Eemil Vuori

State incentives and investments in renewable gas: the case of Finland

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Abstract

Author(s):	Eemil Vuori
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Energy transformation is one of the biggest concerns today. To be able to reach net-zero, government incentives plays a crucial part. This thesis explores the role of state incentives and investments in the renewable gas sector, focusing on Finland’s transition towards renewable gas, particularly biogas and synthetic methane. Despite its potential to decarbonize hard-to-electrify sectors such as heavy transport, agriculture, and industrial processes, Finland's renewable gas sector has lagged behind other Nordic countries like Sweden. Through a combination of theoretical frameworks, including the Multi-Level Perspective (MLP), Institutional Theory, Stakeholder Theory, and Policy Instrument Theory, this study identifies the key challenges constraining Finland's renewable gas development. These challenges include regime lock-ins, permitting constraints, stakeholder asymmetries, and gaps in policy instruments. The empirical analysis is based on expert interviews and a review of policy documents. Additionally, a comparative analysis with Sweden highlights differences in infrastructure, policy frameworks, and institutional support, offering valuable insights for Finland's renewable gas strategy. The thesis concludes with actionable recommendations for both short-term operational improvements and long-term institutional reforms aimed at accelerating Finland's renewable gas transition, ensuring alignment with national climate goals, and fostering sustainable investment in the sector.

Contents

Glossary

Biomethane	Upgraded biogas that meets natural gas quality standards and can be injected into the gas grid or used as a transport fuel.
Feed-in Premium	A policy instrument that offers renewable energy producers a fixed premium on top of the market price for electricity or gas.
Guarantee of Origin	A certificate that proves a unit of energy was produced from renewable sources, used for tracking and verification in European energy markets.
RED III	The third iteration of the Renewable Energy Directive by the European Union, setting binding renewable energy targets for member states.

1 Introduction

Globally, investments in energy has been on the rise and the overall amount of investments in 2024 towards energy exceeded $3 trillion, which is more than ever before (IEA, 2024). Looking at the allocation of these investments some $2 trillion was towards clean-energy, which comprises ‘’renewables, electric vehicles, nuclear power, power-grids, storage, low-emissions fuels, efficiency improvements and heat pumps. The remainder, slightly over $1 trillion, was set to go to oil, gas and coal’’ (IEA, 2024). Global demand for energy has shown a consistent upward trend, which in turn has spurred growing investments in the energy sector (Ritchie, 2020). Historically, global energy consumption has increased by approximately 1.5% annually. However, in 2023, this growth rate accelerated to 2.2%, reflecting intensifying consumption patterns driven by population growth, industrial development, and electrification across sectors (Enerdata, 2022).

Finland has set one of the most ambitious climate goals globally, committing to achieving carbon neutrality by 2035**,** which means that Finland’s emissions needs to be net-zero or negative on or before 2035 (Ministry of Environment, 2023). Finland has made significant progress toward this target by commissioning the first new nuclear reactor in Europe in over 15 years and with the help of government incentives rapidly expanding wind energy capacity. As a result, Finland now has the second-lowest share of fossil fuels in its energy supply among IEA member countries. Additionally, it has been actively reducing its reliance on Russian energy imports, enhancing energy security by diversifying supply sources, increasing domestic renewable energy production, and improving energy efficiency (IEA, 2024).

Finland has made significant strides in scaling up wind and solar energy. However, investments in renewable gas particularly biogas and synthetic methane remain relatively marginal (IEA, 2024). Despite the technology’s potential to decarbonise sectors that are hard to electrify, such as heavy

transport, agriculture, and industrial processes In 2022, renewable gas contributed less than 1% to Finland’s final energy consumption (Finnish Energy Authority, 2023). signalling both an investment gap and an untapped opportunity. This contrasts starkly with Sweden, where more proactive policies, stronger institutional coordination, and long-term support mechanisms have led to considerably higher levels of investment in the sector (IEA, 2023). This reveals a missed opportunity for Finland but also raises compelling questions about national policy design, institutional frameworks, and market dynamics. Making renewable gas an ideal and necessary focal point for this research.

The primary research question that this thesis aims to answer is: "How can Finland strengthen its renewable gas policy through policy reform, infrastructure investment, and institutional coordination, in light of comparative insight from Sweden?" By addressing this question, the thesis explores the key barriers and opportunities within Finland's renewable gas sector, while drawing comparisons to Sweden's more successful approaches to policy design, stakeholder engagement, and investment in renewable gas infrastructure.

This thesis is structured to provide a comprehensive analysis of Finland’s renewable gas transition. Following the Introduction, Second section details the Methodology, outlining the qualitative approach and the use of primary interview data alongside secondary literature. Third develops the Theoretical Framework, drawing on Multi-Level Perspective (MLP), Institutional Theory, Stakeholder Theory, and Policy Instrument Theory to establish a lens for analysing transitions. Section four presents the Empirical Analysis of Finland’s renewable gas transformation, focusing on permitting barriers, stakeholder imbalances, and misaligned policy instruments. Building on this, Section five offers a Comparative Analysis between Finland and Sweden, investigating infrastructure, policies, and stakeholder dynamics to highlight differing transition paths. In section six, Recommendations for firstly looking lessons from Sweden and then moving into short- and long-term reform and a reflection on the broader implications for Finland’s energy future. The thesis concludes in the last section with conclusion of thesis question.

While the core focus of this thesis is on Finland’s renewable gas transition, a comparative lens is applied through the inclusion of Sweden as a reference case. The purpose of this comparison is not to provide an in-depth study of the Swedish case in equal detail, but rather to use it as a contextual benchmark to highlight systemic gaps, policy divergences, and institutional contrasts. Sweden offers a relevant and proximate example due to its stronger investment levels, more developed infrastructure, and clearer regulatory support for renewable gas. This contrast helps illuminate Finland’s relative weaknesses and opportunities, thereby enriching the analysis. By comparing specific dimensions such as policy instruments, stakeholder ecosystems, and technological deployment, the thesis draws insights that would be less visible in a single-country study. Thus, the inclusion of Sweden strengthens the validity and depth of the findings on Finland.

2 Methodology

This study adopts a qualitative research design, as it enables an in-depth exploration of perceptions, institutional dynamics, and policy interpretations in the context of Finland’s renewable gas sector. As Saunders, Lewis and Thornhill (2019) note, qualitative research is particularly appropriate when the aim is to understand the meaning participants assign to social phenomena. In this case, the role of government incentives in shaping investment decisions. Since the objective is not to test a hypothesis through measurable variables, but rather to explore "how" and "why" questions, qualitative methods are the most suitable choice.

A case study strategy was selected to allow focused investigation of a contemporary phenomenon the development of renewable gas investments within its real-life context. According to Saunders et al. (2019), case studies are ideal when the boundaries between the phenomenon and its context are not clearly evident, and when multiple sources of evidence (e.g. interviews, documents) are used. The inclusion of Sweden as a comparative reference enhances the analytical depth, enabling the identification of differences in

institutional conditions and policy effectiveness without detracting from Finland as the core focus.

The primary data for this thesis was collected through semi-structured interviews, conducted via Microsoft Teams on March 2025. This format was chosen to provide both consistency and flexibility, enabling the researcher to follow a predefined question guide while also exploring emerging themes based on participant responses. The interview questions were designed to align closely with the research objectives and were informed by the theoretical framework and previous studies on energy policy and investment behaviour. The interviews were audio-recorded with the consent of each participant and subsequently transcribed verbatim for analysis. In line with the guidance of Saunders, Lewis and Thornhill (2019), the transcribed data was analysed using thematic analysis, which involved coding the content to identify key patterns, concepts, and themes.

Two expert interviews were conducted to support the empirical analysis of this thesis. For the purposes of confidentiality, the participants are referred to as Interviewee A and Interviewee B. Interviewee A is a senior executive at a mid-sized biomethane production company operating in Finland, which is owned by a non-Finnish investment firm. This interview provided valuable insights into the commercial, infrastructural, and regulatory challenges encountered by industry actors and also reflecting interest of investors outside of Finland. Interviewee B is a professional working for a national advocacy organisation focused on promoting biomethane and circular economy solutions in Finland. Their perspective contributed a deeper understanding of policy development, sectoral representation, and institutional bottlenecks in the Finnish renewable gas landscape

A non-probability purposive sampling technique was applied, selecting participants who held direct relevance to the research problem namely, professionals in energy companies, biogas industry representatives. As Saunders et al. (2019) argue, purposive sampling is particularly useful in

exploratory research where the goal is to gain insight from those most knowledgeable or involved in the subject matter.

2.1 Data Analysis

Data from the transcribed interviews was analysed using thematic analysis, which enables the researcher to identify, code, and interpret patterns or themes that emerge from qualitative data. This method was chosen because it aligns well with theory-driven qualitative analysis and allows for flexibility in interpreting complex institutional, political, and behavioural dimensions. According to Saunders et al. (2019, p. 651), thematic analysis is especially effective when the researcher aims to relate empirical findings to theoretical constructs. As is the case in this thesis, where insights are analysed through the lens of MLP, Institutional Theory, and Policy Instrument Theory.

Although the thesis incorporates some secondary quantitative data (e.g. investment volumes and policy timelines), the primary analytical focus remains qualitative. Thematic analysis allows these diverse sources to be triangulated and interpreted meaningfully, without the need for statistical testing, which would be unsuitable for the research objectives.

2.2 Limitation

While this study provides meaningful insights into the role of government incentives in shaping renewable gas investments in Finland, several limitations should be acknowledged. Firstly, the number of interviews conducted was limited due to time and access constraints. Although participants were selected based on their expertise and relevance to the sector, a broader range of perspectives including more policymakers, municipal energy planners, and larger biogas operators could have enhanced the depth and generalisability of the findings. Secondly, the research primarily draws on qualitative data and interpretive analysis. As such, it does not produce statistical generalisations or predictive models. The absence of a large-scale quantitative dataset restricts

the study's ability to measure the precise magnitude of policy impacts across the renewable gas sector, though the chosen approach aligns with the study's exploratory and theory-informed goals.

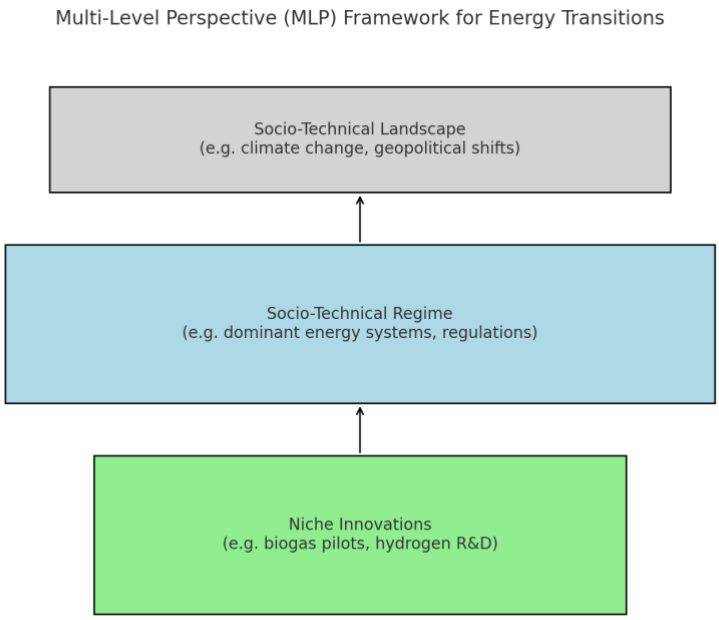
Thirdly, while the comparative reference to Sweden adds valuable contrast, the analysis remains limited in scope and does not constitute a full cross-country case study. This may obscure deeper structural differences in regulatory frameworks, infrastructure, or market dynamics that influence policy effectiveness and the transferability of recommendations. Lastly, the research is time-bound. Given the rapidly changing nature of energy technologies and policy frameworks, some of the conclusions may be rendered outdated over time. Future research could address these limitations by expanding the interview sample, incorporating quantitative methods, or conducting longitudinal studies to capture the evolving dynamics of renewable gas transitions in Finland and beyond.

3 Theoretical Framework for Analysing the Renewable Gas transition in Finland

Transitions from fossil-based to renewable energy systems are complex, long-term processes that involve technological, institutional, and social transformations. In Finland, this transition is particularly urgent given the dual pressures of climate targets and energy security concerns following the 2022 geopolitical crisis. Renewable gases such as biogas, biomethane, and synthetic methane are increasingly seen as a critical component of the national decarbonisation strategy. However, despite technical feasibility and EU-aligned policy rhetoric, the sector's development has been slow and uneven, compared to Nordic peers (IEA, 2023). To understand the dynamics behind this stagnation, this chapter draws on four interrelated theoretical frameworks: the Multi-Level Perspective (MLP), Institutional Theory, Stakeholder Theory, and Policy Instrument Theory. These approaches enable a holistic understanding of socio-technical change, offering insights into the barriers, actors, and mechanisms shaping Finland's renewable gas transition.

3.1 Socio-Technical Transitions and the Multi-Level Perspective

The Multi-Level Perspective (MLP), developed by Geels (2002; Geels and Schot, 2007), is a foundational framework in transition studies. It conceptualises change as the outcome of interactions between three levels: niche innovations (micro), socio-technical regimes (meso), and the socio-technical landscape (macro). Niche innovations emerge in protected spaces through experimentation, often supported by subsidies, R&D, and pilot programmes. Socio-technical Regimes represent the dominant practices, infrastructures, regulations, and cultural norms that stabilise the current system. The socio-technical landscape includes broader exogenous forces such as geopolitical shocks, macroeconomic trends, and climate policies which can influence the system but are beyond the control of individual actors. See, figure 1 for visualized MLP.



Source: (Geels, 2002)

Figure 1 MLP visualized

The Multi-Level Perspective (MLP) is particularly useful for explaining the gradual and path-dependent nature of energy transitions in Finland. Although technological solutions such as biogas and synthetic methane are already

commercially viable, their large-scale deployment has remained limited. This can be interpreted, through the MLP lens, as a result of regime-level lock-ins and a lack of alignment between niche innovations and existing institutional structures a pattern that will be explored in the empirical chapters. Landscape-level events such as the 2022 energy crisis may act as destabilising shocks that open windows of opportunity, but only when niches are mature and regimes are receptive to change. Geels and Schot (2007) outline several transition pathways, including substitution, transformation, and reconfiguration. Based on current trends, Finland's renewable gas sector appears to be following a transformation pathway, where regime actors implement incremental changes while maintaining the dominant system configuration.

This systems-level perspective also clarifies why technical potential alone is insufficient to drive transition. The scaling of renewable gas depends not only on cost reductions or innovation but on the reconfiguration of infrastructure, user practices, regulatory frameworks, and policy support mechanisms. The MLP framework therefore sets the stage for deeper exploration of the institutional, political, and stakeholder-related barriers addressed in the sections that follow.

3.2 Institutional Theory: The Rules That Shape Regime Stability

While MLP captures the structural dynamics of transitions, it does not fully explain the stickiness of socio-technical regimes. Institutional Theory fills this gap by examining how formal rules, informal norms, and shared belief systems create stability and path dependency in organisational fields (Scott, 1995; North, 1990). Institutions shape what actions are considered legitimate, what technologies are supported, and who is empowered to make decisions. In energy systems, this includes laws, subsidy structures, regulatory bodies, and professional cultures.

A key concept in Institutional Theory is isomorphism, the process through which organisations become more similar over time. DiMaggio and Powell (1983)

distinguish between coercive isomorphism (legal or normative pressure), mimetic isomorphism (copying under uncertainty), and normative isomorphism (shared standards and training). In the Finnish renewable gas context, these dynamics are clearly present. Coercive isomorphism is evident in EU directives such as RED III, which mandates renewable energy targets (European Parliament and Council, 2023). Yet Finland's delayed transposition of RED III into national law suggests a form of what Bromley and Powell (2012) call "decoupled compliance," where formal policy adoption is not matched by substantive change.

There are indications of mimetic isomorphism in Finland's renewable gas sector, particularly in the adoption of biogas plant technologies resembling those developed in Germany, which is seen as a global leader in the field (IEA Bioenergy, 2020). However, due to differences in institutional capacity and market maturity, the results in Finland have not always mirrored the outcomes in Germany an example of what Boxenbaum and Jonsson (2017) describe as "isomorphism without integration. Normative isomorphism appears weaker in Finland, partly due to the absence of strong intermediary institutions. Unlike Sweden's Energigas Sverige, Finland lacks a central professional body to promote operator certification and sector-wide standards. While SBB Ry has initiated efforts in this direction, workforce coverage remains low relative to neighbouring countries (Nordic Energy Certification Board, 2023).

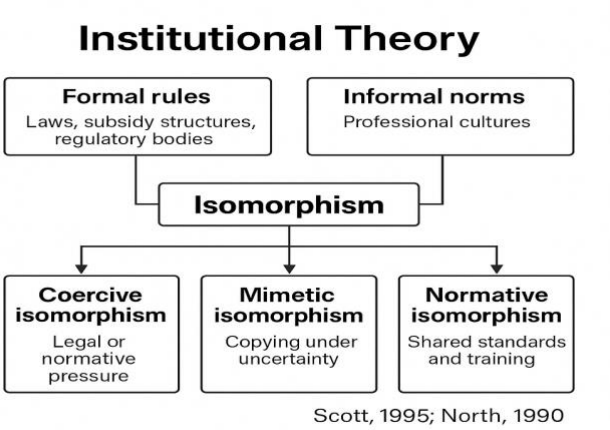


Figure 2 Institutional theory

Mahoney and Thelen (2010) identify mechanisms through which institutional change can occur: displacement, layering, conversion, and drift. In Finland, efforts to streamline permitting or develop certification frameworks represent layering, but have yet to challenge the deeper structures of regime dominance.

Institutional voids. Such as the lack of a national biogas coordination body, further undermine systemic change by leaving gaps in governance. Institutional Theory thus explains why change is often slow and fragmented, despite apparent alignment with high-level policy objectives.

3.3 Stakeholder Theory: Power, Legitimacy and Urgency in Transition Governance

Stakeholder Theory brings attention to the actors involved in shaping energy transitions. Freeman (1984) originally defined stakeholders as any group or individual that can affect or is affected by an organisation’s objectives. Mitchell, Agle and Wood (1997) introduced a salience framework, suggesting that stakeholder influence depends on the combination of power, legitimacy, and urgency. This model is highly relevant in the context of renewable gas, where a range of actors from utilities and industrial users to farmers and local governments hold varying degrees of influence over outcomes.

Power in the Finnish renewable gas sector is shaped by institutional structures that favour large-scale, centralised actors, particularly through the design of support schemes and regulatory instruments. For instance, most state investment aid is structured in ways that advantage technologically mature, capital-intensive projects, often excluding smaller, decentralised producers who struggle to meet eligibility criteria or absorb upfront costs (Business Finland, 2024). This design reinforces structural bias toward incumbents with existing administrative capacity and financial leverage. Legitimacy within the policy process is similarly uneven. While agricultural stakeholders provide the majority of Finland's biogas feedstock, their representation in national energy governance remains limited. According to a 2023 report by the Ministry of Agriculture, only 19% of members in national energy working groups come from the agricultural sector—despite their crucial role in renewable gas production. From a Stakeholder Theory perspective, this reflects both power asymmetries and a misalignment between operational importance and institutional voice.

Urgency varies across stakeholders. While national policymakers face time-bound decarbonisation targets, mid-sized renewable gas projects often struggle with financing and visibility. This leads to what Eesley and Lenox (2006) describe as "intermediate stakeholder blindness," where actors fall between grassroots movements and large industrial interests. Advocacy groups such as SBB Ry attempt to bridge this gap, but their ability to influence national strategy remains constrained. Stakeholder Theory therefore illuminates both the actor-based and structural challenges of energy governance, particularly in contexts where transition priorities conflict or misalign.

3.4 Policy Instrument Theory: State Tools and Strategic Intervention

While the above frameworks explain systemic dynamics, institutional stability, and actor relationships, Policy Instrument Theory addresses the practical levers available to governments for steering socio-technical change. Drawing on the typology developed by Hood (1986) and further elaborated by Howlett (1991), policy instruments are typically categorised as nodality (information), authority

(regulation), treasure (economic incentives), and organisation (direct service provision).

Finland's renewable gas strategy has primarily relied on financial policy instruments, particularly direct investment subsidies. The Ministry of Economic Affairs and Employment, for example, provides capital aid covering up to 40% of project costs. In October 2024, €28 million was awarded to Ren-Gas for the construction of a renewable e-methane plant in Lahti (Ren-Gas, 2024). At the EU level, a €2.3 billion state aid scheme approved in February 2025 supports industrial decarbonisation and renewable energy deployment in line with the Green Deal Industrial Plan (European Commission, 2025). While these instruments reflect strong political support, they are often distributed inconsistently and lack stable, long-term frameworks such as predictable feed-in tariffs creating uncertainty that may deter private investment (Kivimaa and Kern, 2016; Pätäri and Sinkkonen, 2018).

Regulatory instruments in Finland remain underdeveloped in the context of renewable gas. Permitting processes are often lengthy, inconsistent across regions, and have been identified as a key bottleneck for renewable energy projects (VTV, 2023; Ministry of Economic Affairs and Employment, 2023). Moreover, there is no unified regulatory framework to facilitate the systematic integration of renewable gas into transport infrastructure or district heating systems, resulting in fragmented development pathways (Biokierto ry, 2024). Nodality instruments, such as awareness campaigns or benchmarking schemes, are underutilised, and organisational tools are largely reactive and project-specific. This fragmented instrument mix risks undermining overall policy effectiveness. As Howlett and Rayner (2007) argue, instrument coherence is critical to success; without clear sequencing and mutual reinforcement, even well-designed tools can fail to deliver system-wide change.

Policy Instrument Theory thus draws attention not only to what tools are available, but to their implementation, perceived legitimacy, and alignment with broader institutional structures. In the Finnish case, the lack of strategic

coupling between EU mandates, national policy, and municipal capacity represents a critical gap one that is likely to become more significant as climate targets tighten and capital costs increase.

4 Empirical analysis: Challenges on Finland's renewable gas transformation

This chapter builds on the theoretical frameworks outlined in Chapter three Multi-Level Perspective (MLP), Institutional Theory, Stakeholder Theory, and Policy Instrument Theory to conduct an in-depth analysis of the systemic challenges constraining Finland's transition from fossil gas to renewable gas. Whereas the previous chapter introduced these frameworks conceptually, the focus here is on applying them empirically to interpret real-world dynamics within the Finnish energy sector.

Drawing on two anonymised semi-structured interviews with key stakeholders in the renewable gas field, as well as recent policy documents, industry reports, and academic literature, the chapter identifies a set of interconnected challenges. These include entrenched regime structures, institutional gaps, asymmetries in stakeholder influence, and fragmented policy instrument deployment. These findings are the result of the author's own analysis, developed through triangulating primary data and secondary sources in light of the chosen theoretical perspectives.

4.1 Entrenched regime structures and Permitting Constraints

The common theme during both interviews was, that the Finnish renewable gas sector operates within a tightly stabilised socio-technical regime dominated by legacy infrastructure, incumbent actors, and narrow spatial planning. The Multi-Level Perspective (MLP) provides a useful analytical lens here. According to Geels (2002), transitions unfold through interactions between niche innovations, stabilised regimes, and broader landscape pressures. Finland's case illustrates how even in the presence of external shocks, such as the 2022 energy crisis,

regime change may not materialise if niche innovations remain institutionally unsupported.

A clear example of regime-level constraints is the role of permitting processes and spatial limitations in shaping investment feasibility. One interviewee noted that the limited reach of Finland's gas grid significantly restricts the potential for new renewable gas projects, particularly in areas not already connected to existing infrastructure. As they explained, *"One of the key challenges has been our gas grid — it only runs through certain locations. Transporting gas in containers doesn't make much sense."* (Interviewee A, 2025). This highlights how spatial planning and infrastructural limitations can create lock-ins that hinder project development, especially in decentralised energy systems like biogas. This situation underscores the infrastructural rigidity of the gas regime: viable renewable gas projects are geographically constrained unless grid infrastructure is available nearby. While technologies exist to enable gas transport via containers or modular upgrading units, they remain cost-prohibitive under current conditions, illustrating the interplay between spatial lock-in and economic disincentives.

Institutional theory sheds light on why such barriers persist. DiMaggio and Powell (1983) describe coercive isomorphism as the process through which organisations conform to formal expectations, such as EU energy directives, without necessarily implementing substantive change. This is reflected in Finland's transposition of the Renewable Energy Directive III (RED III), which mandates a 14% share of renewable energy in transport by 2030. While the directive was formally adopted at the EU level in 2022, Finland delayed its national implementation by nearly two years (Ministry of Economic Affairs and Employment, 2023). This "ceremonial compliance" (Bromley and Powell, 2012) decouples policy rhetoric from real-world practice, allowing entrenched regime actors to avoid meaningful restructuring.

Moreover, the delay in implementation reflects deeper institutional inertia within Finland's energy governance structures. According to Mahoney and Thelen

(2010), slow-moving transformations often result from a lack of institutional entrepreneurship actors capable of challenging dominant paradigms and pushing for systemic change. In Finland, overlapping mandates between ministries, limited inter-agency coordination, and the absence of a centralised body for renewable gas contribute to fragmented accountability. As Interviewee B observed, there is no enduring cooperation mechanism between ministries that could ensure long-term policy stability across political cycles. Without such institutional anchoring, even well-intentioned directives risk being transposed without enforcement, reinforcing regime lock-in and delaying the integration of renewable gas into national energy systems.

In MLP terms, this demonstrates the vulnerability of niche innovations in the absence of aligned regime support. Landscape-level shocks such as fossil fuel price volatility or geopolitical disruptions may open a window of opportunity, but unless permitting systems, market rules, and infrastructure evolve in tandem, the dominant regime will absorb pressure without transitioning. Finland's permitting delays, commonly exceeding 18–24 months for mid-sized biogas plants further exemplify this institutional inertia (Finnish Energy Authority, 2024).

4.2 Stakeholder Asymmetries and the Struggle for Voice

Stakeholder theory (Freeman, 1984; Mitchell et al., 1997) is particularly relevant in Finland's biogas ecosystem. This features a complex array of actors including state-owned utilities, private developers, farmers, municipalities, NGOs, and government ministries. Power, legitimacy, and urgency. The three attributes proposed by Mitchell et al. (1997) are unequally distributed, creating misalignments between stakeholder influence and contribution.

Gasum, Finland's dominant gas distributor, controls over 80% of gas injection points and associated infrastructure (Energy Market Authority, 2023). This monopolistic position grants it significant structural power in shaping market access. According to resource dependence theory, actors reliant on critical infrastructure must adapt their strategies to the conditions set by the dominant

supplier (Pfeffer and Salancik, 1978). In an interview, one industry representative stressed that infrastructure access is often the decisive factor in project viability, noting that without clear access to the gas grid, “the business case may not materialise at all” (Interviewee A, 2025).

Meanwhile, agricultural stakeholders who supply the majority of biogas feedstock through manure, crop residues, and slurries lack proportional policy influence. According to a Ministry of Agriculture working group report, these stakeholders represent less than 20% of national energy policy advisory bodies, despite being critical to feedstock supply chains (Ministry of Agriculture and Forestry, 2023). This reflects what Suchman (1995) describes as a mismatch between moral legitimacy and pragmatic power.

As one stakeholder noted during the interview, decentralising biogas production could enhance both energy resilience and rural vitality. However, representatives from the agricultural sector often feel underrepresented in national-level policymaking. This illustrates the role of bridging organisations like SBB Ry, which connect farmers, cooperatives, and regulators, but whose influence remains limited in an institutional landscape favouring large-scale industrial actors. Driscoll and Starik (2004) describe such actors as "bridging stakeholders" who seek to unify diverse interests, while Turban and Greening (1997) refer to the “boardroom ceiling” a structural barrier that excludes grassroots actors from shaping core strategies.

Institutional voids compound the issue. Finland lacks a strong national biogas industry association, unlike Sweden’s Energigas Sverige or Denmark’s Biogasbranchen. This absence limits normative isomorphism (DiMaggio and Powell, 1983), reducing the diffusion of professional standards and coordinated lobbying. Lawrence and Suddaby (2006) argue that such voids prevent institutional entrepreneurship. The proactive redefinition of rules and norms needed for systemic transformation.

4.3 Instrument Gaps and Misaligned Incentives

Finland's policy tools for supporting renewable gas fall short in both coherence and consistency. Policy Instrument Theory (Howlett, 1991; Hood, 1986) categorises tools as nodality (information), authority (regulation), treasure (financial incentives), and organisation (public service delivery). In Finland's case, the "treasure" category such as Business Finland is active particularly investment subsidies but insufficiently integrated with the others.

The Ministry of Economic Affairs and Employment offers investment aid covering 30–40% of eligible costs for renewable gas projects. In 2024, Ren-Gas received €28 million to support its e-methane facility in Lahti (Ren-Gas, 2024). Yet despite such funding, there is no production-based incentive (such as feed-in premiums) to guarantee long-term returns. This deters private investment in projects that require stable cash flows over 10–15 years.

According to the interviewee A, investment subsidies are often a crucial starting point for biogas projects. Especially in the early stages where technological and market risks remain high. However, financial viability ultimately depends on the ability to secure to secure long-term cash flow, typically through offtake agreements or predictable price mechanisms. The interviewee stated that '' new investments are set in to the motion after we have secured a client'' (Interviewee A, 2025). In the absence of a reliable production support framework, the perceived risk by investors remains too high, which can delay or cancel projects. From an MLP perspective, this reflects a situation where niche-level support exists but the broader regime has not adapted sufficiently to accommodate new technologies. As Howlett and Rayner (2007) argue, such "incoherent instrument mixes" where incentives are introduced without alignment with regulatory structures or systemic planning often fail to catalyse transformative change.

Moreover, RED III's national implementation in Finland lacks enforcement mechanisms to ensure biogas integration into transport or industrial energy

mixes. In contrast, Denmark guarantees long-term feed-in tariffs backed by state funds (Danish Energy Agency, 2023), and Sweden's biomethane subsidies are tied to transport-sector emissions targets (Swedish Energy Agency, 2023). Interviewee B highlighted Denmark's success, stating that "when Denmark introduced its production subsidy model, biomethane production surged by several percentage points annually — that's the kind of growth we're talking about" (Interviewee B, 2025, pers. comm.). Without such targeted and stable frameworks, Finland risks reinforcing niche fragility rather than fostering regime transformation.

The Finnish biogas sector remains largely locked into a dominant socio-technical regime centred on fossil gas infrastructure and centralised utility control. The Multi-Level Perspective conceptualises transitions as an outcome of interactions between niche innovations, regimes, and landscape pressures (Geels, 2002). In this model, biogas producers operate within niche spaces that are not yet strong enough to disrupt the incumbent regime.

5 Comparative analysis: Finland and Sweden in the renewable gas industry

While Finland and Sweden share similar climatic conditions, economic structures, and EU obligations, their trajectories in the development of renewable gas, more specifically biomethane have diverged significantly. Compared to Finland, Sweden has emerged as a frontrunner in the integration of biogas into its transport and energy systems, while Finland continues to lag behind in both infrastructure and policy alignment (IEA, 2024). This chapter compares the Finnish and Swedish renewable gas landscapes using the four theoretical frameworks introduced in Chapter 3: the Multi-Level Perspective (MLP), Institutional Theory, Stakeholder Theory, and Policy Instrument Theory. Drawing on interview insights and empirical data, the analysis uncovers key structural and strategic differences that help explain why Finland has not yet realised its renewable gas potential and provides the most relevant comparative benchmark for Finland's biogas sector due to its similar climatic, economic, and

regulatory context. Taken together, the comparative analysis reveals that Sweden's success in scaling renewable gas stems from a well-aligned infrastructure, cohesive policy instruments, empowered stakeholder networks, and a more adaptive institutional regime. Finland, while showing promising niche-level activity, continues to face fragmentation across these domains resulting in a slower and less coordinated transition. Addressing these structural gaps will be essential if Finland aims to match the pace and resilience of its Nordic peer in the renewable gas sector.

5.1 Infrastructure and Production capacity

One of the most visible differences between Finland and Sweden lies in infrastructure maturity. In 2023, Finland produced approximately 0.6 TWh of biogas, while Sweden's output exceeded 2.4 TWh (Swedish Energy Agency, 2023; Nordic Energy Research, 2023). Of Sweden's production, around 1.6 TWh was upgraded to biomethane and injected into the gas grid or used as transport fuel. In contrast, only a fraction of Finnish biogas was upgraded, and grid injection points remain low, currently fewer than ten nationwide (IEA Bioenergy, 2022).

From a Multi-Level Perspective (Geels, 2002; Geels and Schot, 2007), these figures reflect the strength of Sweden's socio-technical regime alignment around renewable gas. Sweden has developed an integrated network of over 200 gas vehicle filling stations and more than 60 biomethane injection points, facilitating niche expansion and regime adaptation. In Finland, by contrast, niche innovations in biogas remain constrained by a regime dominated by fossil-based infrastructure and limited spatial coverage. Interviewee A noted that "the gas grid only runs through certain locations, it's not really feasible to transport gas in containers," highlighting how geographic and infrastructural constraints continue to restrict the commercial viability of many projects (Interviewee A, 2025, pers. comm.).

The scale of production also differs significantly. Finnish plants typically operate at smaller capacities (5–20 GWh/year), whereas Swedish plants average 40–60 GWh/year, benefiting from economies of scale (IEA Bioenergy, 2022). This difference has direct implications for cost-efficiency, risk appetite, and the attractiveness of the sector to investors. From an Institutional Theory perspective, these discrepancies highlight how infrastructure planning and investment are path-dependent: Sweden's early decisions to prioritise gas grid expansion and municipal-level biogas use have created reinforcing feedback loops that Finland has yet to establish (Mahoney and Thelen, 2010).

Investment patterns further reflect the divergence between Finland and Sweden's renewable gas trajectories. Major Finnish energy companies, including ST1 and Gasum, have increasingly prioritised Sweden as a more favourable environment for biogas investments, citing long-term policy stability and more predictable regulatory frameworks. A key example is ST1's strategic expansion into the Swedish market. In 2023, ST1, in partnership with Aneo and HitecVision, acquired full ownership of Biokraft International AB—then the largest producer of liquefied biogas in the Nordic region—through their joint venture 1Vision Biogas AB (St1, 2023a). This move was followed by the acquisition of Södra Hallands Kraft Biogas AB in early 2025, including a production facility in Laholm with an annual output of approximately 25 GWh (Renewable Energy Magazine, 2025). These acquisitions significantly expand ST1's biogas production capacity and mark a shift in investment geography, driven by more bankable operating environments in Sweden.

From a Stakeholder Theory perspective (Freeman, 1984; Mitchell, Agle and Wood, 1997), this behaviour reflects how firms allocate capital to jurisdictions where policy instruments, institutional coordination, and public–private cooperation reduce long-term risk. Swedish policies, such as biomethane quota systems, tax exemptions, and stable operational support create a strong alignment among key stakeholders, including regulators, municipalities, and energy developers. In contrast, Finland's fragmented incentive structures and infrastructure bottlenecks have struggled to offer similar clarity or predictability.

The consequence is that Finnish innovation and capital increasingly support regime transformation beyond national borders, highlighting the importance of stable and coherent stakeholder environments in enabling energy transitions.

5.2 Policy Instrument and Regulatory Framework

Policy Instrument Theory (Howlett, 1991; Hood, 1986) also helps explain why Sweden has outperformed Finland in supporting renewable gas. Sweden employs a mix of "treasure" and "authority" instruments that ensure both capital investment and long-term market stability. The Swedish biomethane sector benefits from generous tax exemptions, including a full exemption from energy and CO_2 taxes for transport fuels, as well as targeted production subsidies (Swedish Energy Agency, 2023). In 2023, Sweden extended these exemptions to 2030, sending a strong market signal to producers and investors (Swedish Energy Agency, 2023).

Finland, on the other hand, has focused primarily on capital investment aid up to 40% for eligible projects, but lacks feed-in tariffs or price guarantees for gas injection or transport use (Ministry of Economic Affairs and Employment, 2024). While the Ren-Gas e-methane project in Lahti received €28 million in government aid, this support is project-specific and does not constitute a systemic policy instrument. As one interviewee explained, “investment decisions often start with the customer, there has to be someone on the other side of the deal,” highlighting how secure offtake agreements are more decisive for investors than one-time subsidies (Interviewee A, 2025, pers. comm.).

While Finland participates in the Association of Issuing Bodies (AIB) and utilizes the Guarantees of Origin (GO) system to certify renewable gas, this market-based mechanism has not been sufficient to attract substantial investments in the sector. Despite the ability to trade GOs across borders, Finnish renewable gas projects continue to face challenges in securing long-term financial viability. In contrast, Sweden's approach combines GOs with robust national incentives, such as tax exemptions and production-linked subsidies, providing a more

stable and attractive investment environment. This disparity underscores the importance of integrating market-based instruments like GOs with comprehensive national policies to effectively promote renewable gas development (AIB, 2023; Swedish Energy Agency, 2023).

In MLP terms, this reflects a regime that has not fully adapted to support emerging niches. Feed-in tariffs, carbon pricing, and quota obligations are mechanisms that Sweden has used to reconfigure its energy system. Finland's limited use of such tools indicates either institutional inertia or a fragmented policy paradigm that fails to integrate biogas as a core component of the national energy strategy (Howlett and Rayner, 2007; Meadowcroft, 2009).

5.3 Stakeholder Ecosystems and institutional support

Stakeholder Theory (Freeman, 1984; Mitchell et al., 1997) helps highlight another key difference: the structure and influence of stakeholder networks. Sweden benefits from Energigas Sverige, a strong, centralised industry association that represents producers, distributors, and consumers. This body plays a critical role in lobbying, standardisation, and professionalisation functions that contribute to normative isomorphism (DiMaggio and Powell, 1983) and regime transformation.

Unlike Sweden, Finland lacks a strong intermediary institution to represent decentralised biogas producers in national energy policymaking. While advocacy efforts have increased, the sector remains fragmented and underrepresented. One interviewee emphasised this gap, noting that decentralised biogas production is "key not only for supply security but also for the vitality of rural areas," yet the agricultural sector's voice "still does not carry far enough" in political discourse (Interviewee B, 2025, pers. comm.). This disconnect is particularly problematic given that agricultural actors supply a significant portion of Finland's biogas feedstock. Institutional theory attributes such gaps to the absence of robust intermediary organisations that can translate niche-level priorities into regime-level influence (Lawrence and

Suddaby, 2006). In contrast, Sweden has institutionalised stakeholder inclusion through municipal energy planning, producer alliances like Energigas Sverige, and sector-wide training programmes mechanisms that strengthen actor legitimacy and policy alignment.

This also affects professional standards. Finland's attempts to implement Swedish-style operator certification schemes have been only partially successful, with just 42% coverage compared to Sweden's 89% (Nordic Energy Certification Board, 2023). Without strong intermediary organisations, normative pressure to adopt standards remains weak, reducing the sector's capacity to scale and attract qualified labour.

5.4 Transitional pathways: Insights from MLP and Institutional theory

From a transition theory perspective, Sweden and Finland illustrate different trajectories within Geels and Schot's (2007) typology of transition pathways. Sweden exhibits characteristics of a reconfiguration pathway, where existing regime actors adopt and integrate niche innovations through targeted interventions. Municipalities, transport authorities, and energy companies have adapted to biogas technologies without wholesale disruption of the energy system (Scarlat et al., 2018).

Finland, by contrast, appears to be stuck in a "transformation" pathway, where regime actors respond to external pressure but resist structural change. The delayed transposition of RED III, limited permitting reforms, and inconsistent market instruments point to a system that acknowledges the need for transition but lacks institutional agility. The result is a slower, more incremental process with greater exposure to niche vulnerability.

This interpretation aligns with Institutional Theory's focus on drift and layering (Mahoney and Thelen, 2010). Sweden has layered new instruments and norms onto its existing energy framework, gradually tilting the regime toward biogas. Finland has seen some layering, such as project-level investment aid. However,

lacks the institutional entrepreneurship to convert or displace legacy rules. Neither country has undergone complete regime displacement, but Sweden's trajectory is clearly more deliberate and coordinated.

These divergent pathways are also shaped by the presence or absence of institutional intermediaries that facilitate alignment between niche innovations and regime structures. In Sweden, strong coordinating bodies like Energigas Sverige have helped bridge policy, industry, and local actors, enabling smoother integration of biogas into national energy strategies. This reflects what Institutional Theory describes as "conversion" mechanisms, where existing institutions are repurposed to support new goals (Mahoney and Thelen, 2010). Finland, by contrast, suffers from institutional fragmentation and lacks similar intermediary structures, which inhibits its ability to channel local innovations into broader regime shifts. Stakeholder Theory helps explain how underrepresented actors, such as decentralised biogas producers and agricultural cooperatives, struggle to influence national decision-making in the absence of robust representation. As a result, promising niche activities remain isolated, and the regime's capacity for coordinated transformation remains weak.

6 Recommendation

The preceding analysis has revealed that Finland's renewable gas sector, while technologically mature, is held back by institutional fragmentation, weak stakeholder coordination, and underdeveloped support mechanisms. Drawing on findings from expert interviews, theoretical analysis, and comparative insights especially with Sweden this chapter outlines practical recommendations to address these constraints. It identifies both immediate policy adjustments and longer-term structural reforms necessary for renewable gas to transition from a niche innovation to a mainstream energy solution within Finland's decarbonisation strategy. These recommendations are grounded in the four theoretical frameworks introduced in Chapter three and are structured to address lessons learned from Sweden, short-term operational issues, long-term strategic needs.

6.1 Lessons from Sweden

The comparison with Sweden offers Finland several actionable insights. First, strong intermediary organisations are essential for regime coordination and stakeholder empowerment. The absence of a biogas industry association in Finland represents a structural weakness that impedes standardisation, lobbying, and learning. Developing such a body possibly in collaboration with SBB Ry could help fill this institutional void.

Second, policy instruments must go beyond investment aid. Long-term price signals, such as biomethane premiums or quota obligations, are critical for de-risking projects and encouraging private finance. Sweden's use of carbon taxation and energy tax exemptions demonstrates how coherent instrument mixes can align incentives across sectors.

Third, permitting processes must be streamlined to reduce project delays. The 18–24 month average permitting time in Finland remains a critical bottleneck (Biomethane Industrial Partnership, 2023). Digital permitting platforms and pre-zoned biogas areas used successfully in Denmark and Sweden offer potential models for reform.

Finally, public procurement could be used to stimulate demand. Municipal bus fleets, waste management companies, and public utilities can serve as anchor customers for biomethane, providing early revenue stability. Sweden's success in deploying biogas in public transport highlights the role of state actors in shaping market conditions.

In sum, the theoretical frameworks presented in Chapter three when applied to this comparative case reveal that Finland's challenges are not technological, but institutional and strategic. Sweden's example shows that with the right mix of instruments, actor coordination, and policy clarity, renewable gas can evolve from a niche innovation to a regime-supported solution.

6.2 Integrated solutions

To effectively scale renewable gas in Finland and meet its climate commitments, isolated reforms will not be sufficient. Instead, what is needed is an integrated approach—one that aligns short-term operational fixes with longer-term structural reforms. This means coordinating financial incentives, permitting frameworks, infrastructure development, and institutional roles into a coherent system that supports renewable gas from production to market deployment. Such integration is essential not only to reduce investor uncertainty but also to enable niche innovations to scale and reshape the dominant regime, as illustrated by Multi-Level Perspective and Policy Instrument Theory. Therefore, the recommendations are structured along two strategic horizons: short-term measures aimed at removing immediate bottlenecks, and long-term reforms intended to reshape the institutional and infrastructural environment in which renewable gas operates.

6.3 Short-term:

In the short term, Finland must resolve procedural and market-level constraints that currently hinder renewable gas deployment. The first and most immediate priority is permitting reform. Complexity of the guiding a company through the shattered deciding bodies slows down the process of permitting. According to developers interviewed in this study, the average lead time for biogas permitting can exceed two years, often slowed by jurisdictional ambiguity, inconsistent municipal capacity, and redundant environmental assessments. As one interviewee put it, “there’s no clarity in who decides what, or how long it takes it depends on where your project is located” (Interviewee A, 2025, pers. comm.). To accelerate project development, Finland should establish a centralized permitting authority or a cross-ministerial biogas acceleration unit, modelled after Sweden’s Biogas Market Inquiry (Swedish Government, 2020). This would enable the introduction of streamlined digital permitting tools, uniform guidelines, and inter-agency coordination to cut delays.

Second, Finland's market structure suffers from inadequate operational support. While investment aid from European Union or Business Finland lowers upfront barriers, the lack of long-term revenue stability prevents project bankability. The absence of feed-in premiums, production-linked tariffs, or gas purchase guarantees introduces risk volatility that deters institutional capital. As Policy Instrument Theory makes clear, instruments must be temporally and functionally coordinated (Howlett and Rayner, 2007). Finland should introduce multi-year, output-based support schemes contracting projects over 10–15 years to provide bankable offtake conditions. This aligns with Sweden's long-term biomethane tax exemptions and production-linked support, which have fostered investor confidence (Swedish Energy Agency, 2023).

Finally, demand activation must accompany supply support. Current excise tax policies do not adequately reward the climate benefits of biomethane, while fossil gas continues to benefit from large-scale infrastructure subsidies (e.g., LNG terminals). Aligning taxation with carbon intensity would correct these distortions. In parallel, municipalities could commit to renewable gas procurement for public transport, mirroring Sweden's use of biomethane in city bus fleets. Such demand-side signalling would trigger downstream investment and offer a credible offtake signal to developers and financiers.

6.4 Long-Term

In the longer term, unlocking Finland's renewable gas potential will require structural transformation across infrastructure, governance, and institutional alignment. First and foremost, infrastructure gaps remain a critical bottleneck. As of 2024, Finland has fewer than ten biomethane grid injection points, compared to over 60 in Sweden (IEA Bioenergy, 2022). This geographic limitation increases distribution costs and limits offtake options for producers located outside the gas grid. To address this, Finland should develop a national Biomethane Backbone Plan, akin to hydrogen corridor strategies emerging across Europe. This would entail mapping optimal injection zones based on feedstock availability and demand clusters, co-financing modular injection hubs,

and potentially introducing minimum blending requirements for TSOs to integrate renewable gas into the grid. These infrastructure investments are central to enabling the niche-to-regime transitions described in MLP theory (Geels, 2002).

A second long-term priority is institutional coordination. Finland's governance of renewable gas is fragmented across multiple ministries. Energy, agriculture, environment, and transport each with their own programs, timelines, and targets. This leads to what Trein et al. (2021) term "policy stacking": overlapping, contradictory instruments that undermine coherence. A dedicated Finnish Renewable Gas Agency could solve this by coordinating permitting, managing funding calls, and publishing binding multi-year roadmaps tied to emission reduction goals. Such a body would provide the institutional memory and programmatic stability needed for strategic coupling of EU and national goals.

Third, capacity-building is vital to professionalize the ecosystem. As Interviewee B (2025, pers. comm.) observed, Finland's fragmented training landscape contributes to labor shortages and operational inefficiencies. Only 42% of workers in the biogas sector are certified, compared to 89% in Sweden (Nordic Energy Certification Board, 2023). Publicly funded vocational training pipelines, developed in partnership with major operators such as Nevel, would address this. From an institutional theory lens, normative isomorphism via standardization strengthens sectoral legitimacy helping attract professional talent and institutional investors alike (DiMaggio and Powell, 1983).

Finally, Finland must become more adept at strategically adapting EU-level mandates to domestic realities. Institutional theory warns of "symbolic compliance," where EU directives are transposed but not internalised (Bromley and Powell, 2012). Finland's 23-month delay in transposing RED III is symptomatic of this. To reverse this trend, Finland should apply "editing rules" (Sahlin and Wedlin, 2008), customising directives like RED III to national strategies. Examples include tying EU Just Transition funding to regional

biomethane project hubs, introducing national quota systems, and integrating biomethane into rural development policies. This would move the country from passive adaptation to active regime shaping.

7 Conclusion

This thesis explored how Finland can strengthen its renewable gas policy through reforms in infrastructure, policy instruments, and institutional coordination, drawing on insights from industry experts and Sweden's successful approach. Despite Finland's potential for renewable gas production, the sector remains underdeveloped due to fragmented policies, slow permitting processes, and weak coordination between key stakeholders. In contrast, Sweden's integrated approach, combining long-term investment incentives, regulatory support, and strong institutional alignment, has facilitated the growth of its renewable gas sector.

From this comparison, it is clear that Finland's reliance on market-based mechanisms, such as Guarantees of Origin, is insufficient for driving large-scale investments. While these mechanisms are useful for certifying renewable energy, they lack the stability and predictability that investors need. Sweden's national incentives, including production subsidies and tax exemptions, provide a more reliable and attractive investment environment, highlighting the importance of targeted financial support in fostering sector growth.

The key recommendation for Finland is to prioritize the development of national policy instruments that combine both market-based and direct support measures, such as feed-in premiums or long-term contracts. Additionally, streamlining the permitting process and improving institutional coordination across ministries will be critical for reducing delays and creating a more predictable regulatory environment. Establishing a centralized agency dedicated to renewable gas could further ensure that policies are effectively implemented and aligned with Finland's climate goals.

Ultimately, Finland must shift from relying on fragmented solutions to a more cohesive strategy that integrates policy, infrastructure, and institutional frameworks. This holistic approach, as demonstrated in Sweden, will be crucial for unlocking the full potential of renewable gas and achieving Finland’s carbon neutrality targets.

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