Department for Energy Security & Net Zero

Heat Network Zoning Pilot

Supporting Methodology Statements

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Contents

Introduction

This document provides a set of supporting methodology statements to accompany the Zone Opportunity Reports published as part of the Heat Network Zoning Pilot Programme (hereafter the Pilot or Pilot programme). The Pilot set out to develop a process for identifying zones in a consistent and standardised manner across a range of towns and cities in England.

The programme was fully funded and led by DESNZ, working alongside 28 Local Authorities, and multiple consultancy firms, to develop and test an approach at a local level. Most of the work was undertaken before, and during, the development of the Heat Network Zoning policy itself, and should not be viewed as the final methodological approach for identifying zones once the legislation is introduced. Lessons from the Pilot will be used to improve on the methodology for identifying zones in the future.

This document contains the following sections:

Appendix 3 – Glossary & Definitions: A glossary of terms and definitions used throughout the zone opportunity reports.

Appendix 4 – Tables & Graphs: Specific definitions and methodologies used to calculate figures provided in tables and graphs.

Appendix 5 – Methodology Statements: A detailed methodology outlining the steps for the identification and refinement of heat network zones.

Appendix 3 – Glossary & Definitions

Acronym/Term	Description
Anchor Load	Buildings with such significant and consistent heat demands that they are among the first to be connected to heat networks projects.
Advanced Zoning Programme (AZP)	As part of this programme, DESNZ is working with a small group of towns and cities to support the construction of new zonal scale heat networks as quickly as possible following the launch of heat network zoning in 2025.
Campus Heat Networks	A series of buildings connected to a district heat network where the building owner and heating plant owner are either the same or are related parties, for example a university, prison or hospital site.
CapEx	Capital expenditure
Central Authority	A new national body that will perform zoning tasks requiring a standardised approach across England, for example the national mapping exercise. The Central Authority will also support Zone Coordinators in undertaking their functions.
Communal Heat Network	A type of heat network in which heating, cooling or hot water is supplied only to a single building divided into separate premises or persons in those premises.
CO2e	Carbon dioxide equivalent
Data Room	The key data sets generated or collected throughout the Pilot programme
Department for Energy Security and Net Zero (DESNZ)	The central government department responsible for heat network policy and delivery. See: https://www.gov.uk/government/organisations/department-for-energy-security-and-net-zero
District Heat Network	A type of heat network in which heating or cooling is supplied to two or more buildings by a pipework network typically transmitting hot or cold water.
Energy Act 2023	Primary legislation that provides powers for the Secretary of State to introduce heat network zoning in England, via zones regulations.
Existing Heat Network(s)	An existing heat network is a heat network which is wholly or partly within a heat network zone
Full Opportunity Capacity	The maximum theoretical or modelled heat supply capacity from a given heat source

Green Heat Network Fund (GHNF)	A government capital grant fund that supports new and existing heat networks in England to adopt low-carbon technologies such as heat pumps, geothermal, recovered heat and energy from waste. See: https://www.gov.uk/government/publications/green-heat-network-fund-ghnf
Geographic Information System (GIS)	A computer system that uses software to gather, analyse, and display geographic data
Heat Network (HN, HNs)	Heat Network - A network that, by distributing a liquid or a gas, enables the transfer of thermal energy for the purpose of supplying heating, cooling or hot water to a building or persons in that building (and includes any appliance the main purpose of which is to heat or cool the liquid or gas).
Heat Networks Investment Project (HNIP)	A £320 million government funding programme that is now closed for applications. It aims to increase the number of heat networks being built, deliver carbon savings and help create the conditions necessary for a sustainable heat network market to develop. See: https://www.gov.uk/government/publications/evaluation-of-the-heat-networks-investment-project-hnip-scheme
Heat Networks Delivery Unit (HNDU)	A team within DESNZ which provides support to local authorities and others in England and Wales through the early stages of heat network development, including heat mapping, energy master planning, techno-economic feasibility and detailed project development.
Heat Network Operator	An organisation that is responsible for the day-to-day operation and maintenance of a heat network and its infrastructure. See “Heat Network supplier” used in recent consultation.
Heat Network Opportunity Area	An area, identified by the National Zoning Model, which fulfils zone criteria and may present an attractive commercial opportunity for heat network developers but is not currently designated as a heat network zone and therefore does not confer or provide access to any zoning. See “Indicative HNZ(s)”
Heat Network Supplier	An organisation that is responsible for the supply of heating, cooling or hot water through a heat network often via contractual terms to end consumers. See “Heat Network operator” used in the HNZ pilot.
Heat Network Zone (HNZ)	A “heat network zone” will be a defined geographical area where heat networks are expected to provide the lowest cost solution for decarbonising heat.
Heat Network Zoning Pilot	DESNZ is working with 28 English cities and towns to develop and test the zoning methodology that will identify and designate heat

Programme (HNZPP)	network zones, using a prototype heat network zoning model to identify potential heat network zones.
Existing Heat Network(s) (formerly incumbent)	Referring to a heat network that is already operating or developing in an HNZ, prior to the introduction of zoning regulations. In the pilot, referred to as "Existing and planned HN(s)"
Indicative HNZ(s)	The map and data produced by the National Zoning Model (NZM) which have yet to undergo refinement. See "Heat Network opportunity area". In the pilot, this includes both Strategic and Other HNZs (See definitions in this section).
Initial Zone Opportunity (IZO)	Initial Zone Opportunities – One or more areas within a HNZ where the strongest investment opportunities may exist for heat network development.
kgCO_2e	Kilograms of carbon dioxide equivalent
kt	Kilotonnes (i.e. one thousand tonnes)
kW	Kilowatt (rate of energy)
kWh	Kilowatt hour (amount of energy)
kWp	Kilowatt peak (maximum amount of energy)
Local Authority (LA)	An administrative body in local government
Linear Heat Density (LHD)	A metric that measures the annual heat demand (MWh/yr) per meter (m) of pipe in a heat network. It is sometimes used a proxy for economic viability.
mt	One mega tonne – i.e. One million tonnes
New development	Any type of new development (e.g. commercial, residential, industrial) with an anticipated heat demand greater than 100MWh/yr, with an expected 'spade in the ground' after 2025 and but before 2035.
National Zoning Model (NZM)	A data-led spatial energy model developed by DESNZ to support the identification of indicative heat network zones across England.
OpEx	Expenses incurred, generally to run and operate capital assets
Other Buildings	Buildings which are not required to connect under the Heat Network Zoning policy
Other Heat Network Zone	Zones that are generally smaller and discrete
Public Sector Decarbonisation Scheme (PSDS)	Public Sector Decarbonisation Scheme - DESNZ scheme which provides grants to public sector bodies to fund heat decarbonisation and energy efficiency measures

RepEx	Replacement expenditure incurred for replacing capital assets
Required to connect (Buildings/Heat demand)	Buildings that may be required to connect under the Heat Network Zoning policy. This assumes the proposal as per the 2023 consultation - new buildings, large non-domestic buildings, and communally heated residential blocks in zones and within connection distance to an existing or proposed heat network.
Strategic Heat Network Zone	The largest zones which are generally seen as strategically significant to developing heat networks in an area
t	Tonne – One metric tonne, i.e. one thousand kilograms
TEM	Techno-economic model or modelling - The process of estimating the technical and economic performance of a proposed or envisioned project, through use of a computer-based simulation/calculation tool typically developed in a spreadsheet or specialist software package.
Zone	See HNZ
Zoning Technical Consultant (ZTC)	Consultants who undertook the work in the Pilot programme

Appendix 4 – Tables & Graphs

Executive Summary Specific Definitions:

Acronym/Term	Description and outline methodology
CapEx	The 'Capital Expenditure' required for the: - full build out of heat networks within all the zones identified; - build out of the IZOs identified within the Strategic zones. The CapEx for the build out of the Initial Zone Opportunities (IZOs) has been calculated within a techno-economic model developed for the Pilot programme. These outputs were then used to extrapolate the CapEx for the full build out of heat networks across all the zones identified. This full build out across all zones identified is therefore a high-level estimate, and not a calculated figure. Costs include main capital plant; energy centres; connections to heat sources; heat network and connections; utilities connections; costs associated with addressing the most severe obstacles to network build-out. Costs exclude any secondary or tertiary upgrade/retrofit costs; costs associated with area-wide utilities upgrades and wider enabling infrastructure beyond the project's envelope (e.g. new electrical grid supply points).
Heat	The total annual requirement for space heating and hot water is summarised for: - All buildings within **all zones identified** in the study area; - All buildings within the **strategic zones** identified; - Buildings generally only considered required to connect in the **initial zone opportunities** identified. - These figures are primarily generated from outputs from the prototype NZM. Where metered data was available this has been used instead. New development heat loads have been benchmarked using DESNZ guidance, applied by the Consultants. All buildings within **all zones identified** includes all buildings identified within the heat network zone boundary, including buildings that may be required to connect; buildings that are voluntary connections, and

	buildings where heat networks may not be the lowest cost approach to decarbonising heat. All buildings within the **strategic zones**, is as described above but within the 'strategic' zones described within the report. Buildings within **initial zone opportunities** include building that may be required to connect[1] *only*, that were both within the strategic zones and connected to an initial zone opportunity – i.e. a network that met the criteria outlined in Appendix 5.
Heat Sources	The key low-carbon heat sources which have could supply heat to the IZOs identified within each strategic heat network zones. Some heat sources have been identified without a detailed review of their feasibility, applicability to the scheme, or thermal capacity. These sources require further investigation for verification.
CO_{2e} Savings	The sum of CO_2 equivalent savings that would accrue against a gas boiler counterfactual, over a 40-year period.

IZO Summary Specific Definitions:

In the IZO section(s) of the report the following definitions apply to the summary statistics table. In some cases, there may be more than one IZO per strategic heat network zone.

Acronym/Term	Description
CapEx	'Capital Expenditure' represents the sum of CapEx as an output from the techno-economic model (see Appendix 5). Costs included: main capital plant; energy centres; connections to heat sources; heat network and connections; utilities connections; costs associated with addressing the most severe obstacles to network build-out Costs excluded: in-development upgrade/retrofit costs; costs associated with area-wide utilities upgrades and wider enabling infrastructure beyond the project's envelope (e.g. new electrical grid supply points).

[1] The building categories being considered as required to connect include new developments, large non-domestic buildings, and communally heated residential blocks as described in Heat Network Zoning Consultation (2023)

Heat	The total annual requirement for space heating and hot water of all buildings assumed connected to each IZO. This generally includes only buildings that may be required to connect (both existing and proposed new developments). These figures are primarily derived from building-level outputs generated by the prototype NZM. Where available, metered data has been utilised instead. Heat loads for new developments have been benchmarked using DESNZ guidance, as applied by the Consultants.
Network	The total estimated trench length (not total length of flow and return pipework) needed to link the identified heat sources and buildings for each IZO network within the strategic heat network zone. Network routes are conceptual, and often created using in-house algorithmic pipe routing tools which optimise for the shortest distance between buildings that follow known roads or paths. In most cases they do not constitute a detailed network route design unless such information was available via an existing or proposed heat network.
CO_{2e} Savings	The sum of CO_2 equivalent savings that would accrue against a gas boiler counterfactual, over a 40-year period.
Linear Heat Density (LHD)	Average annual quantum of heat (MWh) transmitted through each metre of pipework (trench length, not total length of flow and return pipework) for the IZO. Units for LHD are: MWh/metre/annum. In this metric, heat loads and pipework trench lengths exclude proposed new developments where this metric is less comparable to the existing built environment. New developments may also have limited information relating to the spatial distribution and density of the build. However, all other figures presented in this table include the impact of new developments.
Heat Sources	The key heat source(s) which are expected to supply the IZOs within this zone. Some heat sources have been identified without a detailed review of their feasibility, applicability to the scheme, or thermal capacity. These sources require further investigation for verification.

Heat Demand Summary Specific Definitions:

In the heat demand section(s) of the report the following definitions apply:

Category	Description and examples
Council owned	This category consists of local authority owned buildings and council-run / council-operated facilities including, but not limited to, leisure centres, swimming pools, council offices, council-owned schools, libraries, community facilities, etc.
New development	This category consists of new build developments. This includes any type of new development (e.g. commercial, residential, industrial) with an anticipated heat demand greater than 100MWh/yr, with an expected 'spade in the ground' after 2025 and but before 2035. New development that does not meet this definition has been excluded.
Public sector	This category consists of all other public sector buildings not owned by the local authority/ council. This includes, but is not limited to, academies, universities, hospitals, public sector care homes, government estates and agencies, police stations, fire stations, MOD sites, courts, prisons, public-sector transport assets, etc.
Non-domestic	This category consists of all non-residential, private sector buildings, including, but not limited to, commercial, offices; retail, industrial, cultural and religious.
Residential	This category consists of suitable residential properties and other existing buildings with communal heating systems.

Appendix 5 – Methodology Statements

This appendix includes several method statements to help explain the information contained in the Pilot programme Zone Opportunity Reports.

Indicative Zone Identification

The Pilot programme developed an approach to the initial stages of the heat network zone lifecycle. Though much of the early work was done before the 2023 Heat Network Zoning consultation[2], it broadly adheres to the principles outlined in that document. The first stage of the zoning lifecycle is the identification of indicative heat network zones across England using a standard national methodological approach (the National Zoning Model (NZM)).

The Pilot programme used an early prototype version of the NZM outputs to support the identification of indicative zones. These are geographical areas where heat networks are expected to be the lowest cost technology to decarbonising heat used in buildings. The NZM produced a set of maps and datasets describing the location and scale of the indicative zones. These describe the location and scale of the indicative zones in each of the 28 areas that participated in the programme. Current NZM outputs will likely vary from those used here as the assumptions and modelling has improved over time.

Each area collaborated with key local stakeholders, particularly those who own or operate the largest heat demands or heat sources within an area. The engagement focused on collecting data for the purposes of identifying and heat network zones and modelling. Local authorities and the Zoning Technical Consultants (ZTCs) conducted stakeholder engagement. Data was collected via a privacy notice that permitted its use for developing heat network zoning in England. Some data and information have been withheld due to commercial sensitivity. Further engagement would likely need to be led by a zone co-ordinator (see consultation[2]) and/or heat network developer. It would also need to extend to the full list of statutory and non-statutory consultees proposed.

The following sections describe the NZM steps; the refinement stage; the identification of initial zone opportunities (IZOs); and the other approaches to modelling.

[2] https://www.gov.uk/government/consultations/proposals-for-heat-network-zoning-2023

Prototype National Zoning Model

Step 1 – Heat demand mapping

The National Zoning Model (NZM) maps the annual heat demand for every building across England. This is mainly by estimation of heat demand based on the building type, derived from Ordnance Survey AddressBase classification codes. Non-domestic buildings use a kWh/m^2 benchmark derived from CIBSE published benchmarks, domestic buildings use an approach developed for the THERMOS model derived from domestic meter data. All estimated demands are normalised against the DESNZ Subnational Consumption Statistics.

Where actual consumption data is held for a building (e.g. provided by local stakeholders), this is used rather than the estimation. Peak heating demand is estimated from the annual heat demand.

Step 2 – Lowest cost test

The NZM evaluates the cost of building and operating heat networks against the cost of building and operating individual air source heat pumps (ASHPs) for each building across England. Zoning opportunities are identified where heat networks offer the lowest 40-year present cost against the ASHP counterfactual.

The costs associated with building and operating ASHPs for each building are estimated using DESNZ assumptions for the CapEx, RepEx and OpEx of each technology option (using HM Treasury Green Book curves for fuel costs).

Unlike the counterfactual, the costs associated with building and operating a heat network are dependent upon which buildings are networked, the network route, and heat supply. Costs are calculated as part of an optimisation process as described further in Step 4.

Step 3 – Zone shapes produced

The NZM produces ‘regions’ which determine the shape of potential zone boundaries. As all buildings within a region are considered for inclusion in a zone as a group, they are the building blocks of zones. The NZM model regions follow sensible human and geographic features, such as roads, railways, or the boundaries of Ordnance Survey (OS) Sites such as university campuses.

Step 4 – Candidate zones produced

‘Candidate zones’ are produced using an optimiser. The map is divided into ‘clusters’ of around 750 buildings so the optimiser is run efficiently. The optimiser determines the least whole-system present cost solution (over 40 years) for each cluster. This may be a mix of heat networks and individual ASHP solutions. The solution is

calculated for a range heat price scenarios, i.e. the assumed cost of heat into the distribution network from a transmission supply. The output derives the lowest cost solution (ASHP or heat network) for each building that is valid where heat is available at or below the scenario price.

The candidate zones, which have been produced for a range of heat price scenarios, are then matched to potential low carbon heat sources. This includes available supply points from the NZM waste heat database as well as a fall-back supply option (a large scale ASHP). For each possible supply point, the model calculates the present cost of constructing an energy centre and any required transmission pipework to meet the distribution network within the candidate zone.

This stage produces many candidate zones, several of which may compete spatially or for the same supply point.

Step 5 – Indicative zones selected

The final selects the ‘best’ zones. All candidate zones are ranked by heat demand networked, followed by the present value of the zone. The ‘best’ zone is kept and any zones which compete spatially or for the same heat source are removed. The process is then repeated until all indicative heat network zones are selected.

Zone Refinement

The second part of the zoning methodology is the refinement of the indicative heat network zones. As described above, the prototype NZM identified indicative HNZs for each town/city in the Pilot programme. Consultants (ZTCs) then worked with local authorities and other key local stakeholders to test an approach to refining the zone shapes and boundaries. Guidance on refining zones during the Pilot programme was intentionally minimal to allow subject matter experts and local stakeholders to test various approaches independently, rather than following a government directive. Refinement included the addition, expansion, reduction, and removal of zones based on local information e.g. This exercise was conducted before the 2023 consultation and will require updates for future policy use, incorporating lessons learned from the Pilot programme.

The refined zones were then analysed to identify which should be regarded as ‘Strategic’. This was based on local knowledge and professional judgement and comprised largest zones which are generally seen as strategically significant to developing heat networks in an area A key factor was the identification of initial zone opportunities (IZOs) within each zone (described below).

Some heat demands, not used in the NZM, were then added (e.g. new developments) and/ or manually corrected where known to be incorrect. The heat demand model in the current NZM has significantly improved since the prototype

version used for the Pilot programme which was known to overestimate heat demand from some industrial and commercial buildings. At a city or town level, the figures are more accurate as they were corrected back to the Subnational Consumption Statistics.

The standardised TEM was then used to generate the Techno Economic information for the IZOs identified. Assumptions relating to the cost of installing heat network infrastructure were applied consistently across the programme and based on best available national datasets. However, this approach will lead to different CapEx estimates when compared to detailed local feasibility studies, Green Heat Network Fund (GHNF) applications, and the Advanced Zoning Programme, which will have all used project specific assumptions to underpin modelling.

IZO Modelling and Optimisation

The Pilot programme attempted to define areas within zones where the most attractive heat network development opportunities might exist. For the purposes of this programme *only* these are called an 'initial zone opportunity' (or IZO). IZOs are illustrative of the scale of a potential heat network that may be considered economically viable. IZOs are unlikely to cover the full extent of the heat network zones (unless the zone is very heat dense) as the zone itself seeks to identify areas where heat networks provide the lowest cost solution to decarbonising heat, whereas the IZO seeks to identify the extent to which a network might be considered economically viable to a heat network developer.

The approach considered economic viability, investment scale and returns, decarbonisation impact and deliverability. They were developed solely around buildings which could be required to connect[1] under the proposed Heat Network Zoning policy and did not consider potential voluntary connections.

Initial zone opportunity design targeted a linear heat density (LHD) of 4MWh/m/yr, for the existing built environment. This is considered a relatively low proxy for economic viability with the heat network sector in England and typically LHDs towards 8MWh/m or more are considered more attractive. A low threshold was chosen to reflect the full potential of opportunities that might exist as the economics of installing heat network infrastructure, their associated costs, and operating costs, all improve in the future. A proxy for economic viability also avoids making detailed assumptions regarding the cost of building connection, or heat network tariffs, which are subject to further work.

It should be noted that LHD does not account for the variability in costs of accessing heat sources, the cost of installing heat network distribution pipework, and/or the cost of heat sales, rather it assumes based on the length of pipework that needs to be installed per unit of heat that may be sold. The cost of installing heat networks in

new development should, in general, be cheaper than retrofitting the equivalent scale of existing domestic and non-domestic buildings and therefore a lower LHD in a new build may be just as attractive as a higher LHD in a built-up, complex, urban environment. As such, a more flexible approach was used for new development sites, where different economic success criteria are likely to be applied. To standardise the way opportunities were assessed, the IZOs presented in this report may differ from, or overlap with, existing or planned heat network infrastructure. Campus style heat networks (e.g. in hospitals or university campuses) were considered as potential heat loads with a single point connection.

For residential and non-residential new developments, the heat network length of an IZO includes up to the boundary of the building, communal block, apartment or home, but not any associated internal pipework. For non-residential new developments, it was assumed that each building will have its own metered heat interface system and therefore each was treated as a bulk heat connection.

Where heat network routing could not be established due to the lack of maturity regarding development plans, benchmarks were agreed across the Pilot programme. These were applied to various levels of development intensity (low, medium or high) based on conversations with local planning officers. Proposed IZO routing for new developments will therefore not be shown on the maps.

In situations where heating demands for new developments were uncertain, DESNZ provided benchmarks for various levels of development/heat load certainty. These included using kWh per dwelling figures when residential dwelling numbers were known; kWh/m^2 figures when dwelling or non-residential unit numbers were unknown but the Gross Internal Area (GIA) was also available; and kWh/m^2 (land allocation/plot) when only the size of the plot for development was known. This is described as the ‘Pilot Methodology’ in the reports.

For existing buildings listed within the reports, heat demands were based on either ‘metered’ data (collected as part of this project); nationally collected data (i.e. Estates Returns Information Collection (ERIC) dataset for NHS Trusts and assets in England); the NZM (as described above) or other benchmarks where more applicable. Note that these tables may exclude key anchor loads already connected to existing heat network schemes and exclude certain building typologies for which no reliable data was available, e.g. large industrial loads. IZO modelling did not account for internal pipework or the specific costs associated with connecting to the heat network as these are too variable and could not be modelled in a standardised manner. Therefore, all work should be subject to further detailed analysis during later stages of development.

Indicative energy centre location(s) were identified for each IZO, considering the heat sources within, and outside of, the potential zone. Typically, each IZO has a

dedicated heat sources but where there are opportunities to use the same heat source for multiple zones, this will be described in the report. An approach to indicative energy centre plant peak capacities was developed across all ZTCs to standardise the figures used. Engagement with local planning officers helped to determine potential energy centre locations, but these will be subject to further discussions.

The modelling generally does not account for known information about the quality or remaining life of existing heat network pipework. This to avoid placing a value on the infrastructure, and therefore standard assumptions have been applied across the Pilot programme. This approach will lead to discrepancies about known or planned work to expand, improve or decarbonise existing heat networks. It does however connect relevant buildings to the IZO, where they have been identified.

The final stage was to optimise and iterate to find the largest possible IZO that met the criteria set out. Each ZTC used their own modelling and software to undertake this task and therefore there will likely be some variation across the Pilot programme. These identified IZOs were compared across the programme to ensure a sufficient level of consistency, but further improvements could be made to improve the standardisation, including the potential use of the NZM to support this task.

Techno-Economic Model

A standardised and simplified techno-economic model (TEM) was provided by DESNZ to estimate the CapEx and CO_{2e} emission savings for the full roll out of heat networks in all zones of a town/city. The TEM was designed to take key inputs and assumptions (consistent across the Pilot programme) to generate a comparative economic assessment across all areas.

This approach may result in discrepancies with detailed feasibility studies or capital funding projects (e.g., GHNF), as these involve more specific designs and their own assumptions. Key input parameters included: heat network length; hard dig/soft dig proportions; constraints; annual heat demand required to connect (by building type); balance of plant across energy centre(s); high level specification of EC building(s); and primary low carbon plant/energy system type (e.g. river source heat pump, air source heat pump, etc.).

Key inputs assume the size and operation of primary low carbon and top-up/back-up plants. These assumptions estimate costs for the plant, network, and other associated expenses, providing an estimated capital cost. An energy balance based on plant type and annual heat demand generates a cash flow to derive economic outputs. The TEM then assesses carbon emissions and social value over 40 years compared to the selected counterfactual system.

The TEM results are preliminary and should not be used to confirm the viability of a heat network opportunity. Further technical and commercial analysis is needed. The aim was to identify potential opportunities and enable comparative assessments to support further investigations.

Mapping Coventions

To generate the final set of outputs, a unified mapping convention was implemented across all ZTCs. This approach aims to facilitate readers of multiple reports in understanding the content more effectively. It employs a consistent set of icons and a standardised colour palette throughout all sections. The symbology is detailed in Appendix 1.

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