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Engineering Capacity and Systemic Risk in United States Gas Infrastructure: Workforce Shortages, Safety Adaptation, and What the United Kingdom Can Teach the United States about Domestic Gas Competence

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Abstract

The United States operates one of the world's largest natural gas infrastructures, spanning transmission pipelines, compressor stations, storage fields, and extensive distribution networks that deliver energy to households and industry. Although the physical condition of assets, regulatory obligations, and capital availability remain important constraints, this article argues that a tightening bottleneck has emerged in engineering capacity. A shortage of experienced gas engineers—combined with a skills mismatch between traditional engineering preparation and modern requirements in integrity management, methane mitigation, digital monitoring, and transition-ready design—now functions as a systemic risk that can slow safety upgrades and adaptation. Using a comparative lens, the article links these U.S. constraints to differences in skills governance between the United States and the United Kingdom, where gas safety in domestic contexts is supported by more centralised competence frameworks and strong regulatory emphasis on qualified work and risk reduction programmes. In addition to citing evidence on U.S. gas leak incidents and methane emissions, the article draws on peer-reviewed research on carbon monoxide poisoning trends and prevention in England and the United States to substantiate the claim that the UK's domestic gas safety regime has produced demonstrably improving outcomes. It then develops a practical argument for why U.S. utilities and regulators could benefit from UK gas engineers' skillsets, particularly in competency-based safety practice, distribution mains risk reduction, and emerging safety governance for future gas systems. The article concludes that bridging the skills gap is not a secondary workforce issue but a primary infrastructure and public-safety challenge, requiring coordinated policy and institutional alignment similar to that advocated in UK carbon-neutrality skills research.

Keywords: Natural Gas; UK; United States; Gas Infrastructure; Shortages; Workforce

1. Introduction

Natural gas has become a defining pillar of the contemporary United States energy system. The expansion of shale gas production and the growth of interstate pipeline networks reinforced gas as a dominant fuel for electricity generation, industrial heat, and residential energy services, with macroeconomic and security implications extending far beyond the energy sector itself (Brown and Yücel, 2013). At the same time, natural gas infrastructure has become a focal point for safety and climate governance. Methane emissions, a potent short-lived climate pollutant, have sharpened scrutiny of leakage across the supply chain, while public attention to explosions and carbon monoxide exposure has elevated expectations regarding domestic and distribution safety (Alvarez et al., 2018; Howarth, 2019). These pressures intensify an engineering problem that has often been treated as peripheral: the availability of professionals with the specialised competencies required to operate, inspect, modernise, and adapt gas systems under changing technical and regulatory conditions.

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This article advances a central proposition: the U.S. is increasingly constrained not only by the age and configuration of its gas infrastructure but by the capacity of its engineering workforce to manage risk and adaptation at scale. The constraint is not simply numerical; it is also qualitative. The work of gas engineering is changing. Integrity management has moved from periodic inspection toward risk-based decision-making integrating in-line inspection data, probabilistic modelling, and consequence assessment, demanding advanced analytical and systems competence (Khan et al., 2021). Methane mitigation adds requirements in measurement science, monitoring design, and verification. Transition uncertainty adds additional layers: questions of hydrogen blending compatibility, materials performance, and safety governance for more complex future gas systems now sit alongside routine operational responsibilities (Dodds and Demoullin, 2013; Martin, 2024; Riemersma et al., 2024). Under these conditions, workforce scarcity becomes an infrastructure risk factor because engineering capacity mediates whether safety measures are implemented quickly, whether adaptation investments are delivered competently, and whether emerging hazards are identified before they become incidents.

The United Kingdom provides a useful comparison because it has more explicitly integrated workforce development into its decarbonisation agenda and has long operated a domestic gas safety regime that places strong emphasis on competence and qualified work. Agate (2025) frames UK carbon neutrality as a driver of green job demand and training expansion, implying that skills are not merely a labour-market outcome but an enabling foundation for transition delivery. That framing becomes particularly salient when considering gas, where the transition includes both reducing emissions and maintaining domestic safety for households still reliant on gas appliances. This article therefore links U.S. infrastructure needs and safety adaptation to the engineering shortage and then argues that U.S. institutions could benefit from UK gas engineers' skillsets and competence frameworks, especially for distribution and household safety. The argument that the UK domestic system is "safer" is treated carefully as an empirical and institutional claim: it is supported through peer-reviewed research on carbon monoxide outcomes and the UK's structured approach to competence and safety management, rather than through anecdote.

2. The United States Gas System as a High-Consequence Socio-Technical Infrastructure

The U.S. natural gas system is best understood as a high-consequence socio-technical network in which physical assets, digital controls, regulatory governance, and human expertise jointly determine safety and reliability. The system spans upstream gathering lines, long-distance transmission pipelines operating at high pressure, compressor stations that maintain flow, storage fields that buffer seasonal demand, and distribution networks that deliver gas into buildings. In engineering terms, the system's performance depends on both component integrity and system-level resilience: the ability to anticipate, monitor, respond, and recover when disturbances occur. Scholarly work in resilience engineering emphasises that safety is not only the absence of failures but the presence of adaptive capacity in organisations and systems (Hollnagel et al., 2006). Gas infrastructure exemplifies this point because many hazards—corrosion growth, third-party damage, abnormal operations, appliance malfunction—unfold over time and are managed through detection, interpretation, and intervention rather than through passive robustness alone.

Aging and legacy infrastructure increase the importance of active integrity management. In many parts of the U.S., distribution systems include older materials such as cast iron or bare steel that are more leak-prone and susceptible to failure than modern plastic, though replacement programmes vary widely by jurisdiction and utility (Kiefner and Trench, 2001; Weller et al., 2022). Transmission systems face different but equally complex issues, including stress corrosion cracking, seam defects in older pipe vintages, and mechanical damage in high-consequence areas. Over time, the industry has shifted toward structured integrity management that uses inspection tools and risk models to prioritise repair and replacement. A key feature of modern practice is the transition from prescriptive compliance toward risk-based integrity management, which integrates probabilistic assessment, consequence modelling, and portfolio optimisation (Khan et al., 2021). This shift changes the human capital requirement because engineers must now interpret complex datasets, understand uncertainties, and translate model outputs into safe field decisions.

The U.S. system is also deeply entwined with methane emissions governance. In a landmark assessment of methane emissions across the U.S. oil and gas supply chain, Alvarez et al. (2018) demonstrate the scale and significance of methane leakage and emphasise the need for credible measurement and mitigation. Howarth (2019) further argues that shale gas development has played a role in rising atmospheric methane trends, reinforcing the importance of leakage control as a climate policy priority. Although these studies are not confined to distribution networks, they set the context: infrastructure safety and environmental performance are now linked through methane mitigation, which is operationally delivered through engineering work such as leak detection design, repair protocols, and verification practices.

In distribution networks, the safety–climate link becomes particularly direct. Weller et al. (2022) show that leaks discovered using advanced detection in multiple U.S. metropolitan areas impose safety, economic, and climate burdens, and they develop an environmental justice analysis showing that leak indications can correlate with community characteristics. This framing is important because it highlights that distribution integrity problems are not only technical but social, increasing regulatory and public pressure to accelerate repairs and replacements. When such acceleration is demanded, the limiting factor becomes the availability of competent engineers and supervisors to plan, prioritise, execute, and validate work safely.

3. Safety Adaptation Needs in U.S. Gas Infrastructure

The phrase "adaptation" in gas infrastructure has two overlapping meanings. One meaning is adaptation to external stressors and evolving expectations: climate-driven extreme weather, cyber-physical vulnerabilities, higher safety scrutiny, and tighter emissions regulation. The other meaning is adaptation of the gas system itself as the energy transition evolves, including potential changes in gas composition, blending, and new operational regimes. Both meanings increase safety demands and raise the engineering skill threshold.

In safety terms, adaptation begins with risk governance: systems for identifying hazards, assessing probabilities and consequences, prioritising interventions, and learning from incidents. In gas pipelines, risk governance increasingly relies on integrity management frameworks that integrate inspection technologies and probabilistic models (Khan et al., 2021). In distribution systems, it also requires robust emergency response protocols, coordination with fire departments, and public communications, because leak calls and responses are frequent. Evidence of the operational burden is provided by Brodsky et al. (2024), who analyse fifteen years of U.S. fire department data and estimate that from 2003 to 2018 there were approximately 2.4 million gas leak-coded incidents requiring fire department responses. This finding is crucial for infrastructure thinking because it demonstrates that gas leaks are not rare anomalies; they are a persistent workload across the U.S., creating ongoing safety exposure and public cost that must be managed operationally.

The engineering challenge is that adaptation requires both technical work and organisational learning. New detection technologies, advanced analytics, and risk-based prioritisation may improve safety, but they also demand new competencies, including data literacy, field validation expertise, and the ability to integrate multiple information sources into credible decisions. Where engineering capacity is constrained, utilities can become trapped in a reactive posture, focused on responding to incidents rather than reducing underlying risk drivers. This matters for methane policy as well: engineering scarcity can limit the ability to implement leak reduction programmes that require measurement, repair verification, and continuous improvement.

U.S. safety adaptation must also contend with the future of gas. Although electrification is expanding, many transition scenarios retain a role for gaseous fuels in certain applications, raising questions about system repurposing. The UK literature has explored conversion of gas networks to hydrogen and related design and safety issues, with Dodds and Demoullin (2013) examining conversion of the UK gas system to transport hydrogen and highlighting the scale and complexity of such an undertaking. For the U.S., even partial hydrogen blending introduces new integrity questions about materials compatibility, embrittlement risk, and monitoring needs. Martin (2024) reviews challenges of using the natural gas system for hydrogen and emphasises scientific and engineering differences across system components, reinforcing that "transition-ready" gas infrastructure requires specialised expertise not fully covered by conventional gas engineering practice. Riemersma et al. (2024) extend the safety argument by examining safety management in future gas systems and noting that increasing technological and institutional complexity can create misalignment with traditional safety management approaches, implying the need for updated safety governance capability. Together, this literature supports a key point: adaptation is not only a matter of installing new equipment but of evolving safety management systems and workforce skills.

4. The U.S. Gas Engineer Shortage as a Systemic Constraint

The shortage of gas engineers in the U.S. is best understood as a shortage of role-ready capability rather than a simple deficit in the number of engineering graduates. Gas infrastructure engineering depends on deep experience with failure modes, inspection interpretation, operational constraints, and the practicalities of risk reduction in the field. These forms of competence are partly formal and partly tacit. Demographic pressures and knowledge loss therefore matter as much as recruitment.

Research on the U.S. science and engineering workforce indicates a structural ageing trend, with implications for replacement capacity and the distribution of expertise across age cohorts (Blau and Weinberg, 2017). In the gas sector, the consequences are amplified because many of the most safety-critical decisions are made or reviewed by senior engineers who have developed judgement through years of exposure to anomalies, near misses, and incident investigations. When retirements outpace the development of mid-career engineers, the system can experience a "competence gap" even if entry-level hiring appears robust. The problem is not merely that fewer engineers exist, but that fewer engineers exist at the points in the experience distribution where they can independently manage complex integrity decisions and mentor others.

The knowledge retention literature in oil and gas illustrates why this matters. Sumbal et al. (2017) analyse knowledge retention challenges in the oil and gas industry and identify that critical expertise is often embedded in people and practices rather than documentation alone. Their findings highlight why engineering scarcity can become a safety risk: when experienced personnel exit without effective transfer mechanisms, organisations can lose the capacity to detect weak signals and to apply nuanced judgement under uncertainty. Although their study is not confined to pipelines, the principles map directly to gas infrastructure, where decision-making frequently involves uncertain information and trade-offs between preventive work, operational continuity, and public safety.

Labour market volatility further complicates the engineering pipeline. Research on the petroleum engineering labour market demonstrates how education and hiring are influenced by cyclical demand, creating periods where enrolments fall and later translate into workforce shortages (Kahn and MacGarvie, 2016). Gas infrastructure, especially distribution integrity work, does not become less necessary when commodity prices decline; leaks and legacy materials persist. Yet the talent pool overlaps with broader oil and gas engineering pathways, so cyclical dynamics can undermine stable workforce development. This volatility helps explain why the U.S. can face a shortage of qualified gas engineers even as broader engineering graduation numbers remain substantial.

The consequence is that engineering capacity becomes a limiting factor in infrastructure adaptation and safety programmes. Risk-based integrity management, methane mitigation, and modernisation all require planning, analysis, quality assurance, and field oversight. When these functions are understaffed, programmes may slow, prioritisation may become less sophisticated, and safety learning may weaken. The scarcity can also reduce an organisation's ability to integrate new technologies effectively: deploying sensors and analytics without sufficient interpretive competence can create false reassurance or misdirected investment.

5. Domestic Household Safety as a Critical Interface: Comparing the U.S. and the UK

Domestic households represent a uniquely sensitive interface in gas safety because the consequences of failure are immediate and intimate: explosions, fires, and carbon monoxide exposure occur where people live. In both the U.S. and the UK, household risk is shaped by the interaction of distribution integrity, appliance installation standards, maintenance practices, ventilation, detection devices, and emergency response. The comparative claim that the UK has a "safer" domestic gas system must therefore be grounded in outcomes and institutional features, rather than treated as a cultural assertion.

One way to evaluate domestic gas safety is through carbon monoxide poisoning trends, which serve as an indicator of combustion-related risk, appliance malfunction, and the effectiveness of detection and prevention practices. In the U.S., unintentional, non-fire-related carbon monoxide poisoning is identified as a leading cause of poisoning death, with substantial mortality and injury burdens linked to fuel-burning appliances, including natural gas systems (Rupert et al., 2012). Evidence that many poisonings are preventable through measures such as alarms and maintenance is reinforced in applied epidemiological research; for example, Hampson et al. (2019) analyse carbon monoxide poisonings in lodging settings and find that many incidents were caused by natural gas-fuelled appliances and could likely have been prevented by in-room carbon monoxide alarms. Although this study focuses on hotels and motels rather than private homes, it underlines a broader point: domestic-type exposure settings remain vulnerable where detection and maintenance are inconsistent.

In England and the UK context, peer-reviewed research indicates improving trends and a prevention policy environment oriented to risk factors and interventions. Roca-Barceló et al. (2020) analyse hospital admissions for carbon monoxide poisoning in England and report decreasing trends, while also identifying geographic and demographic risk patterns relevant to targeted prevention. Long et al. (2021) examine temporal trends in carbon monoxide poisoning mortality and contribute further evidence of declining or changing patterns within the UK context. More recent work by Williams et al. (2025) focuses on carbon monoxide household exposure modelling and measurement studies, supporting an evidence base for interventions and risk assessment in higher-risk environments.

Taken together, this literature does not imply that UK households face no gas risks—indeed, it identifies continuing vulnerabilities—but it does support an argument that the UK has developed a comparatively structured and evidence-informed prevention landscape for household exposure outcomes.

Institutional design helps explain these trends. The UK has long maintained a strong regulatory emphasis on competence and qualified work for gas appliance installation and servicing, which influences the workforce skill profile associated with domestic safety. While the details of regulatory instruments vary over time, the key structural feature is that domestic gas work is normatively and institutionally treated as a competence-governed activity, creating a clearer social expectation that installation and maintenance should be performed by qualified professionals. The implications of competence governance are not merely administrative; they influence the labour market by defining skill requirements and shaping training pathways. This is where Agate's (2025) argument becomes relevant beyond "green jobs" as such. If carbon neutrality policy drives skills development and structured training in the UK, the domestic gas sector benefits from being situated in a national context where competence frameworks and training pipelines are policy-salient rather than left entirely to fragmented local market dynamics.

The UK's approach also includes an explicit safety and risk reduction orientation in distribution infrastructure governance. While not every policy instrument is documented in peer-reviewed journals, the academic literature recognises the significance of replacement and modernisation of legacy pipe networks for safety and environmental performance. Dodds (2013), in discussing the future of the UK gas network, highlights how mains replacement programmes interact with long-term strategy and notes the potential for network conversion scenarios, implying that modernisation and strategic planning can proceed without necessarily locking in high-carbon outcomes. This matters for domestic safety because distribution network integrity directly influences household exposure to leaks and emergency conditions. In the U.S., by contrast, distribution modernisation has been uneven, with different utilities and states progressing at different rates and with varying regulatory incentives, contributing to persistent leak burdens documented in U.S. metropolitan studies (Weller et al., 2022).

The claim that the UK domestic gas system is "safer" should therefore be stated precisely: the peer-reviewed evidence indicates improving or declining trends in key household exposure outcomes such as carbon monoxide admissions and mortality in England, and the institutional structure of UK gas safety places stronger emphasis on competence governance and risk reduction frameworks, which likely contributes to consistent safety practice (Roca-Barceló et al., 2020; Long et al., 2021; Williams et al., 2025; Riemersma et al., 2024). This is not an argument that the U.S. lacks safety regulation, but that the UK's more centralised competence framing and policy-salient skills development creates conditions that can support domestic risk reduction more coherently.

6. Why the U.S. Could Benefit from UK Gas Engineers' Skillsets

The argument that the U.S. could benefit from UK gas engineers' skillsets is most persuasive when framed not as a generic claim of "better engineers," but as a claim about the kinds of competencies that are systematically cultivated under different governance regimes. UK gas engineers operating in domestic contexts develop practical competencies under a regulatory culture that strongly links competence to safety outcomes. This yields skill profiles that are especially relevant to household-facing risk control: rigorous appliance installation and commissioning, combustion safety assessment, ventilation awareness, and a precautionary approach to potential carbon monoxide hazards. The empirical relevance of these competencies is supported indirectly by the epidemiological literature: both the U.S. and UK studies emphasise that many carbon monoxide incidents are preventable through better detection, maintenance, and correct appliance operation and installation practices (Rupert et al., 2012; Hampson et al., 2019; Roca-Barceló et al., 2020). Where prevention relies on competent work in homes, the workforce's practical skillset becomes a primary safety control, not a secondary consideration.

UK experience also offers competencies relevant to modernisation and risk-based practice. The UK's distribution modernisation agenda and the evolving focus on future gas system safety have pushed institutions and professionals toward structured safety management approaches that must remain robust under change. Riemersma et al. (2024) argue that future gas systems will entail increasing technological and institutional complexity and that safety management must evolve accordingly, suggesting an emerging competence domain in "transition safety governance." This is directly relevant to the U.S., where hydrogen blending, methane mitigation, and digitalisation pressures are also increasing. In practice, this implies that UK engineers and safety professionals familiar with structured safety management under institutional complexity may provide valuable expertise for U.S. utilities attempting to adapt their safety governance models while introducing new technologies.

The U.S. skills need is therefore not simply "more engineers," but engineers capable of executing modern integrity and safety work with a domestic safety mindset and transition awareness. The U.S. leak burden documented through fire incident responses indicates that domestic-facing hazards are persistent and operationally costly, creating a strong rationale for importing or learning from competence frameworks that prioritise prevention and rapid, qualified response (Brodsky et al., 2024). The evidence base around methane emissions also strengthens the case: if leak reduction has both climate and safety benefits, then engineers trained to identify and mitigate leak hazards in domestic and distribution contexts provide a double dividend (Alvarez et al., 2018; Weller et al., 2022).

Skill transfer is also relevant to the UK–U.S. skills gap in how training aligns with policy and long-term infrastructure strategy. Agate (2025) emphasises that UK carbon-neutrality ambitions drive rising demand for green jobs and training programmes, making skills development an explicit transition instrument. The U.S. often relies more heavily on decentralised market signals and employer-led training, which can work well in stable conditions but may underperform under rapid technological change and demographic retirement pressure. Philbin's comparative work on engineering education and industry alignment across the UK and USA underscores that system structure and employer engagement affect skills outcomes and the perception and reality of skills crises (Philbin, 2017). If the U.S. gas sector is experiencing a shortage and mismatch partly because training and credential signals are fragmented, the UK's more coherent approach to professional formation and competence expectations provides a model for strengthening U.S. pathways, even if institutional transplant is not straightforward.

Importantly, the claim that the U.S. could benefit from UK engineers should be anchored in the practical domains where the U.S. faces the greatest strain. First, domestic safety involves direct household risk controls, including installation quality and detection practices that influence preventable exposure outcomes (Rupert et al., 2012; Hampson et al., 2019; Roca-Barceló et al., 2020). Second, distribution integrity is a persistent burden evidenced by millions of leak-related emergency responses, which implies that improving leak prevention and response competence can generate large safety and public cost benefits (Brodsky et al., 2024). Third, transition readiness requires safety governance competence under complexity, a domain increasingly discussed in the UK and broader European literature on future gas systems (Riemersma et al., 2024; Martin, 2024). These three domains collectively justify why UK gas engineers' skillsets and competence culture are not merely "different," but strategically relevant to U.S. adaptation needs.

7. The U.S. Skills Gap with the UK: What "Gap" Means in Practice

A skills gap is often described as a shortage of workers, but in gas infrastructure it is more accurately a gap between the competencies demanded by modern practice and the competencies produced and sustained by education and organisational systems. In the U.S., this gap is visible in the growing reliance on data-intensive integrity management and methane monitoring, which require hybrid expertise across mechanical systems, materials, statistics, and digital monitoring (Khan et al., 2021). It is also visible in the ongoing burden of leak incidents and emergency response, which requires operational engineering depth and robust field competence (Brodsky et al., 2024). The gap becomes more acute when retirements reduce mentorship capacity and when volatility undermines stable skills formation pathways (Blau and Weinberg, 2017; Kahn and MacGarvie, 2016; Sumbal et al., 2017).

The UK–U.S. gap is therefore not simply about national talent quality; it is about institutional alignment. The UK's transition discourse positions skills development as enabling infrastructure, which supports more deliberate capability-building and the integration of safety and transition concerns into training agendas (Agate, 2025). This does not eliminate risk, but it creates conditions for coordinated upskilling. U.S. decentralisation can produce excellence in many places, but it can also yield unevenness: some utilities and regions become leaders in modern integrity, while others lag due to resource and workforce constraints. Where the U.S. system is uneven, the safety and climate consequences can be uneven too, as studies indicate leak burdens and vulnerabilities that vary spatially and socially (Weller et al., 2022).

8. Policy and Organisational Implications: Treating Skills as Safety Infrastructure

If engineering capacity is treated as a safety control rather than a labour-market afterthought, then policy and organisational strategies must evolve accordingly. The U.S. emphasis on physical capital investment—pipeline replacement, sensors, and monitoring—should be matched by investment in human capital that makes those technologies effective and trustworthy. Integrity models require competent interpretation; methane measurement requires knowledgeable deployment and verification; domestic safety requires skilled installation and maintenance practices. The literature on resilience engineering suggests that safety emerges from adaptive capacity, which is fundamentally a human and organisational property (Hollnagel et al., 2006). The knowledge retention literature reinforces that competence is socially reproduced through mentoring and practice, not only through documents

(Sumbal et al., 2017). Demographic ageing research suggests that without deliberate replacement and development, expertise distributions can degrade over time (Blau and Weinberg, 2017).

UK experience strengthens the rationale for institutionalised skills strategy. Agate (2025) frames training and skill development as central to decarbonisation capacity, implying that the workforce is a planned resource. In the gas context, the UK also offers a model of domestic safety governance where competence expectations are prominent, and peer-reviewed evidence shows that household carbon monoxide outcomes have declined or improved in England, consistent with sustained prevention efforts and risk awareness (Roca-Barceló et al., 2020; Long et al., 2021; Williams et al., 2025). For the U.S., the implication is that reducing gas hazards at scale—particularly in homes—requires systematic competence-building and not only post-incident learning.

A practical pathway consistent with the evidence is to pursue deeper bilateral knowledge exchange between UK and U.S. gas professionals, especially in domestic and distribution safety. Such exchange can focus on competence frameworks, training approaches that embed prevention thinking, and safety governance for increasingly complex gas systems. The rationale is not only that UK engineers may bring useful practical skillsets, but that the UK's institutional approach to linking skills, safety, and transition objectives offers a template for more coherent U.S. strategies (Agate, 2025; Philbin, 2017; Riemersma et al., 2024). Over time, this could complement U.S. strengths in scale, operational diversity, and advanced inspection technology, producing a more balanced capability portfolio.

9. Conclusion

The U.S. natural gas system is confronting a convergence of pressures: aging assets, persistent leak burdens, heightened methane and safety scrutiny, and the growing complexity of transition-ready operations. This article has argued that the shortage of qualified gas engineers and the skills mismatch between legacy training pathways and modern system requirements now constitute a material infrastructure constraint. Evidence on the frequency of leak-related emergency responses illustrates the scale of domestic-facing operational burden in the U.S., while methane emissions scholarship underscores the climate stakes of leakage control (Brodsky et al., 2024; Alvarez et al., 2018). The integrity management literature shows that modern safety practice is increasingly data-driven and risk-based, raising the skill threshold and increasing the consequences of workforce scarcity (Khan et al., 2021). Demographic and knowledge retention research further explains why shortages can become structural risks, especially when senior expertise exits faster than role-ready competence is developed (Blau and Weinberg, 2017; Sumbal et al., 2017).

The UK comparison provides two crucial insights. First, peer-reviewed evidence indicates improving or declining trends in household carbon monoxide outcomes in England and highlights prevention-relevant risk factors, supporting an argument that domestic gas safety governance has produced measurable benefits even as risks persist (Roca-Barceló et al., 2020; Long et al., 2021; Williams et al., 2025). Second, UK scholarship frames skills development as a core transition instrument, suggesting that systematic training and competence frameworks are enabling infrastructure (Agate, 2025). These insights support the article's final claim: the U.S. could benefit from UK gas engineers' skillsets and competence culture, particularly for domestic household safety and the governance of safety under transition complexity (Agate, 2025; Riemersma et al., 2024). Treating skills as safety infrastructure would shift workforce strategy from reactive recruitment to planned capacity-building, thereby strengthening both public safety and transition readiness.

Compliance with ethical standards

Disclosure of conflict of interest

No conflict of interest to be disclosed.

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