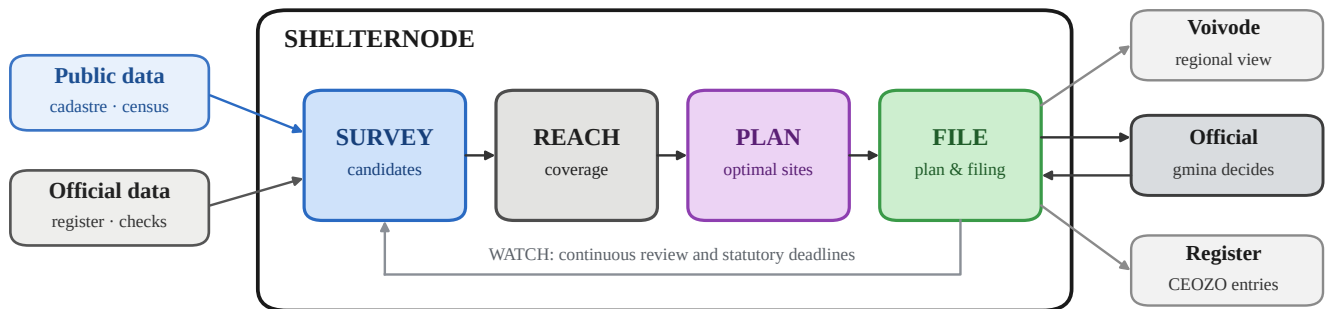


Figure 1. Shelternode at a glance. Public and official data feed a continuous loop owned by each municipality: SURVEY identifies candidate buildings, REACH computes coverage under the distance rule, PLAN selects and costs the sites that meet the statutory target, and FILE produces the plan, the funding application and register entries. The municipal official decides; WATCH reopens the plan whenever a statutory trigger occurs.

1 Introduction

Protecting civilians has moved, in Poland, from a contingency exercise to a political priority. Russia’s full-scale invasion of Ukraine in 2022 placed a high-intensity war on the country’s eastern border, and the years since have brought violations of Polish airspace and sabotage against infrastructure. The state’s response has been legal and financial. The Act of 5 December 2024 on civil protection and civil defence [1] requires the competent authorities to plan collective-protection objects so that, within city limits, at least 50% of the population expected to be present can shelter in a

collective-protection object and at least 25% in a protective structure; outside cities the thresholds are 25% and 15% (art. 90(2)). The Act earmarks at least 0.3% of GDP a year, more than PLN 10 billion, for civil protection, and the 2025–26 Programme allocates PLN 2.4 billion (2025) and PLN 3.6 billion (2026) to collective-protection objects [2].

The starting point is weak. The government’s own Programme describes “a general lack of a concept for how the whole system should function, in particular legally, and of an effective mechanism for financing it” [2, p. 9], and summarises the Supreme Audit Office’s finding that fewer than

4% of residents can count on a place in a shelter or hiding place, ranging from 0.3% to 9% across voivodeships [3]. It names protective structures “the priority in allocating the funds that voivodes direct to local governments” [2, p. 16].

Whether that priority turns into shelters depends on a chain of local decisions: which buildings, where, at what cost, in what order, documented in a form the funder accepts and kept current as the building stock changes. These decisions fall on 2,477 municipalities (*gminy*), 88% of which are rural or mixed urban–rural. This paper tests a simple proposition: *the binding constraint on Poland’s shelter programme is no longer money but municipal planning capacity*. If the proposition holds, the policy response is not only more funding but tools that let small authorities plan continuously (Fig. 1 sketches one, described in Section 7).

Poland is the sharpest case of a European pattern. The report on civil and military preparedness commissioned by the President of the European Commission cites upgrading and, where needed, expanding civil-defence shelters as an example of measures that concretely enhance the ability to survive a crisis [4]; the Preparedness Union Strategy of March 2025 commits the Commission to guidelines that cover “shelter availability” [5], not yet adopted in October 2026; and since September 2025 EU regional funds can finance civil-preparedness investment, with a new indicator that counts shelter places built or renovated [6]. Across Europe, money and mandates appear to be arriving faster than the local capacity to turn them into specific, verified buildings. Poland is where that gap can be measured first, because the statute, the data and the funding already exist.

Contributions. We make six, all built only from public data. (i) To our knowledge, the first published municipality-level estimate of the art. 90(2) requirement and of the existing gap. (ii) A probabilistic estimate of what closing the gap costs and how long it takes. (iii) An analysis of every shelter-related tender in the national procurement bulletin since January 2025. (iv) An estimate of what the new-building rules will contribute. (v) A complete siting analysis for one town on official cadastral data, which turns the national figures into a concrete planning workload. (vi) A comparison of official shelter figures and municipal duties in eleven other European countries, which places the Polish findings in a European frame.

2 Institutional setting

The Act distributes duties across three tiers (Appendix A). Municipal, county and voivode authorities plan the number and capacity of collective-protection objects (art. 90(1)), keep the building stock under continuous review to identify candidates (art. 91(1)), excluding single-family houses and buildings without underground storeys (art. 91(2)), and commission technical checks from the fire service or building control (art. 91(3)–(4)). Collective-protection objects comprise *protective structures* (shelters and hiding places built to technical standards [7]) and *ad-hoc shelter places* (MDS, *miejsca doraźnego schronienia*), lighter spaces such as basements and garages organised at 1.5 m² per person [8]. The siting regulation requires that the distance from a protective structure to where people are present not exceed 500 m within city limits and 1,000 m outside them, set “taking into account

the length of the radius from the entrance and the expected routes of people’s movement” [7, §4].

New construction is governed by arts. 93–95a as amended in 2026 [9]. Public-use buildings must contain a protective structure unless exempted; underground storeys of multi-family and public-use buildings and underground garages must be designed to host MDS at one place per 20 m² of dwelling area, per 15 m² of public-use area, or two per parking space, capped at 1.5 m² per person on 75% of the net underground area (art. 94). Investors in public-use buildings notify the municipality, which has 14 days to agree the competent authority and 45 days to set capacity and resistance category (art. 95a). Grants may cover up to 100% of the additional investment cost of protective functions (art. 106(3)). The state is building a central register of collective-protection objects (CEOZO) [2].

The law sets targets but no deadline. The planning problem is therefore not a one-off exercise but a standing duty, discharged by authorities that differ by three orders of magnitude in size.

3 Data and methods

Appendix B summarises data, methods and assumptions for each analysis.

3.1 Statutory requirement and existing capacity

We use the official population of each *gmina* on 31 December 2024, split into urban and rural parts [10], and apply the art. 90(2) thresholds to each part (37,489,087 residents; 22,275,967 urban). Existing capacity comes from the fire service’s national inventory of October 2022–February 2023 [11]: 10,622 protective structures (1,903 shelters, 8,719 hiding places) with a capacity of about 1.43 million, and 224,113 MDS with a nominal capacity of 49.2 million. The inventory reports structure counts but not capacities by voivodeship; we allocate national capacity in proportion to counts (mean 135 places per structure). We use resident rather than daytime population (Section 8).

3.2 Cost and time

No national cost estimate has been published. We draw 100,000 Monte Carlo samples of two uncertain inputs (Table 1): the share of existing places usable after repair, and the cost per new or adapted protective-structure place, anchored on recent Polish projects [12–15] and a Swiss benchmark [16]. Time to target is computed for three funding paces, assuming all shelter funding buys places at the sampled cost.

3.3 Public procurement

We retrieved every contract notice and tender-result notice published in the national procurement bulletin between 1 January 2025 and 8 October 2026 whose subject matched shelter-related terms [17], excluded false positives (e.g. homeless shelters, cleaning contracts), joined notices by tender identifier and classified each tender by subject into technical assessment, design documentation, design-and-build, or construction/adaptation. The bulletin carries national procedures from PLN 130,000 up to the EU thresholds; smaller purchases and procedures published in the EU’s Official Journal are not included.

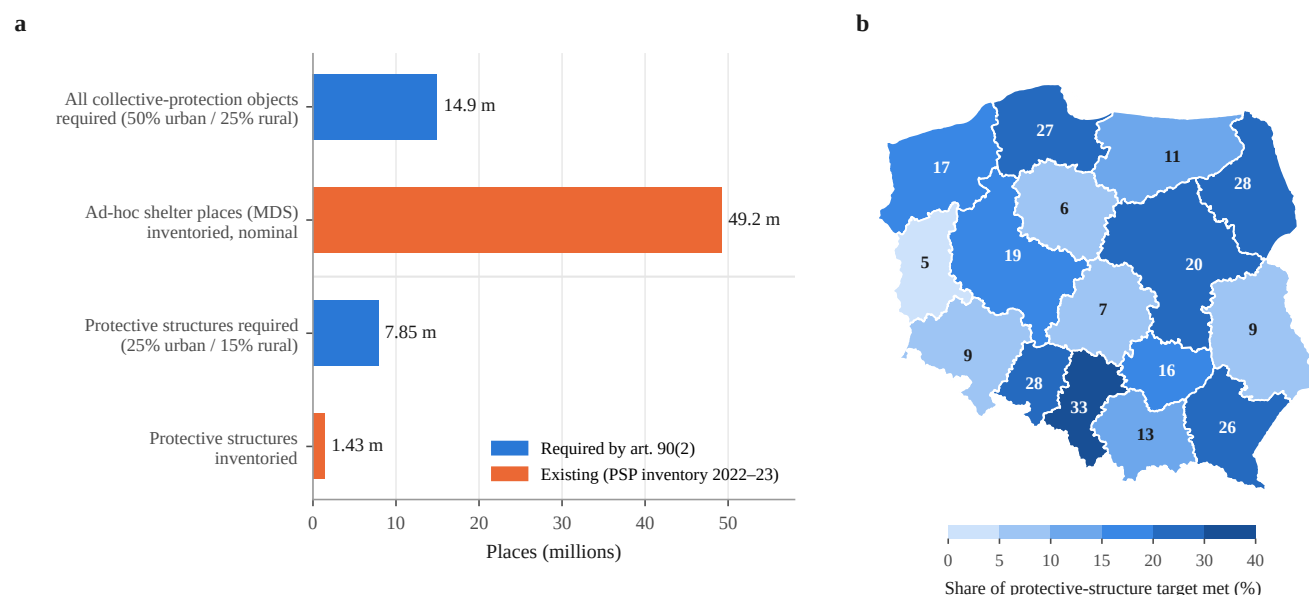


Figure 2. The statutory requirement and existing capacity. (a) Places required under art. 90(2), applied to the population of each gmina on 31 December 2024, against the fire-service inventory of 2022–23. MDS capacity is nominal: spaces were inventoried, not certified. (b) Estimated share of the protective-structure target met, by voivodeship (%). Regional capacity is estimated from structure counts at the national mean of 135 places per structure. Sources: [10, 11]; own calculation.

Table 1. Cost anchors and model inputs. Project figures are reported totals divided by places; the two inputs are sampled in the Monte Carlo model. All other quantities come from official sources.

Reference project or benchmark	PLN per place
Strzyżów 2026: new hiding place for 200, > PLN 5 m [12]	≈ 25,000
Siedlce 2026: modernisation for 150, PLN 3.8 m [13]	≈ 25,300
Gorlice 2026: first-stage grant of PLN 8.4 m for ≈ 1,000 [14]	≥ 8,400
Świętokrzyskie 2026 programme, implied [15]	11,000–19,000
Basel-Stadt replacement levy of CHF 1,400 from 2026 [16]	≈ 6,400
<i>Model inputs</i>	
Cost per new or adapted place (PLN), triangular min / mode / max	6,000 / 15,000 / 30,000
Usable share of the 1.43 m existing places after repair, uniform; widespread poor condition reported by the audit office [3]	0.5–1.0

3.4 New construction

We combine the 179,715 non-individual dwellings permitted in 2025 [18] with the art. 94 rule in a Monte Carlo stock–flow model for 2026–35, sampling annual permits (150,000–200,000), the share of dwellings in buildings with underground storeys (50–85%) and mean dwelling area (50–65 m²), with a 2.5-year lag from permit to occupancy.

3.5 Case study: Wschowa

Wschowa (Lubuskie voivodeship; 12,843 residents) is a small county town in the voivodeship furthest from its target. Building footprints and the walkable network come from OpenStreetMap [19]. For each building we retrieved the official cadastral record (EGiB) from the county’s public map ser-

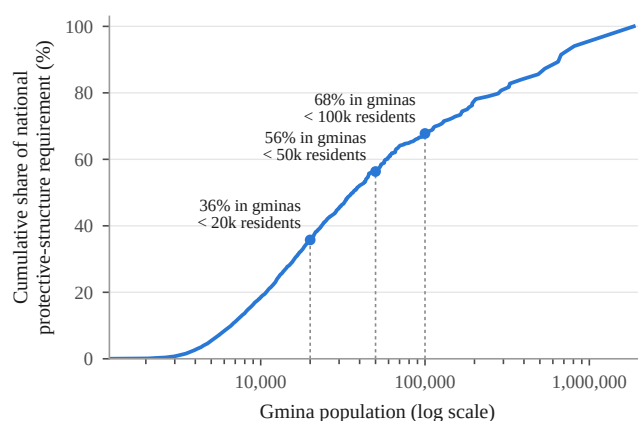


Figure 3. Where the planning burden falls. Cumulative share of the national protective-structure requirement by gmina population (2,477 gminas, log scale).

vice [20]: function class, footprint and the number of storeys above and below ground. Records were obtained for 2,864 of the 3,304 buildings within the town boundary; only 34 buildings with footprints above 200 m² lack a record, none of them tagged as residential in OpenStreetMap (26 carry no type tag).

Residents are allocated to residential buildings in proportion to cadastral floor area (footprint × storeys), a standard dasymetric method [21]. Following art. 91(2), candidates are multi-family residential (three or more storeys, or a footprint of at least 300 m²) and public or commercial buildings with at least one underground storey. No building-level capacity rule for protective structures can be applied from cadastral attributes alone, so we use the statutory density for ad-hoc places as a proxy for space usable after adaptation (art. 94 and [8]): 1.5 m² per person on 75% of the net underground area, with net area taken as 80% of gross footprint per under-

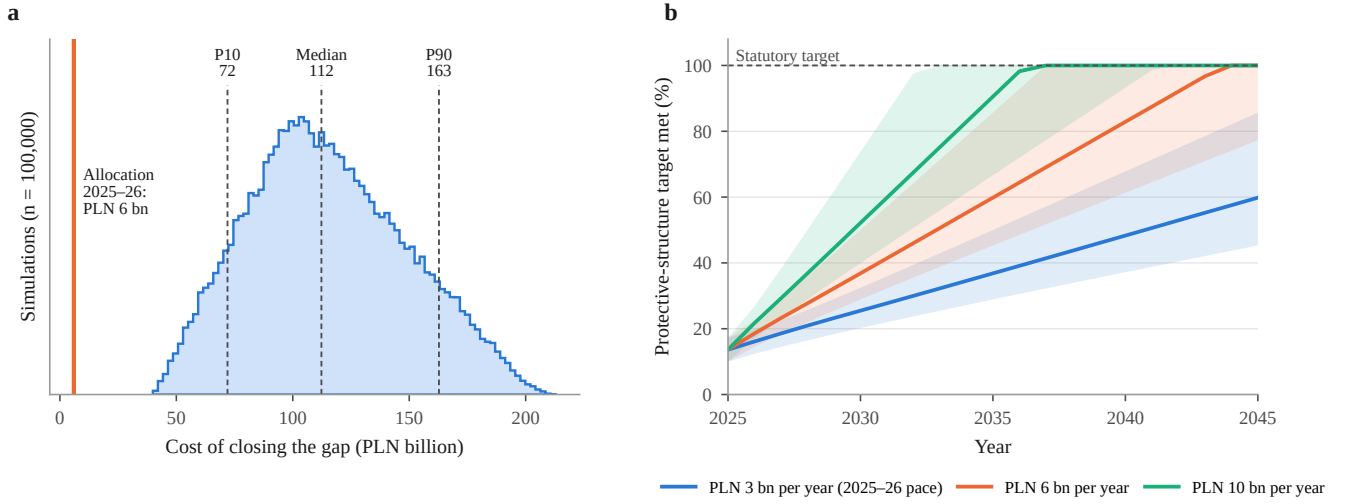


Figure 4. Cost and duration of closing the gap. (a) Distribution of the cost of closing the protective-structure gap across 100,000 simulations (inputs in Table 1), against the 2025–26 allocation. (b) Share of the target met over time under three funding paces; lines show medians and bands the P10–P90 range.

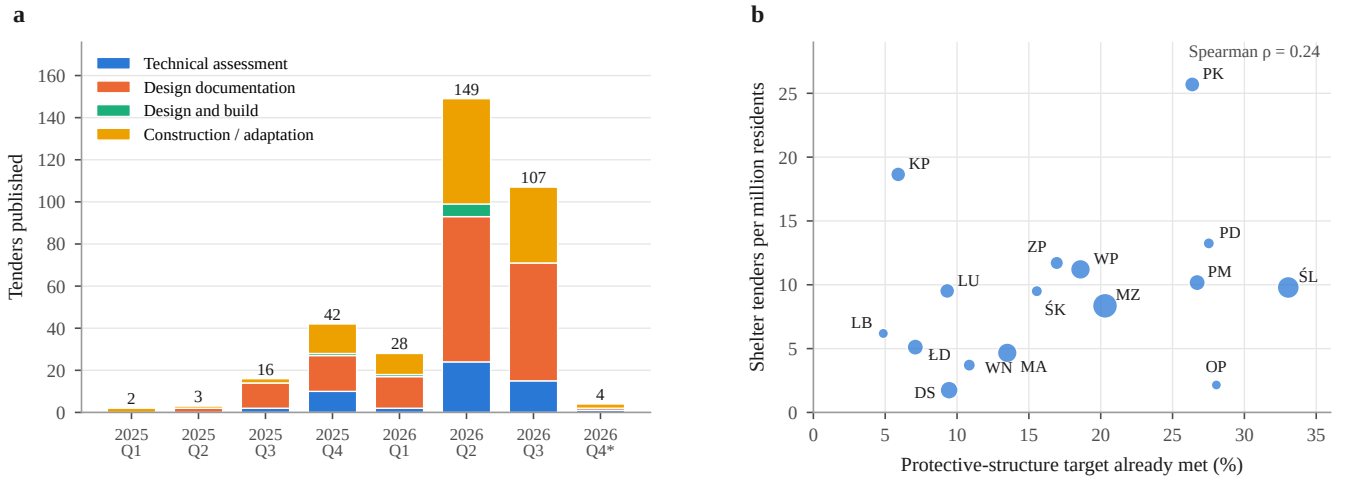


Figure 5. Shelter-related public procurement, January 2025–October 2026. (a) Tenders per quarter by subject (* to 8 October 2026). (b) Tenders per million residents against the share of the protective-structure target already met, by voivodeship of the contracting authority; marker area is proportional to population. Source: own classification of national bulletin notices [17]; procedures from PLN 130,000 up to EU thresholds.

ground storey; buildings below 30 places are excluded. The technical regulation for protective structures [7] sets its own space and equipment standards, so capacities are indicative upper bounds. Distances are computed both as straight lines and as shortest walking routes on the street and footpath network [22].

Site selection is a capacitated maximal covering location problem [23, 24]. With demand cells i (population p_i , 100 m grid), candidates j (capacity c_j) and the set $N_i = \{j : d_{ij} \leq 500 \text{ m}\}$:

$$\begin{aligned} \max \quad & \sum_i \sum_{j \in N_i} p_i x_{ij} \\ \text{s.t.} \quad & \sum_{j \in N_i} x_{ij} \leq 1 \quad \forall i, \quad \sum_i p_i x_{ij} \leq c_j y_j \quad \forall j, \\ & x_{ij} \leq y_j, \quad \sum_j y_j \leq k, \quad x_{ij} \in \{0, 1\}, y_j \in \{0, 1\}. \end{aligned} \quad (1)$$

We solve it with CBC for $k = 1, \dots, 12, 15, 20$ and 25 under both distance definitions (20 s limit per run; reported solutions are best found).

4 Results

4.1 The gap is in protective structures, not places on paper

Applying art. 90(2) to every gmina, Poland requires 14.9 million places in collective-protection objects and 7.85 million (20.9% of residents) in protective structures (Fig. 2a). On paper the first threshold is exceeded more than three times over by the 49.2 million nominal MDS places. The binding constraint is the second: 1.43 million places exist, 18.2% of the requirement and 3.8% of residents, consistent with the audit office's figure [3]. The shortfall is uneven (Fig. 2b): Lubuskie meets an estimated 5% of its target, Kujawsko-Pomorskie 6% and Łódzkie 7%, while Śląskie, with the largest inherited stock, reaches 33%.

4.2 The requirement is dispersed across small authorities

The median gmina must plan for 1,188 protective-structure places, and 1,014 gminas for fewer than 1,000. The ten

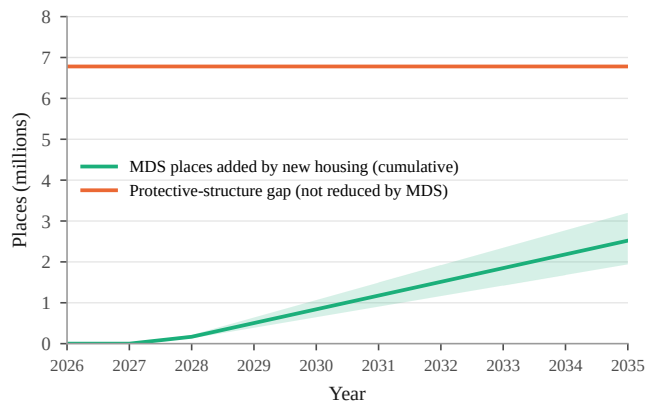


Figure 6. Contribution of the new-building rule. Cumulative MDS places added by new multi-family housing under art. 94 (median, P10–P90 band) against the protective-structure gap, which MDS do not reduce. Permits issued after 31 December 2025 are assumed to reach occupancy after 2.5 years.

largest cities carry only 20% of the national requirement; gminas of fewer than 50,000 residents carry 56%, and those under 20,000 carry 36% (Fig. 3). Most of the planning work therefore sits with small administrations, which are unlikely to employ specialist planning or engineering staff for this task.

4.3 The cost is large and the timeline long

The median remaining gap is 6.78 million places (P10–P90: 6.49–7.07 million) and the median cost PLN 112 billion (72–163 billion; Fig. 4a). The 2025–26 shelter allocation of PLN 6 billion covers about 5% (4–8%). At the 2025–26 pace of roughly PLN 3 billion a year, the median simulation reaches the target in 37 years (24–54); at PLN 6 billion a year in 19 years (12–27); at PLN 10 billion in 11 (7–16; Fig. 4b). Because the law sets no deadline, none of these paths is unlawful, but each implies a period of decades in which the *order* of investment, which buildings first, determines how many people are protected at any given time. That order must be re-decided every year as funds arrive.

4.4 Few authorities are buying, and mostly documents

We identify 351 shelter-related tenders (Fig. 5a). Demand rose from late 2025: 21 tenders were published in the first three quarters of 2025, 42 in the fourth and 149 in the second quarter of 2026 alone. Design documentation accounts for 172 tenders (49%), construction or adaptation for 117 (33%), technical assessments for 54 (15%) and design-and-build for 8 (2%). Median contract values are PLN 290,000 for design, 171,000 for assessments and 1.09 million for works. The prevalence of documentation partly reflects programme design, which directs 2025 funds “first to repairs, modernisation, expert assessments and designs” [2, Annex 1].

The market is thin and fragile. Of 276 tenders with a published result, 77 (28%) ended without a contract; the median number of offers was four, and 14% of contract parts drew a single bid. Only 158 gminas, 6.4% of the total, appear as buyers. Activity per resident ranges from 25.7 tenders per million in Podkarpackie to 1.7 in Dolnośląskie and shows no relationship with need (Fig. 5b); if anything it is slightly higher where more of the target is already met (Spearman $\rho = 0.24$ between activity and share of target met, $n = 16$,

$p = 0.37$). Kujawsko-Pomorskie, second-furthest from its target, is among the most active, while Łódzkie and Lubuskie, also far from theirs, are below the median.

4.5 New construction adds the wrong kind of place

New multi-family housing will add about 336,000 MDS places a year (P10–P90: 258,000–427,000), or 2.5 million (1.9–3.2 million) by 2035 (Fig. 6), about 17% of the all-objects requirement. It adds none of the protective-structure places that are missing: art. 94 creates MDS, and only public-use buildings (art. 93, with exemptions) and underground transport structures (art. 95) must contain protective structures. The protective-structure gap must be closed by deliberately choosing, adapting and funding existing buildings, municipality by municipality.

4.6 What the target means for one town

The cadastre shows that underground space is common in housing but rare in public buildings: 69% of Wschowa’s 550 multi-family residential buildings have at least one underground storey, against 30% of its 104 public and commercial buildings of 300 m² or more (Fig. 7c). Under the statutory capacity rule, 414 buildings qualify as candidates, with a combined capacity of 42,311, more than three times the town’s population. Reach is not the problem: 99.1% of residents live within 500 m of a candidate in a straight line and 94.3% by walking routes.

Capacity per building is. The median candidate holds 76 people and the largest 419. Meeting the 25% target (3,211 places) requires at least nine buildings: six residential blocks, two education or sports buildings and one office building, together holding 3,334 places (Fig. 7a). Because capacity rather than distance binds, the straight-line and walking definitions give the same answer up to $k = 20$ (Fig. 7b). If only 75% of the statutory capacity proves usable on inspection, the model needs twelve buildings; at 50%, nineteen. An earlier run of the same model on OpenStreetMap footprints and assumed basements returned six buildings under walking distance: planning on approximate data understated the workload by a third.

Scaled nationally, the case study converts a financial gap into an administrative one. Dividing the 6.78-million-place gap by the mean capacity of Wschowa’s nine selected buildings (370) gives about 18,000 buildings; at the median candidate capacity (76), about 90,000. Each is a separate project that must be identified, inspected, designed, funded under art. 106, built, entered in CEOZO and kept under review. For comparison, the national bulletin recorded 351 tenders in 21 months.

5 Beyond Poland

5.1 No common yardstick

We found no EU, NATO or OECD source that publishes comparable figures on shelter capacity. The first EU-level metric, an indicator for the “capacity of multi-purpose shelters built or renovated (persons)” added to the European Regional Development Fund in 2025 [6], will count only co-financed projects, not national stocks. We therefore assembled the most recent official figure for twelve countries from agency reports, parliamentary answers and audit-office find-

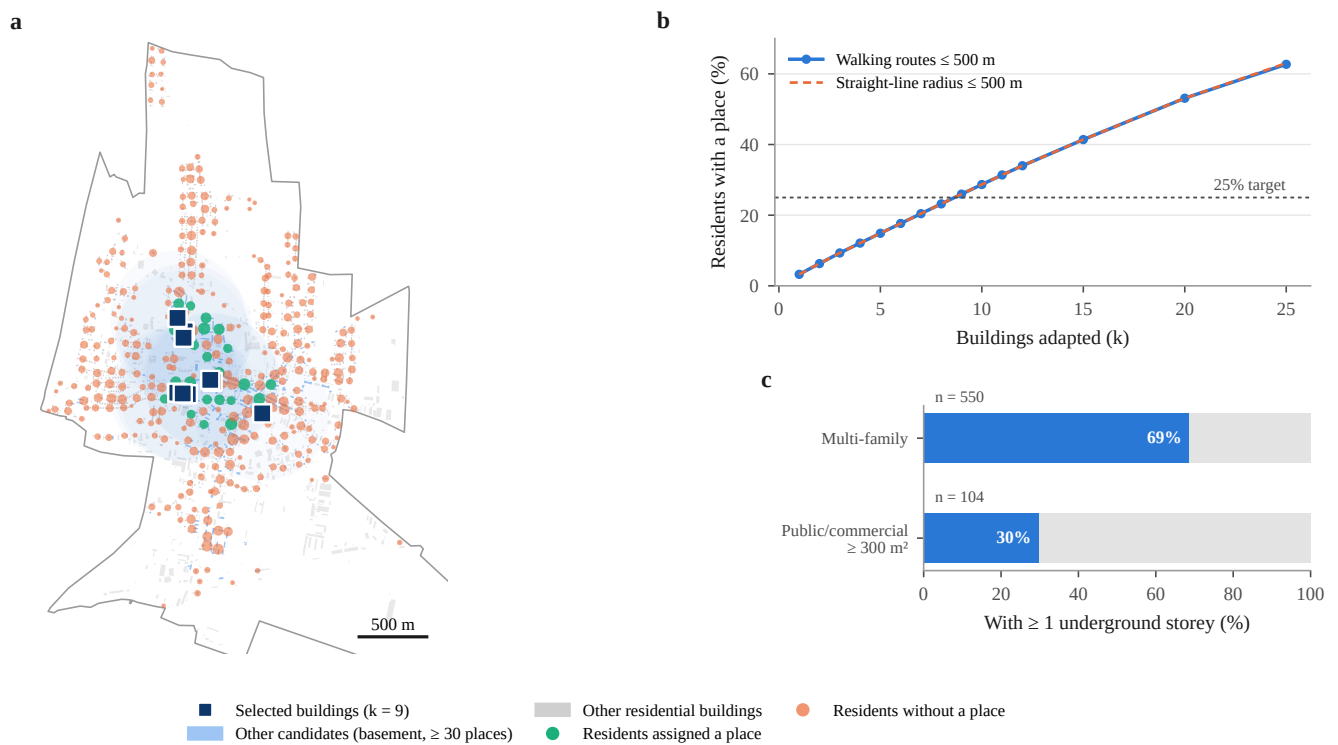


Figure 7. Case study: Wschowa. (a) The nine buildings that meet the 25% protective-structure target under walking distance, with residents assigned and not assigned a place (100 m cells); adjacent selected buildings overlap at this scale. Shaded discs indicate a 500 m radius. (b) Share of residents with an assigned place as a function of the number of buildings adapted, under walking-route and straight-line readings of the 500 m rule. (c) Share of buildings with at least one underground storey in the cadastre. Candidates and capacities are estimated from cadastral attributes and do not describe existing protective structures. Sources: [10, 19, 20]; own calculation.

Table 2. Approaches to municipal shelter planning against the requirements implied by the findings. ✓ met; ◦ partly; – not met.

Requirement (finding)	One-off study	National register	Generic GIS	Continuous municipal system
R1 Stays current under art. 91 review	–	◦	◦	Re-runs as buildings, permits and funding change
R2 Usable by a gmina without specialist staff (56% of need in gminas < 50k)	◦	✓	–	Built for one official; public data pre-loaded
R3 Works from cadastral detail, not footprints (workload understated by a third)	◦	–	◦	EGiB attributes, art. 91(2) filter, statutory capacity rule
R4 Chooses and orders buildings under a budget (decades-long sequence)	◦	–	◦	Capacitated optimisation with cost and art. 106 funding
R5 Comparable across gminas for the voivode (weak link between need and activity)	–	◦	–	Common criteria; regional view and reporting
R6 Produces the documents the process requires (49% of purchases are documents)	✓	–	–	Plan, application and register export generated from one model

ings (Fig. 8; Appendix C); Austria publishes none. Reported coverage spans more than two orders of magnitude, from about 106 places per 100 residents in Switzerland, where the law aims at one place for every resident [26], to 0.6 in Germany, whose 579 remaining public shelters the federal government describes as “neither functional nor operational” [27]. Austria’s federal government reports no figure, leaving shelters to the states’ building codes [28]. Definitions explain part of the spread: Switzerland, Finland, Sweden, Norway, Czechia and Germany count shelters built to a protection standard, while Denmark, Lithuania, Latvia and Estonia count designated or adapted spaces, mostly basements. Poland shows the problem within one country: 3.8 places per 100 residents in protective structures, 131 in nominal ad-hoc

places.

5.2 The duty is moving to municipalities

Countries that are expanding capacity now rely largely on designating existing buildings, alongside new-build requirements, and several assign that work to local government, as Poland does. In Germany, municipalities administer the remaining public shelters [29], and the federal civil-protection agency’s guidance to local authorities assigns them the identification and recording of public refuge rooms in existing buildings, such as underground car parks, metro stations and basements, from March 2026, with follow-on costs left to them [30]. The underlying federal–state concept is still to be put to the autumn 2026 interior ministers’ conference, and implementation had begun with two pilot projects by July

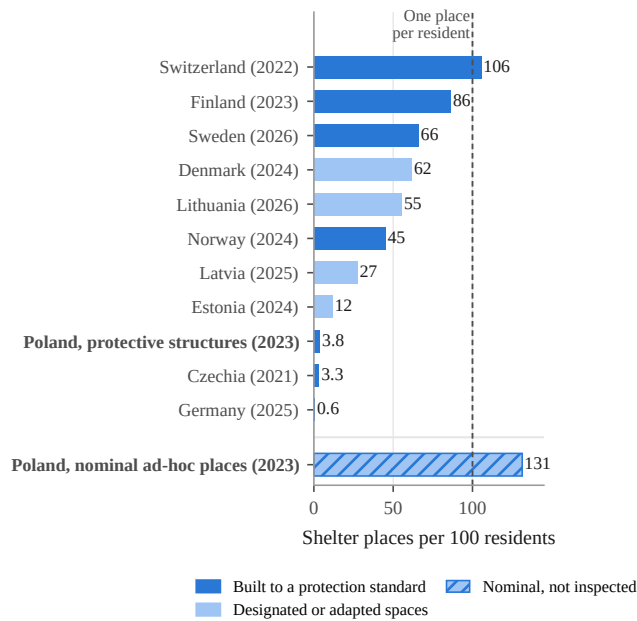


Figure 8. Reported shelter capacity in Europe. Most recent official figure for each country, divided by resident population; year of the capacity figure in brackets. Definitions differ (shading; hatched: nominal places, not inspected); Danish figures include basements that must be prepared before use, and Germany’s 579 remaining public shelters are reported as not operational. Austria publishes no figure. Sources in Appendix C; population from Eurostat [25] and GUS [10].

2026 [31]. In Lithuania the mayor determines the need for shelters and approves their selection; the national audit office found that none of the municipalities it assessed could document the required consultations and described “a vacuum of responsibility” [32]. Czech law makes the municipal office responsible for sheltering the population, while the national shelter statistics are kept voluntarily by the interior ministry [33]. Norway’s draft regulation of June 2026 proposes municipal shelter-capacity plans and lower-protection spaces such as parking garages instead of a general duty to build shelters in new buildings [34]; Sweden has added a lower-protection category of protected spaces since June 2026 [35]. The counter-cases are instructive: Estonia centralises the task in the national Rescue Board [36], Latvia’s fire service surveys and certifies shelters while municipalities hold the location data [37], and Denmark transferred the power to require shelters in new buildings from municipalities to the state in 2026, while municipalities keep the public shelters [38].

5.3 What transfers

The method of Section 3 needs population by small area, a building register that records use and underground storeys, and a walkable network. The network is available everywhere from OpenStreetMap; registers exist in national formats, and Denmark already used its building register to update shelter counts [39]. Thresholds, distance rules and capacity norms differ by country, so a planning system must hold the law as parameters rather than hard-coding it. What transfers unchanged is the shape of the problem: many small authorities, thousands of building-level decisions, and plans that must be kept current.

6 Discussion

6.1 Why current approaches do not close the gap

The findings point to a mismatch between the shape of the task and the shape of the tools. The task is continuous (art. 91), dispersed across thousands of small authorities (Fig. 3), sequential over decades (Fig. 4b), and decomposes into tens of thousands of building-level decisions that depend on cadastral detail (Fig. 7). Table 2 turns these findings into six requirements, R1–R6, and scores the three kinds of tool available against them. One-off consultant studies produce a plan for a single municipality at a point in time; at the observed price of documentation few small authorities have bought them (Fig. 5), and a one-off study does not stay current under a continuous duty. The national register records objects once identified but does not identify, compare or prioritise candidates. General-purpose GIS can do all of these things in principle but requires skills that a gmina of 10,000 people does not employ.

6.2 Design principles

Beyond R1–R6, three principles follow from the institutional setting. *The public authority must own the data:* individual building attributes are public, but an aggregated map of where a region’s protection is weakest is sensitive, so deployment must be possible on the national government cloud or on the authority’s own servers. *Legal choices must be explicit:* where the regulation leaves room, as in combining radius and walking routes, the system should compute both readings and show the difference. *People decide and reasoning is visible:* software proposes candidates and orderings; officials decide, and licensed engineers or the fire service verify every site under art. 91. Together with R1–R6 these define what a planning system must do to relieve the constraint identified here.

7 Shelternode: a continuous planning system

We have begun building such a system, *Shelternode*, named for its object of work: every candidate building, protective structure and authority is a node in a network whose state changes as buildings are permitted, inspected, funded and rebuilt. It implements the analysis of Sections 3–4 as a loop owned by each gmina, with a regional view above it (Fig. 1). *SURVEY* identifies candidate buildings from the topographic database (BDOT10k), the cadastre (EGiB), GUS and OpenStreetMap, applying the art. 91(2) exclusions. *REACH* computes coverage under both readings of the distance rule. *PLAN* solves the capacitated siting problem of Eq. (1) with cost ranges and available funding, and ranks options by places gained per złoty. *FILE* produces the municipal plan, the funding application and data for the national register. *WATCH* keeps the plan current: it tracks the art. 91 review, the art. 95a clock triggered by investor notifications, and other statutory deadlines. *REGION* gives the voivode office comparable views of all its gminas; *BUILD* lets developers and architects compute art. 94 capacity and prepare art. 95a notifications.

Run on Wschowa, the loop is concrete. *SURVEY* returns 414 candidates; *REACH* shows that 94% of residents live within a 500 m walk of at least one; *PLAN* proposes the nine buildings of Fig. 7a and the sequence in which to fund them; *FILE* drafts the application; the official chooses, and an en-

gineer inspects the selected sites before money is committed. When a block is permitted or a school is rebuilt, WATCH re-opens the plan rather than waiting for the next study. The approach starts in Poland because the statute, the funding and the urgency coincide there. Section 5 shows the same local identification task present in Lithuania and Czechia and emerging in Germany and Norway; because civil protection is a national competence, each country needs its own rule set and data adapters rather than a different method.

8 Limitations

Data. National capacity dates from the 2022–23 inventory and regional capacities are estimated from counts. The case study relies on cadastral storey counts, which record the presence of underground storeys but not their condition, height or fit-out; capacities use the ad-hoc-place density as a proxy and are upper bounds that inspection may reduce, as the sensitivity analysis shows.

Population. Art. 90(2) refers to the population expected to be present, not residents. Daytime population differs in town centres and industrial areas; a working system must model both.

Costs. Table 1 rests on a handful of projects and one foreign benchmark, and repairs to the existing usable places are not costed, so in that respect the estimate is conservative. The range is wide by design; the qualitative conclusions, a gap tens of times larger than annual funding and a timeline measured in decades, hold across it.

Procurement. The bulletin excludes purchases below PLN 130,000 and above the EU thresholds, and classification relies on titles. The 6.4% figure is a lower bound on the share of municipalities buying anything.

Extrapolation. The national workload estimate scales one town's capacity distribution; large cities with deep basements and underground garages will need fewer, larger projects, and rural gminas more, smaller ones.

Comparisons. The European figures use national definitions and reference dates from 2021 to 2026 and, for Denmark, Lithuania, Latvia and Estonia, count designated rather than purpose-built spaces. They indicate orders of magnitude and the location of duties, not a ranking.

Scope. We model capacity and distance, not resistance categories, ventilation or CBRN protection. Which threats to plan against is a policy decision. Because aggregated gap analyses are sensitive, results are reported at voivodeship level and for one illustrative town.

9 Conclusion

Poland has written shelter targets into law and is spending real money to meet them. The evidence assembled here suggests that money is necessary but not sufficient: at current rates the protective-structure target is decades away, new construction adds the wrong kind of place, few municipalities have entered the market, and most of what they buy is documentation that a continuous duty will require to be kept up to date. In one small town, meeting the target means choosing nine or more specific buildings out of four hundred candidates on the basis of cadastral detail; nationally, tens of thou-

sands of such choices must be made, sequenced and revisited. The scarce input is the capacity of 2,477 municipalities to make those decisions continuously. That capacity can be built in software, and the next step is to test it: on official data for a pilot municipality with fire-service verification of every proposed site, and then in a voivodeship against a real funding round. The same test matters beyond Poland: as Germany, the Baltic states and others expand capacity by designating existing buildings, and as EU funds begin to pay for shelter places, the question everywhere will be not whether money exists but whether someone can say, building by building, where it should go.

Data and code availability

All inputs are public and listed in the references. Analyses were written in Python (pandas, GeoPandas, NetworkX, PuLP/CBC, matplotlib). Municipality-level results other than the illustrative case are withheld for security reasons and are available to public authorities on request.

Competing interests

The author is developing the planning system described in Section 7.

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A Recurring duties under the Act

Provision	Duty	Responsible	Timing
Art. 90(1)–(2)	Plan the number and capacity of collective-protection objects against the 50/25 (urban) and 25/15 (rural) thresholds	Wójt or mayor, starosta, voivode	Continuous
Art. 91(1)–(2)	Review buildings, including planned ones, to identify candidates; exclude single-family houses and buildings without underground storeys	As above	Continuous (<i>bieżący przegląd</i>)
Art. 91(3)–(4)	Commission checks of candidate buildings by the fire service or building control	As above	As candidates are identified
Art. 90(3)	Building control notifies the mayor when a building designed with protective-structure conditions is put into use	Building control, gmina	On each occupancy
Art. 93(2)–(3)	Decide on exemptions from the protective-structure duty in public-use buildings; appeal to the voivode	Wójt or mayor	Per application
Art. 95a(2)–(4)	For public-use buildings and underground transport structures: agree the competent authority (14 days) and set capacity and category (45 days); after 3 months the investor may proceed with ≥ 30 places	Gmina, starosta, voivode	Per investor notification
Art. 106	Grants of up to 100% of the additional investment cost, on application by the owner or manager	Owner applies; voivode or minister pays	Each funding round

B Summary of methods and assumptions

Analysis	Data	Method	Key assumptions
Requirement and gap	GUS population by gmina, urban and rural, 31.12.2024 [10]; fire-service inventory [11]	Art. 90(2) thresholds applied to town and rural parts of each of 2,477 gminas	Residents as expected population; regional capacity = count $\times$ national mean
Cost and time	As above; project costs (Table 1)	Monte Carlo, $n = 100,000$	Usable share $U(0.5, 1.0)$; cost $\text{Tri}(6k, 15k, 30k)$ PLN; funding fully converted to places
Procurement	Bulletin notices 01.2025–10.2026 [17]	Keyword retrieval, exclusion of non-shelter subjects, rule-based classification, join by tender ID	Titles describe the purchase; national procedures only
New construction	GUS permits 2025 [18]; art. 94 [9]	Monte Carlo stock–flow, 2026–35	Permits 150–200k/yr; 50–85% with underground storeys; 50–65 m ² /dwelling; 2.5-year lag
Case study	EGiB building attributes [20]; OSM footprints and paths [19]; GUS town population	Dasymetric population; Dijkstra distances; capacitated MCLP (CBC)	Multi-family = ≥ 3 storeys or ≥ 300 m ² ; capacity = footprint $\times$ underground storeys $\times 0.8 \times 0.75 / 1.5$ m ² ; ≥ 30 places

C European shelter figures

Country	Places	Per 100	Year	What is counted	Source
Switzerland	9.3 m	105.5	2022	Shelters built to the federal standard; aim of one place per resident	Federal Office for Civil Protection [26]
Finland	4.8 m	86.3	2023	Shelters built to decree classes S1, S2 and rock (preliminary data)	Ministry of the Interior [40]
Sweden	7.0 m	66.0	2026	Purpose-built shelters (stable register figure)	Government Offices [35, 41]
Denmark	3.68 m	61.6	2024	Mostly private basements prepared when needed, public shelters, supplementary rooms	Answer to Folketing question [42]
Lithuania	1.6 m	55.4	2026	Designated short-term shelters, mostly basements	Ministry of the Interior [43]
Norway	2.5 m	45.0	2024	Shelters built 1948–1998; none since	Civil Defence (DSB) [44]
Latvia	510,252	27.4	2025	Shelters fully or partly meeting requirements, mostly adapted basements	State Fire and Rescue Service [37]
Estonia	160,000	11.6	2024	Public sheltering places with fragment protection	Government memorandum, Bill 662 SE [36]
Poland	1.43 m	3.8	2023	Protective structures (shelters and hiding places)	Fire-service inventory [11]
Czechia	347,000	3.3	2021	Permanent shelters only	Supreme Audit Office [33]
Germany	477,593	0.6	2025	579 public shelters, reported not operational	Federal government, Bundestag [27, 31]
Austria	–	–	–	No national figure held by federal ministries	Parliamentary answer [28]

Per 100 residents: places divided by population on 1 January of the nearest year (Eurostat [25]; Denmark 1 July 2024, Statistics Denmark [45]; Poland 31 December 2024, GUS [10]). Year is that of the capacity figure; Sweden's is described as current in 2026 documents, and Germany's is the date of the government's answer (the underlying inventory is undated, 2022–24).