Deus Ex Machina

A Critical Discourse Analysis of Singapore's Low-Carbon Transition in The Straits Times

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Abstract

Fossil fuel companies have shifted from outright climate denial to subtler strategies of delay. These include *low-carbon solutions*—carbon capture, utilisation and storage (CCUS) and hydrogen—which legitimise and extend fossil fuel dependency. This study examines how *low-carbon discourses* operate through the media in Singapore, a major refining and petrochemical hub with an authoritarian state-aligned media system. Using Fairclough's critical discourse analysis and carbon lock-in, I analyse 72 online articles (2019–2026) from *The Straits Times* (ST) to investigate how they shape a particular understanding of low-carbon solutions that privileges certain actors and technologies in Singapore's energy transition while delegitimising others. I find that ST employed strategic ambiguity and techno-optimism to advance the interests of the Singaporean state and fossil fuel companies, especially Shell and ExxonMobil. These discursive practices reinforce infrastructural and technological lock-in and institutional lock-in in Singapore, implying lock-in risks for other countries adopting low-carbon solutions.

Keywords: low carbon solutions, critical discourse analysis, carbon lock-in, energy transition, Singapore

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List of Abbreviations

CCS	Carbon capture and storage
CCUS	Carbon capture, utilisation and storage
CDA	Critical discourse analysis
CHI	Centre for Hydrogen Innovations
CO_2	Carbon dioxide
EMA	Energy Market Authority
IPCC	Intergovernmental Panel on Climate Change
LNG	Liquefied natural gas
NTU	Nanyang Technological University
NUS	National University of Singapore
PAP	People's Action Party
SPH	Singapore Press Holdings
ST	The Straits Times

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1 Introduction

In 2024, global mean surface temperature exceeded 1.5 °C relative to pre-industrial levels across an entire year for the first time, signalling a likely breach of the Paris Agreement target of limiting global warming to 1.5 °C (Cannon, 2025). One reason for this collective failure is that fossil fuel companies and other actors with aligned interests have deployed vast resources to delay and block climate policies consistent with the scientific consensus on what is necessary to avoid dangerous climate change (Timmons Roberts et al., 2025). Internal documents by the oil companies ExxonMobil and Shell reveal that they had accurate predictions of how their products could cause catastrophic global warming since at least the 1970s and 1980s, but promoted doubt to the public about the existence of human-caused climate change (Franta, 2018; Supran & Oreskes, 2017; Supran et al., 2023).

More recently, as the burning of fossil fuels has become unequivocally linked to climate change (IPCC, 2023), fossil fuel companies have shifted from the outright denial of climate change to more subtle and sophisticated strategies to delay proposed climate solutions and maintain countries' dependence on fossil fuels (Lamb et al., 2020; Nicolosi et al., 2025; Timmons Roberts et al., 2025). Two such "climate delay discourses" (Lamb et al., 2020) are especially relevant to this study: *techno-optimism*, the belief that environmental problems will be solved by future technological breakthroughs and hence do not require social changes (Megura & Gunderson, 2022); and *fossil fuel solutionism*, where fossil fuel companies attempt to portray themselves as "part of the solution" to the climate crisis through their investments in green technologies (Dutta, 2026; Llavero-Pasquina et al., 2025).

Techno-optimism and fossil fuel solutionism are present in the emerging discourse around *low-carbon solutions*—often used by fossil fuel companies to refer to carbon capture, utilisation and storage (CCUS) and hydrogen (BP, 2026; Chevron, 2026; Eni, 2024; Equinor, 2026; ExxonMobil, 2026; Saudi Aramco, 2025; Shell, 2026b; TotalEnergies, 2024; Repsol, 2025). In particular, CCUS has attracted market and policy support in many countries—driven by its political appeal as a technological "quick fix" that minimises the need for social and institutional disruption (van Wijk & Fischhendler, 2025). Despite this optimism, the feasibility of planned expansions of low-carbon solutions remains contentious given their high historical failure rates (Gibson & Kay, 2025; Kazlou et al., 2024). Moreover, low-carbon solutions typically function as "add-ons" to existing fossil fuel infrastructure, thereby securing future fossil fuel dependency (Szabo, 2021; Vergragt et al., 2011). Challenging this mechanism which makes transitioning from fossil fuels to alternative energy pathways increasingly difficult—known as *carbon lock-in* (Unruh, 2000)—requires critical examination of the public discourses through which fossil fuel companies' preferred technologies are naturalised and legitimised as the inevitable

energy solutions of the future (Buschmann & Oels, 2019). The role of such *low-carbon discourses*—particularly around CCUS—in advancing fossil fuel interests has been critically analysed in countries including Japan (Asayama & Ishii, 2017) and Canada (Jara, 2025), but not in Singapore.

Therefore, my aim is to extend this line of inquiry to Singapore's development of low-carbon solutions in its energy transition, which presents a uniquely instructive case for two reasons. First, since the late 19th century, Singapore has been instrumental to the growth of what became Shell, ExxonMobil, Chevron, and BP (Ng, 2012). These fossil fuel companies, alongside hundreds of others, maintain an established presence in Singapore, which is now one of the world's largest oil refining, bunkering, and petrochemical trading hubs (Ng, 2012; Toledano & Maennling, 2018; Venketram et al., 2026). Furthermore, fossil fuel dependency is the status quo within the city-state, where natural gas accounts for 93% of electricity generation (EMA, 2025). Second, due to the Singaporean state's hegemony over the media (George, 2012), the interests of the state and its industry partners in developing low-carbon solutions may be at once reflected in, and actively advanced through, media discourse. These factors warrant a critical examination of low-carbon discourses in the Singaporean media and the ways in which they might constitute carbon lock-in, undermining the country's energy transition.

1.1 Research Aims

This study investigates the low-carbon discourses present in online articles published by Singapore's leading newspaper *The Straits Times* between October 2019 and February 2026. I use a critical discourse analysis to examine how journalists, state and fossil fuel industry representatives employed linguistic strategies to shape a particular public understanding of Singapore's energy transition that privileges some actors and technologies while foreclosing others. My analysis draws on the concept of carbon lock-in to explain how low-carbon discourses reinforce fossil fuel path dependencies in Singapore's infrastructure, technologies, and institutions.

This inquiry is guided by four research questions (RQs):

RQ1: What meanings of "low-carbon" and "energy transition" are constructed in The Straits Times online articles (2019–2026)?

RQ2: How are fossil fuel companies and low-carbon solutions represented in The Straits Times' low-carbon discourses?

RQ3: How do the news production practices of The Straits Times mediate between the interests of fossil fuel companies and the Singaporean state in its low-carbon discourses?

RQ4: How do low-carbon discourses in The Straits Times constitute carbon lock-in in Singapore?

1.2 Relevance for Sustainability Science

In 2023, the Intergovernmental Panel on Climate Change's (IPCC) Sixth Assessment Report (AR6) stated that CO_2 removals are required to avoid an overshoot of the 2.0 °C warming limit of the Paris Agreement (IPCC, 2023). This makes a mass deployment of low-carbon solutions such as CCUS increasingly unavoidable (Kazlou et al., 2024). However, from a sustainability science perspective, low-carbon solutions as a problem-solving approach must be complemented by critical research to bring relevant institutions and power relations into question (Jerneck et al., 2011). In this case, it is crucial to ensure that low-carbon solutions lead to genuine decarbonisation and are not harnessed by fossil fuel companies to reinforce carbon lock-in (Szabo, 2021; Van de Graaf et al., 2020; Vergragt et al., 2011). This study contributes to an emerging body of discourse analytical approaches to understanding how fossil fuel companies use low-carbon discourses to advance their interests (Asayama & Ishii, 2017; Jara, 2025). By illustrating how such discourses have manifested in Singapore, this study aims to make the strategies of key players, especially Shell and ExxonMobil, more recognisable in other discursive contexts.

2 Background

This chapter provides the contextual background for my analysis. First, I outline the political environment in which ST operates and Singapore's energy transition in relation to its national climate targets and fossil fuel-intensive sectors. Next, I establish key definitions used throughout the study.

2.1 The State-Media Relationship in Singapore

Since the end of British colonial rule in 1959, Singapore has been governed continuously by the centre-right People's Action Party (PAP), making it "one of the world's most enduring electoral authoritarian regimes" (George & Venkiteswaran, 2019, p. 21). Singapore's authoritarianism is a controversial subject. The country consistently ranks among the lowest in press freedom indices by organisations such as the U.S.-based Freedom House and Paris-based Reporters Without Borders (Freedom House, 2026; RSF, 2026). Yet, Singaporean scholars have challenged such rankings for oversimplifying Singapore's press control regime and grouping it with others where "journalists lose not just their liberty but even their lives" (George, 2012, p. 1; Tey, 2008). This critique is situated within a broader discussion on the heterogeneity of authoritarian regimes and the distinctiveness of Singapore's model, which has outlasted many of its post-colonial Asian counterparts (Abdullah, 2018; George & Venkiteswaran, 2019; A. Koh, 2008; Rodan, 2004; Tey, 2008). Two insights from this literature are particularly important for the present study. First, "sophisticated" authoritarian regimes do not merely censor mass media and public discourse, but actively use them to "propagate their own messages and to promote economic objectives" (Rodan, 2004, p. 1). Second, in Singapore's case, these objectives are largely framed as "nation-building", a developmentalist notion which prioritises "economic, social security, and political stability over civil liberties" (Tey, 2008, p. 881).

Singapore's media landscape is dominated by two conglomerates: the state-owned Mediacorp, which operates the news channel *CNA* (formerly Channel NewsAsia), and Singapore Press Holdings (SPH), which publishes *The Straits Times* (ST)—the country's leading English-language newspaper (Kaur et al., 2016) and the focus of this study. Despite not being directly state-owned, SPH remains subject to the PAP's oversight through the Newspaper and Printing Presses Act (NPPA), which requires newspaper companies to be publicly listed and enables the government to approve their management shares (which have 200 times the voting power of ordinary shares) and appoint their board of directors (George & Venkiteswaran, 2019; Tey, 2008). This has resulted in a clear alignment of ST's leadership with the PAP:

> Through the NPPA, the PAP government gained control over key appointments in Singapore's newspapers. Since 1982, the chairman's seat in the Straits Times group and its successor, SPH, has been occupied by a string of trusted former government officials, including three retired cabinet ministers. Former civil servants were appointed as SPH chief executive officers from 1995. Chief editors are experienced journalists drawn from the newsrooms, but only with the assent of the government. (George & Venkiteswaran, 2019, p. 25)

ST is therefore "confined to simple journalism and straightforward reporting" (Tey, 2008, p. 882) that steers clear of politically sensitive topics, such as ethnicity, religion and party politics, which are euphemistically referred to as "OB" (out-of-bounds) markers (Lee, 2002). These "political considerations tend to be internalised by [ST's] senior editors" (George & Venkiteswaran, 2019, p. 25), and the "resulting editorial decisions, consistently government-leaning on controversial issues, are outwardly defended as the outcome of professional judgement" (George & Venkiteswaran, 2019, p. 25). Nonetheless, a 2025 study by the Reuters Institute found that ST remains Singapore's most trusted news source with a 75% trust rating—significantly higher than the global average of 40% for mainstream news (Newman et al., 2025).

2.2 Singapore's Energy Dilemma

As "the sole industrialized small island nation in the world" (Schneider-Mayerson, 2017, p. 166) with no conventional energy resources, Singapore is almost entirely dependent on imported energy (Su et al., 2022). In 2024, total energy imports consisted of mainly crude oil and petroleum products (92%) and natural gas (7%) (EMA, 2025). However, these fuels serve distinct functions: natural gas is dedicated primarily to electricity generation, where it accounts for 93% of the fuel mix (EMA, 2025); meanwhile, oil flows mainly into Singapore's refining, petrochemical, and bunkering facilities on Jurong Island and Bukom Island (Lau et al., 2021). The significance of these islands to the global oil system cannot be understated: they house "three world-scale oil refineries, four large petrochemical complexes, several power plants, one of the world's largest container and oil trading ports, [and] the world's largest bunker fuel hub" (Ng, 2012, p. 4), including ExxonMobil's largest integrated manufacturing complex globally (ExxonMobil, 2024) and, until its sale in 2024, Shell's largest petrochemical production and export centre in the Asia-Pacific region (Shell, 2024). Consequently, Singapore has become the second largest importer and third largest exporter of refined petroleum in the world (OEC, 2026).

Singapore's considerable fossil fuel interests stand in tension with its stated commitments to climate change mitigation as a signatory to the Paris Agreement. Through its Nationally Determined

Contribution (NDC) and Long-Term Low-Emissions Development Strategy (LEDS), Singapore has committed to reducing its emissions to around 60 million tonnes of CO_2 equivalent ($MtCO_2e$) by 2030, further reducing emissions to between 45 and 50 $MtCO_2e$ in 2035, and reaching net zero emissions by 2050 (NCCS, 2025). Although Singapore achieved significant emissions reductions between 1990 and 2000 by transitioning from coal and oil to natural gas-based electricity generation (McGreevy & Chia, 2024), emissions have since followed an upward trajectory, reaching 51 $MtCO_2e$ in 2023 (Ritchie & Rosado, 2025). Moreover, this figure only captures territorial emissions produced within Singapore's borders; in the same year, consumption-based CO_2 emissions from traded fossil fuels and industrial products were more than three times higher, at 187 $MtCO_2e$ (Ritchie & Rosado, 2025). Industry is the largest source of emissions, and within it, the petrochemical sector alone is responsible for a disproportionately large 40% of total national emissions (McGreevy & Chia, 2024). This is a structural dilemma for Singapore, as the fossil fuel industry is simultaneously a pillar of its economy and an obstacle to its climate targets. Rather than acknowledging a trade-off between fossil fuels and climate commitments, the state has launched sustainability initiatives while actively protecting and expanding its fossil fuel industry (Bal et al., 2025; McGreevy & Chia, 2024).

This is evident in the state's approach to energy transition. In October 2019, the Energy Market Authority (EMA) announced its "Four Switches" energy transition framework, where each switch represents a strategic lever for transforming the country's energy supply (EMA, 2019). The four switches are natural gas, retained as an interim fuel; solar, identified as Singapore's most promising renewable energy source; regional power grids, pursued through bilateral cooperation; and "low-carbon alternatives", namely CCUS and hydrogen (EMA, 2019). While the final switch comprising CCUS and hydrogen is the core of my analysis, I also examine how their development affects the other switches, especially natural gas and solar.

2.3 Low-Carbon Solutions

The term "low-carbon" lacks conceptual clarity due to its omnipresent usage across scientific, policymaking, corporate, and other discourses. However, the development literature offers a clue, as the phrase "low carbon development" typically carries the connotation of "using less carbon for growth" (Mulugetta & Urban, 2010, p. 7546). The association of "low-carbon" with economic growth is also present in energy transition contexts. For instance, the IPCC groups renewables and fossil energy with CCUS together as "low-carbon energy sources", while also identifying most of these technologies as drivers of growth (Clarke et al., 2023, pp. 627, 664). Therefore, it appears that "low-carbon" may

generally align with technology-driven approaches to climate mitigation, diverging from alternative pathways such as degrowth (Keyßer & Lenzen, 2021).

Next, given the aims of this study, it is necessary to distinguish renewable energy sources, such as solar and wind, from CCUS and hydrogen, which fossil fuel companies have heavily invested in (Megura & Gunderson, 2022). The IPCC's broad definition of "low-carbon energy sources" (Clarke et al., 2023, p. 627) is not helpful in this regard. In contrast, the EMA's (2019) Four Switches framework is an ideal starting point as it is specific to Singapore's energy transition and makes a distinction between solar and "low-carbon alternatives" (CCUS and hydrogen). Furthermore, major fossil fuel companies in Singapore foreground CCUS and hydrogen as "low-carbon solutions" in their corporate discourses (ExxonMobil, 2026; Shell, 2026b). Following these patterns, I use *low-carbon solutions* to refer to CCUS and hydrogen, and *low-carbon discourses* to describe the language used in reference to these technologies, while *renewables* including solar and wind are treated as a separate category.

The technical details of low-carbon solutions also warrant clarification. First, CCUS (carbon *capture*, *utilisation* and *storage*) refers to three distinct processes. Carbon capture is the capture of CO_2 emissions from fossil fuel power plants, industrial facilities, or directly from the air; the captured CO_2 is then either utilised as an input to create products or services, or stored permanently in underground geological formations (IEA, 2024). The *transport* of compressed CO_2 by ship or pipeline from its point of capture to its point of use or storage is sometimes recognised as the fourth main process (IEA, 2024). For simplicity, I use CCUS as a general term to refer to projects that involve the capture of CO_2 for utilisation, storage, or both.[1]

Hydrogen is categorised into three main types or "colours", distinguished by the energy source and method used to produce it; in each case, the resulting hydrogen gas serves as an energy carrier or fuel. Grey hydrogen, which accounts for 76% of global hydrogen production, is made from natural gas using a method known as steam methane reforming (SMR) (Roy et al., 2025). Blue hydrogen is the result of combining SMR with CCUS, which results in lower CO_2 emissions than grey hydrogen but still relies on fossil fuels (Roy et al., 2025). By contrast, green hydrogen is produced through the electrolysis of water using renewable electricity, generating zero direct emissions (Roy et al., 2025). Green hydrogen has been called "the holy grail of decarbonization" due to its perceived environmental sustainability and compatibility with combustion-based infrastructure in "hard to abate" sectors such as shipping, aviation, and chemicals manufacturing (Scita et al., 2020). However, green hydrogen proposals have

[1] However, many ST articles used the shorter abbreviation CCS (carbon capture and storage), which I retain when quoting them directly.

been criticised for framing grey or blue hydrogen as a necessary “stepping-stone”, thereby legitimising and extending fossil fuel dependency (Hine et al., 2024). This is a plausible risk in Singapore, where Shell has financially backed green hydrogen startups (EMA, 2022). Considering these factors, I categorise green hydrogen as a low-carbon solution in my analysis.

3 Theoretical Framework

This study uses a critical discourse analytical framework, with carbon lock-in as an analytical tool to identify the mechanisms of fossil fuel dependency reproduced by ST's low-carbon discourses. My analysis is ontologically and epistemologically situated within a critical realist paradigm.

3.1 Critical Discourse Analysis

My analysis is structured around Norman Fairclough's (1995) three-dimensional critical discourse analysis (CDA) framework. Fairclough defines discourse as the "use of language seen as a form of social practice" (Fairclough, 1995, p. 7). Namely, discourse analysis assumes that "language is used to *mean* something and to *do* something and that this 'meaning' and 'doing' are linked to the context of its usage" (Richardson, 2007, p. 24). What makes CDA critical is that it seeks to make visible and challenge links between texts and societal power asymmetries that are usually hidden (Fairclough, 1995). Fairclough (1995) cites three theoretical inspirations in his critical approach to studying language and power: Foucault's (1972) analysis of discourse as central to modern forms of power; Habermas' (1984) theory of communicative action, which describes the emancipatory potential of free communication to counter the coercion of formal institutions; and the concept of *ideology*, which Fairclough describes as the "common-sense" assumptions implicit in everyday social interactions. CDA assumes a dialectical relationship between discourses and their social context: discourses are socially shaped, but they simultaneously constitute social identities, social relations, and ideologies (Fairclough, 1995).

The three dimensions of Fairclough's (1995) CDA framework are as follows:

1. *Description* of the linguistic properties of texts. This level of analysis focuses on how words and sentences in a text function to represent social actors, identities and relations. (**RQ1**, **RQ2**)
2. *Interpretation* of the discursive practices through which texts are produced and consumed. Moving beyond individual texts, this level of analysis is interested in how texts are constituted from other already existing texts (intertextuality), and how diverse genres and discourses are combined (interdiscursivity). (**RQ3**)
3. *Explanation* of the relationship between discursive practices and social practices. This level of analysis considers what the text "say[s] about the society in which it was produced and the society that it was produced for" (Richardson, 2007, p. 42), and what causal effects it might have on society (Fairclough, 2003). (**RQ4**)

3.2 Carbon Lock-In

Introduced by Unruh (2000), *carbon lock-in* describes the condition in which "industrial economies have become locked into fossil fuel-based technological systems through a path-dependent process driven by technological and institutional increasing returns to scale" (p. 817). Carbon lock-in addresses an apparent paradox: despite robust scientific evidence on the need for rapid decarbonisation and the availability of cost-effective technologies such as renewables to achieve this goal, governments have been slow to adopt them, while continuing to favour fossil energy through policies and subsidies (Unruh, 2000; Unruh & Carrillo-Hermosilla, 2006). At a macroeconomic scale, this inertia is attributed to "techno-institutional complexes" comprising technological systems as well as public and private institutions that have become tightly interlinked (Unruh, 2000). Crucially, small institutional choices can trigger self-reinforcing positive feedback loops that lock in a chosen path and preclude other paths, even if they are more efficient (Krasner, 1988). As such, from a carbon lock-in perspective, the comparative benefits of non-fossil energy alternatives are irrelevant—instead, the aim is to understand how systems develop inertia around fossil fuels (Brauers et al., 2021).

Since its inception, carbon lock-in has grown conceptually through its wide usage, leading to Seto et al.'s (2016) synthesis of three main types of carbon lock-in: infrastructural and technological lock-in, institutional lock-in, and behavioural lock-in. Subsequently, Buschmann and Oels (2019) proposed discursive lock-in as a fourth dimension that underpins the three identified by Seto et al. (2016). The resulting "four-dimensional" typology of carbon lock-in is as follows:

- *Infrastructural and technological lock-in* occurs when long-lived, capital-intensive fossil fuel infrastructure creates path dependencies through sunk costs and expectations of future returns, committing societies to decades of carbon-intensive energy production (Seto et al., 2016). Fossil fuel infrastructure includes power plants, vehicles and factories that directly emit CO_2, as well as supporting infrastructure such as pipelines, refineries, and refuelling stations (Seto et al., 2016). Opportunities for infrastructural and technological lock-in in Singapore are rife given its numerous fossil fuel-intensive industries such as power generation, petrochemicals, and marine and aviation fuels (Ng, 2012).
- *Institutional lock-in* happens when powerful actors who benefit from existing energy infrastructure leverage their political influence to shape regulatory and policy environments in ways that give them more resources, which they then deploy as further leverage in a self-reinforcing feedback loop (Seto et al., 2016). A key driver of institutional lock-in the *coevolution* of political, scientific, technological and other spheres, whereby norms, actors and logic within

each sphere mutually adapt towards a stable state that can dampen disruptions in any individual sphere (Seto et al., 2016). As such, my study investigates how the coevolution of state, fossil fuel industry, and academic institutions organised around low-carbon discourses leads to a concentration of power within specific institutions.

- *Behavioural lock-in* describes how fossil fuel dependency is embedded in cultural norms and everyday practices of consumption and mobility (Seto et al., 2016). Behavioural lock-in is excluded from my analysis, as the ST articles which I examine primarily discuss low-carbon solutions at a macroeconomic level. Nonetheless, as the different types of lock-in mutually interact to constitute carbon lock-in (Seto et al., 2016), infrastructural and technological lock-in and institutional lock-in likely affect behavioural norms in Singapore.
- *Discursive lock-in* occurs when a dominant discourse is reproduced by institutions in a self-reinforcing cycle (Buschmann & Oels, 2019). Buschmann and Oels' (2019) concept is based on an understanding of environmental politics as "a struggle for 'discursive hegemony' in which actors seek to achieve 'discursive closure' by securing support for their definition of reality" (Scrase & Ockwell, 2010, p. 2228). Accordingly, I examine how the lock-in of low-carbon discourses in ST articles naturalises and legitimises infrastructure, technologies and institutions that consolidate fossil fuel industry interests (Buschmann & Oels, 2019).

3.3 Critical Realism

Following Fairclough et al. (2002), I adopt a critical realist position in my analysis. Critical realism emerged in the 1970s and 1980s as an "alternative paradigm both to scientistic forms of positivism concerned with regularities … and also to the strong interpretivist or postmodern turn which denied explanation in favor of interpretation" (Archer et al., 2016). Among the four core principles of critical realism, two are especially relevant to this study: ontological realism, the position that reality exists independently of our knowledge of it; and epistemic relativism, which holds that our knowledge of reality is always shaped by our social context and therefore fallible (Archer et al., 2016; Gorski, 2013). Critical realism offers a useful framing of low-carbon discourses as causally interrelated with social reality (Bhaskar, 2010), which encompasses and distinguishes between material transactions with nature (e.g., fossil fuel consumption and climate change) and social interactions (e.g., between Singaporean state agencies and fossil fuel companies).

4 Methodology

This chapter outlines the methodology of this thesis, which uses critical discourse analysis in a case study of ST's low-carbon discourses.

4.1 Research Design

I use a qualitative case study research design to investigate ST's low-carbon discourses and their social implications for Singapore's energy transition. Specifically, it is an *instrumental case study*: while I focus on the case of Singapore and its media, state, and fossil fuel industry, my underlying objective is to shed light on the wider phenomenon of fossil fuel companies advancing their interests through low-carbon discourses (Mills et al., 2010; Stake, 1995). I define the *case* as ST's coverage of low-carbon solutions in Singapore's energy transition, with individual online ST articles as the *units of analysis* (Yin, 2003).

My case definition involves two key considerations. First, Singapore's development of low-solutions has no clear beginning and end (Yin, 2003). For this study, a starting date of October 2019 was chosen as it marks the EMA's (2019) announcement of the Four Switches energy transition strategy. The end date of February 2026 was determined by the data collection timeline. Second, I had to delineate which topics—and therefore articles—constitute low-carbon discourses. My preliminary review of ST articles revealed that the term "low-carbon" spans different news topics, including climate change, business and economy, and science and technology. Instead of narrowing the case definition, I formulated RQ1 to explore how the term's "interpretive flexibility" was used strategically (Leigh Star, 2010), while establishing general inclusion criteria which are described in the following section.

4.2 Data Collection

My data consists of online news articles published by ST between October 2019 and February 2026. Articles were retrieved on 20–21 March 2026 via ST's online search function. Ten rounds of sampling were performed, with each round using a distinct search query (Table 1). Articles were sorted by relevance. While the precise workings of ST's sorting algorithm could not be known, I assumed that keyword matching was the primary factor—meaning that higher-ranked articles were those in which search query keywords appeared more frequently (Jordan & Tsai, 2026). Each sampling round was stopped upon encountering at least three consecutive articles failing to meet the inclusion criteria, on the assumption that subsequent articles would be of diminishing relevance.

Table 1. Search queries used to collect ST articles.

Tag	Search query	Theme
K1a	low carbon alternatives	typical phrases with the form "low carbon" + X
K1b	low carbon solutions	
K1c	low carbon economy	
K1d	low carbon transition	
K2a	carbon capture	typical low-carbon solutions
K2b	low carbon hydrogen	
K3a	low carbon data centre	"low carbon" + energy-intensive infrastructure
K3b	low carbon LNG	
K4a	low carbon Shell	"low carbon" + major petrochemical companies
K4b	low carbon ExxonMobil	

Articles were included in the final sample if they met all the following criteria:

- The article was originally published by ST within the date range
- The article contains at least one reference to "low carbon" or "lower carbon"
- The article focuses on the energy transition or low-carbon solutions in Singapore

Both news and opinion articles were included. "Branded content" articles written in collaboration with a company were included unless they had a narrow focus on the sponsor. While republished articles from other news outlets showed potential for intertextual analysis (Richardson, 2007), they were excluded as their significant quantity and the time required for a comparative analysis of original and ST versions exceeded the resources available for this study. The final sample contained 72 articles (see Appendix, Table A1).

4.3 Data Analysis

To structure my analysis, I created a list of 15 analytical categories spanning the three CDA dimensions of description, interpretation, and explanation (Table 2). The categories and their guiding questions were adapted from Richardson's (2007) systematic guide to CDA for newspapers, van Leeuwen's (2008) discourse analytical framework, Bartesaghi and Noy's (2015) chapter on interdiscursivity, Araujo et al.'s (2019) summary of sociolinguistic categories in CDA, Megura and Gunderson's (2022) typology of discursive frames used by fossil fuel companies, and my own additions where analytical gaps were found.

Articles were saved to Nvivo 15 and read in chronological order of their publication date. Each article underwent two rounds of coding. The first applied *a priori* coding using the preconceived analytical categories, while the second followed an open coding approach (Gibbs, 2018) in which codes were generated inductively from the data and subsequently organised into four descriptive categories: actors, energy sources, projects, and "low-carbon" phrase variants; and three analytical categories: impacts, limitations, and discourses. Units of analysis varied in length from one sentence to several paragraphs. To record more detailed observations beyond the codes' descriptive ability, I also annotated specific text and wrote memos to summarise the most salient insights from each article. Finally, codes were iteratively refined and organised to address the four research questions (Saldaña, 2013).

Table 2. List of analytical categories and guiding questions, based on [1] Richardson (2007), [2] van Leeuwen (2008), [3] Bartesaghi & Noy (2015), [4] Araujo et al. (2019), [5] Megura & Gunderson (2022), and [6] own conceptualisation.

Category	**Guiding questions**
Naming [1]	How are actors named? Are actors individualised or collectivised? What are the explicit (denoted) and implicit (connoted) meanings of the terms used?
Predication [1]	How are words used to represent the qualities and characteristics of actors? Are these representations positive or negative?
Transitivity [1,2]	Are events represented as "who (or what) does what to whom (or what)", or are elements missing? Look out for: • Passive constructions • Deleted actors • Actions transformed into relations/state of affairs (nominalisation)
Modality [1,4]	Truth: How certain is the author about reporting a claim? Obligation: How strongly does the author believe an action ought to be taken?
Presupposition [1]	What hidden or implicit meanings are invoked? Is the definite article (the) being used?
Metaphor [1,4]	What types of metaphors are used? What do they obscure? Look out for: • Conceptual metaphors (concepts structured in terms of others) • Orientational metaphors (words with spatial references, e.g. *up/down*) • Ontological metaphors ("materialisation" of abstract phenomena)
Metonymy [1]	What actors/objects/events are being substituted, and to what effect?
Neologism [1]	What new words are being created? Are there shifts in word meaning (especially in a euphemistic direction)?
Objectivity [1]	What background or contextualising information is used to support truth-claims? Does reported speech belong to other people other than the author?
Sources [1]	Who is being quoted/interviewed? How organised are these actors in preparing press materials and representatives?

Intertextuality [1,2]	Is reported speech quoted directly or indirectly? How are other texts used and represented? How are meanings and stakes changed through recontextualisation(s)?
Interdiscursivity [3]	What genres and discourses does the text combine? Does the text borrow the authority/credibility of one discursive context while operating in another?
Naturalisation [1,2]	Is the dominant position framed as natural/necessary/inevitable/unchallengeable? Are alternatives framed as unrealistic/extreme/undesirable?
Omission [2,5,6]	Are potential risks of purely technological solutions/continued use of fossil fuels absent? Are alternative future scenarios than a growing economy powered by increased energy output absent?
Legitimation [2,6]	What type of authority (expert/role model/tradition) is being asserted? Are moral values being asserted? (Look for adjectives such as *healthy*, *normal*, *useful*) Is an actor/object compared to something else associated with positive/negative values? Are success stories or cautionary tales used?

4.4 Limitations

There are four main limitations in this study. First, my analysis is limited to ST articles. Although ST is Singapore's largest news outlet, other publications also cover energy and climate affairs—including *CNA*, *The Business Times*, and non-English newspapers such as the Mandarin-language *Lianhe Zaobao*, Malay-language *Berita Harian*, and Tamil-language *Tamil Murasu*.[2] Nonetheless, focusing on a single outlet allowed for a more nuanced examination of its news production practices and relationships with the state and fossil fuel companies. Second, it is possible that articles engaging in low-carbon discourses did not surface through the search terms used, as ST's search function is designed for general use rather than systematic research. Third, CDA carries an inherent risk of analytical bias: in focusing on the textual features I judged to be most ideologically significant, I may have neglected features that another researcher would consider equally or more revealing (Breeze, 2011). Finally, as a qualitative case study, some findings may not be readily generalisable beyond Singapore's specific political and economic context (Bryman, 2012).

4.5 Positionality

Reflecting on and being transparent about one's positionality is important to ensure the quality of qualitative research as it shapes every facet of the research process, from the selection of research topic and questions to the interpretation of data (Soedirgo & Glas, 2020). This is especially the case for this study as CDA is both heavily interpretative and an explicitly political methodology (van Dijk, 2015).

[2] Singapore has four official languages: Malay, English, Mandarin, and Tamil. English is the primary language used in business, government, and education.

Therefore, before presenting my analysis, I acknowledge the ways in which my identity, background and experiences have impacted this research.

I was born and raised in Singapore, making me familiar with its socio-political context from lived experience. As a Chinese (the largest ethnic group) heterosexual man from an upper-middle-class background, these markers of privilege shielded me from recognising many systemic inequalities during my childhood and adolescence. Furthermore, through Singapore's public education system and mandatory military service, I was exposed to ideological notions such as the emphasis on "survival" that pervades Singaporean society and culture (Abdullah, 2018). On one hand, this enabled me to interpret ST's low-carbon discourses at a deeper level, as their overt technological framing was at times underpinned by assumed background knowledge linked to national identity. On the other hand, there may have been ideologically significant claims that I missed due to perceiving them as "common sense".

My critical perspective on the state-media-fossil fuel industry nexus in Singapore stems from my training in liberal arts and interdisciplinary environmental studies at the bachelor's and master's levels. Through this training and my personal alignment with degrowth, I developed a scepticism towards techno-optimistic narratives, which largely motivated my critical analysis of ST's low-carbon discourses. Nonetheless, I recognise that technological solutions are necessary, but not sufficient, to mitigate the climate crisis.

5 Analysis

This chapter presents my analysis, which follows the order of textual elements (description), discursive practices (interpretation), and finally, social practices (explanation) (Richardson, 2007). First, I describe how ST constructs "low-carbon" and "energy transition" with strategic ambiguity (section 5.1), and how it represents fossil fuel companies as protagonists, framing the low-carbon solutions in which they have vested interests more favourably than renewable alternatives (section 5.2). These choices lay the groundwork for the state and fossil fuel companies to exercise discursive power through their access to ST (section 5.3). Finally, I examine how the discursive practices of ST, the state, and fossil fuel companies reinforce carbon lock-in through Singapore's infrastructure, technology and institutions (section 5.4).

5.1 Constructing "Low-Carbon" and "Energy Transition"

This section examines the meanings of "low-carbon" and "energy transition" constructed by ST. First, I argue that ST's broad usage of "low-carbon" erodes important distinctions between renewables and fossil fuel-linked CCUS and hydrogen. Next, I examine how ST's syntactic choices and omissions undermine the meaning of "energy transition" as a process of change from a defined initial state to a defined end state.

5.1.1 The Low Consistency of "Low-Carbon"

The adjective "low-carbon" was paired with various nouns to two general effects: to denote specific energy sources and technologies (e.g., "low-carbon technologies", "low-carbon energy (sources)", "low-carbon hydrogen"), or to refer to an aspirational social or economic scenario centred around such energy options (e.g., "low-carbon future", "low-carbon economy") (see Appendix, Table A2). "Low-carbon" was only defined explicitly in one article and specifically in the context of hydrogen: "in order to be considered low-carbon, the fuel must be produced in a way that does not emit any CO2 – for example, by using solar energy" (24.7). However, this clarity did not extend beyond hydrogen to other energy options. While some articles separated low-carbon solutions (CCUS and hydrogen) from renewable energy sources (21.14, 21.19, 21.23), others made no distinction (20.8, 21.18, 21.20, 21.26).

ST's inconsistent usage of "low-carbon" (at times distinguishing between renewables, CCUS and hydrogen, and at times grouping them together) implies that these energy options are equivalent in terms of "carbon", which is misleading for two reasons. First, renewables and green hydrogen do not emit any CO_2 during their production of energy, while CCUS and blue hydrogen are inherently connected to fossil fuel power generation. What qualifies CCUS and blue hydrogen as "low-carbon" is

that their usage in fossil fuel combustion and grey hydrogen production enables the capture of some CO_2 that would have otherwise escaped into the atmosphere—however, the captured CO_2 must still be transported to a suitable location for utilisation or permanent storage (IEA, 2024). Second, CCUS and hydrogen largely preserve the centralised infrastructure built around fossil fuels, whereas renewables enable a shift towards decentralised energy systems (Szabo, 2021; Veerasamy et al., 2025).

The ambiguity of "low-carbon" was compounded by the appearance of the closely related term "lower-carbon". Compared to "low-carbon", "lower-carbon" was applied more broadly to fuels and petrochemical manufacturing processes typically connected to fossil fuel companies. The following statements were made by the deputy prime minister[3] at separate opening ceremonies of a Shell plant (21.28) and an ExxonMobil plant (25.5):

> the E&C sector here is in the midst of a transition towards lower-carbon fuels, renewables and sustainable chemicals (21.28)

> Singapore will continue to upgrade its industries, including the energy and chemicals (E&C) sector, to achieve higher-value, lower-carbon, and more sustainable manufacturing (25.5)

The head of ExxonMobil Asia Pacific[4] (22.4) made a similar statement:

> "We have invested $10 million in the Singapore Energy Centre, which carries out research into lower-carbon energy pathways," she added (22.4)

Even natural gas, a fossil fuel, was framed as "lower-carbon":

> For instance, the industry might not need to choose between liquefied natural gas, hydrogen and ammonia as lower- or zero-carbon solutions (21.4)

This framing is discursively smoothed over by ST's repeated characterisation of natural gas as the "cleanest" fossil fuel (19.1, 20.4, 21.8, 21.20) or "cleaner" than other fossil fuels (20.3, 20.7), mirroring the rhetoric of natural gas proponents elsewhere (Chen & Gunster, 2016). LNG's relative cleanliness is then quietly equated with "lower-carbon", itself a relative term. This belies a strategic contradiction: qualifying LNG as "lower-carbon" implies a baseline of specifically coal and oil—yet without explicit clarification from ST, readers are more likely to interpret the baseline as fossil fuels broadly. Whether intentional or not, the terminological proximity of "lower-carbon" to "low-carbon" allows

[3] Deputy Prime Minister and Minister for Trade and Industry Gan Kim Yong
[4] Chairman and Managing Director of ExxonMobil Asia Pacific Geraldine Chin

petrochemical products and LNG to borrow legitimacy from "low-carbon energy sources"—including renewables.

5.1.2 Transition From Where to Where?

Ambiguity also characterised ST's construction of the energy transition, in terms of how "transition" itself was syntactically constructed and how the initial and end states of the transition were framed. Articles predominantly used "transition" as a noun ("the transition") instead of a verb ("to transition"), with three immediate effects. First, nominalisation shifts the meaning of "transition" from something being done to something that exists. Second, although "transition" implies movement from an initial state to an end state, none of the 40 articles containing the term explicitly identified what is being transitioned away *from*.[5] Third, this omission presupposes that the initial state is self-evident—yet this is far from the case: given that Singapore's energy mix includes coal, oil, and natural gas (EMA, 2025), it is not obvious whether all fossil fuels are to be phased out, or only specific ones.

Meanwhile, articles that included what is being transitioned *to* presented varying end states with no specified timeframe. The most ambitious included "clean energy" (21.14, 21.21), "renewable energy" (21.20, 21.22) and "net-zero" (25.5, 26.1). Other end states were considerably vaguer, including "a low carbon society" (22.1), "a low-carbon future" (25.3), "a lower carbon future" (21.3), "a lower-carbon economy" (22.1), and "a greener economy" (20.4). For end states defined in relative terms such as "lower-carbon" and "greener", it remains an open question precisely how much carbon reduction the transition entails.

Most revealingly, by leaving the initial state of transition unnamed and the end state loosely defined, ST articles created discursive space to frame natural gas as a bridge in the energy transition and simultaneously made this framing difficult to argue against. The following reported statements by the chairman of Pavilion Energy[6] and a minister of state[7] illustrate this point:

> the agreement with Qatar Petroleum not only represents the company's ability to supply LNG reliably and competitively to Singapore, but is also a bold step towards energy transition (20.5)

[5] See articles 20.4, 20.5, 20.6, 20.7, 20.8, 20.10, 21.3, 21.4, 21.5, 21.6, 21.7, 21.8, 21.9, 21.14, 21.15, 21.16, 21.19, 21.20, 21.21, 21.22, 21.23, 21.24, 21.28, 22.1, 22.2, 22.3, 22.4, 22.6, 22.11, 23.2, 24.1, 24.2, 24.5, 24.7, 24.8, 24.9, 25.3, 25.4, 25.5, and 26.1.

[6] Pavilion Energy is a Singapore-based oil and gas service provider. It was acquired by Shell in 2025 (Shell, 2025).

[7] Minister of State for Trade and Industry Low Yen Ling

> "Therefore, LNG will continue to play a pivotal role in a country's transition to clean energy. It will remain a key part of most energy systems for decades to come, before low-carbon alternatives such as hydrogen become commercially available," (21.21)

This framing, however, raises an implicit contradiction: given that LNG already accounts for 93% of Singapore's electricity generation, its framing as an enabler of the energy transition—rather than what is being transitioned away from—leaves it entirely unclear what is being phased out.

ST's constructions of "low-carbon" and "energy transition" are evidently marked by strategic ambiguity. This ambiguity obscures meaningful distinctions between energy options and presupposes a shared basis of understanding that, on closer inspection, proves far from obvious. The following section extends this inquiry by examining how fossil fuel companies and low-carbon solutions are represented in ST's low-carbon discourses.

5.2 Representing Fossil Fuel Companies and Low-Carbon Solutions

Focusing on Shell and ExxonMobil due to their dominant presence in Singapore's energy sector and ST coverage, this section describes how ST frames these fossil fuel companies as protagonists by emphasising their stated environmental commitments and highlighting their partnerships with state and academic institutions. I then examine ST's preferential treatment of low-carbon solutions in relation to renewable energy alternatives.

5.2.1 Fossil Fuel Protagonism

An emphasis on fossil fuel companies' decarbonisation efforts pervaded ST articles. At the broadest level, articles highlighted their environmental ambitions in general terms—"Sembcorp, Exxon Mobil find innovative ways to meet environmental sustainability targets" (21.12)—or anchored them in concrete pledges:

> [Shell] has pledged to cut its carbon dioxide emissions in Singapore by about a third within a decade, and be a net-zero emissions energy business by 2050, as the climate crisis becomes more urgent (21.7)

These commitments were further reinforced through specific technology-oriented narratives, with coverage linking fossil fuel companies to investments in CCUS (22.4, 23.1, 24.2, 24.3, 24.4, 24.5, 24.8, 24.9, 25.1, 25.5), hydrogen (21.4, 23.1, 24.4), and even solar (21.7, 22.2, 22.4). Nonetheless, the language framing these efforts warrants closer scrutiny. In particular, the verb "pivot" was used metaphorically to describe Shell shifting its strategic focus from oil operations to cleaner alternative fuels (20.6, 20.7, 20.10, 21.7). This word choice is revealing when set against alternatives like "phase

out", as used by the IPCC (Clarke et al., 2023). Whereas "phase out" implies a concrete, terminal reduction in oil production, "pivot" conveniently carries no such commitment: it can mean the act of turning in place without leaving one's original position.

Articles also legitimised fossil fuel companies by highlighting their collaborations with state and academic institutions. Consistently framed around the development of low-carbon solutions, partnerships involved companies such as Shell, ExxonMobil, and Chevron alongside state agencies, universities, and public research institutions (20.2, 24.3, 24.4). These partnerships are significant because state institutions represent legitimate authority and the public interest; in the same vein, academic institutions carry connotations of scientific rigour and neutrality. These attributes are thus implicitly conferred onto fossil fuel companies through their "joint" efforts with public institutions, which masks their profit motive for investing in low-carbon solutions behind framings of national development and apolitical scientific inquiry. These vested interests become more apparent in the preferential framing of low-carbon solutions over renewable alternatives, described in the following section.

5.2.2 Double Standards

Articles acknowledged the challenges faced by renewables and low-carbon solutions, though with a discernible bias towards the latter. For renewables, there was a focus on the challenges of intermittency and Singapore's geographic constraints:

> renewable resources, which are also subject to intermittency and the forces of nature like the weather (21.21)

> Singapore is a small city state – without natural resources, land, nor the climatic conditions for large-scale deployment of renewable energy sources. (21.18)

Attributing renewables' "inherent and technical challenges" (21.14) to naturalised problems such as "climatic conditions" and "the forces of nature" implies a dead end for renewable energy pathways. Meanwhile, when similar geographical constraints were introduced for low-carbon solutions, this was usually followed by a proposed solution:

> In addition, Singapore has limited potential to store CO2 locally, given the lack of known suitable underground geological formations, and is talking to its regional partners about shipping CO2 to them for potential storage. (24.2)

> Carbon storage is also usually done underground, but Singapore does not have any known suitable geological formations for the permanent storage of CO2 underground, the study found. … The next steps

> for Singapore are to study new chemical processes that could make utilising captured carbon more effectively, and work with partners to overcome the other barriers, said the authorities. (21.8)

This asymmetry extended beyond geography to a broader difference in optimism between renewables and low-carbon solutions. The following statement is illustrative:

> Although there are plans to ramp up the deployment of solar panels on the island, harnessing solar energy is a challenge due to, among other things, the intermittency of sunshine and the shading of solar panels by surrounding buildings. (20.8)

The concessive construction, beginning with "Although there are plans" before cataloguing multiple obstacles, directly undermines the plans it acknowledges. Moreover, the listed obstacles are not insurmountable: setting aside "other things", intermittency can be mitigated through cross-border electricity imports (mentioned later in the same article) and shading through floating solar farms. These solutions are arguably modest compared to what is needed to make low-carbon solutions commercially feasible in Singapore—including the creation of international supply chains for hydrogen and captured CO_2 (21.8, 21.14). Nonetheless, these challenges were discursively mitigated using two narratives applied exclusively to low-carbon solutions: that costs are the primary barrier (24.4, 25.1), and that commercial viability is a matter of time rather than possibility, as implied by the terms "early days", "nascent"/"nascency", and "not yet available" (20.3, 22.7, 24.4, 24.6, 25.1). Compared to the "forces of nature" blocking renewables, these cost- and time-centred frames appear manageable, generating optimism around low-carbon solutions. This optimism manifested as a pervasive faith that future "significant technological breakthroughs" and government action will eventually deliver commercial viability, even amid unresolved technical challenges (21.11, 24.6).

The fact that low-carbon solutions face challenges at least as significant as renewables, yet are consistently framed with greater optimism, is a sign of technological lock-in: a technology may be favoured not because it has inherent technical advantages, but because public and private institutions have invested in it (Cowan, 1990).

5.3 Mediating State and Industry Interests

This section expands the scope of analysis from texts to discursive practices, focusing on ST as a social institution with relationships to fossil fuel companies and state representatives. These relationships were most visible through access to discourse. Access to discourse refers to who holds the resources, whether press materials, institutional authority, or organised media outreach, to speak in the news and shape public knowledge—as such, it is a form of power (Richardson, 2007; van Dijk, 2015). From

this perspective, I examine how fossil fuel companies and the state leverage their privileged access to ST to advance their interests. First, taking Shell as a focal case, I describe the discursive strategies through which Shell representatives and ST journalists together blurred the boundaries between Shell's and Singapore's national interests. I then turn to the Singaporean state, examining how ST enabled it to discursively reconcile its dual commitments to climate action and continued fossil fuel expansion.

5.3.1 Overlapping Identities

ST and Shell employed several discursive moves to legitimise the fossil fuel company as acting primarily in Singapore's national interest. The first was to separate of Royal Dutch Shell from its Singaporean subsidiary:

> This is part of parent company Royal Dutch Shell's plan (20.10)
>
> Ms Aw Kah Peng, chairman of Shell Companies in Singapore, said the pandemic came as a reality check … Shell's parent Royal Dutch Shell decided to cut its global refining portfolio (20.6)
>
> Royal Dutch Shell's pivot away from crude oil towards a low-carbon slate of fuels will cost Singapore 500 jobs … Ms Aw said Shell realises that this is difficult news and is informing its staff well ahead of time (20.7)

A clear discursive pattern emerged: Royal Dutch Shell was consistently positioned as the decision-maker, while Shell Singapore was framed in a reactive role, experiencing a "reality check" from the COVID-19 pandemic and receiving "difficult news" from above. This framing, which constructed Shell Singapore as a quasi-independent local actor subject to forces beyond its control, warrants scrutiny. While Royal Dutch Shell and Shell Singapore are obviously staffed by different people, this does not automatically make Shell Singapore an independent entity. Given that Shell Singapore is a wholly owned subsidiary of Royal Dutch Shell (Shell, 2026a) and operated its largest refinery in the Asia-Pacific region from 1961 to 2024 (Subhani, 2024), it cannot be absolved of its parent company's role in fossil fuel extraction and the climate crisis.

Nonetheless, ST's efforts to construct a local identity for Shell were reinforced by featuring the personal backstories of individuals working at Shell:

> "I was given the opportunity to move around Shell and that keeps my job interesting. When I keep learning, I find that I always have passion and interest in my job," she said.
>
> "Every day is a new learning opportunity for me." (20.10)

This segment transforms Shell from an abstract corporate entity into a community of relatable Singaporean workers. Furthermore, themes of personal growth, passion, and learning appear in the quoted speech, drawing on discourses commonly associated with progressive workplaces. This self-empowerment frame thus operates ideologically to obscure Shell's core operations as a multinational oil and gas company and its structural contribution to climate change.

ST's alignment of Shell's identity with Singapore's national identity was further consolidated through the quoted rhetoric of Shell Singapore's chairperson Aw Kah Peng:

> "We already had our emission goals and low-carbon energy plans, but Covid-19 made us focus on the challenge of the transition even more. We realised what may happen if we are unable to manage climate change," she told The Straits Times in an interview yesterday. (20.6)

Central to this passage is the ambiguous pronoun "we". While ostensibly referring to Shell, its referent expands in the phrase "if we are unable to manage climate change". In this context, the word "manage" is interesting: while corporations have a responsibility to reduce their own carbon emissions, it is not their responsibility to *manage* climate change—which instead falls under the jurisdiction of governments. As such, Aw can be interpreted as speaking not only for Shell but as an agent for the nation of Singapore, implicitly elevating Shell to the status of a national stakeholder in climate governance. Beyond the obvious tension of a fossil fuel company assuming such a role, there is a subtler contradiction: the phrase "We realised what may happen" implies that Shell was previously unaware of the gravity of the climate crisis. This framing of climate change as a recent discovery for Shell—and other petrochemical companies in Singapore—was echoed in a state minister's address:

> Mr Gan said climate change has been identified as the single biggest threat to humanity, while consumers and investors are also increasingly placing emphasis on sustainability. That has put the energy and chemicals sector under the spotlight, because of its high carbon footprint.
>
> "But the good news is that the sector is not standing still. It has recognised the existential impact of climate change on its future and has started to respond proactively," he said. (21.27)

The phrases "has been identified", "has recognised", and "has started to respond" reproduce the same epistemic framing as Aw's "realised": that fossil fuel companies only recently became aware of the severity of climate change, and quickly moved to develop low-carbon solutions in response. The ideological significance of this framing is considerable as it excluded decades of documented evidence of Shell withholding its internal climate projections (Franta, 2018). Instead, Shell and the Singaporean state, mediated by ST, constructed a counter-narrative that positions Shell and other fossil fuel companies as good-faith participants in Singapore's climate governance and energy transition.

5.3.2 Having It Both Ways

Besides framing Shell's goals as aligned with the nation's, ST articles attempted to discursively reconcile the state's dual commitments to ambitious climate action and securing continued long-term cooperation with fossil fuel companies. In articles focusing on climate change and Singapore's collaborations with other countries towards decarbonisation, state representatives made stronger commitments to climate action. For example, in dialogues with leaders from the United States and the European Union, Singaporean state representatives emphasised that Singapore was "fully committed" to its "commitments under the Paris Agreement and taking bold climate actions" (21.13), and firmly expressed that the state "must take decisive climate action" out of moral obligation: "we owe it to our children and grandchildren" (21.9). Such commitments were not limited to contexts in which Singapore's reputation was under international scrutiny, as illustrated by the following statement by Minister for Sustainability and the Environment Grace Fu in a domestic press conference:

> "To tackle such complex, cross-cutting challenges, we must also look for solutions beyond the natural sciences and engineering," she added. "We will tap other disciplines, such as social and behavioural sciences, since influencing human behaviour is key to creating real change." (20.12)

Fu's statement is relevant in two respects. First, it demonstrates that as the environmental minister, she has a progressive understanding of climate change as a complex problem requiring interdisciplinary approaches (Levin et al., 2012), and an awareness of the historical dominance of natural science and engineering approaches to framing and tackling climate issues (Bjurström & Polk, 2011). Given her political status which should enable her to influence how environmental issues are conceptualised and addressed in public discourse, it is intriguing that her interdisciplinary perspective was absent from most ST articles covering the energy transition, which remained centred around low-carbon solutions and the fossil fuel companies involved in their development. Second, as Fu's statement was made at a press conference, ST played a crucial role of reproducing it in text for readers to consume. This may seem trivial, but it must be considered that the ST could have *recontextualised* her words differently—for example, by using a different segment of her conference speech for the article, or by using indirect rather than direct quotations to modify meaning (Richardson, 2007; van Leeuwen, 2008). In this instance, ST's direct quotation enabled Fu's message on the need for a shift from technocratic to socio-behavioural climate solutions to reach readers and thereby shape public knowledge. However, other recontextualisations were less transparent, as illustrated by two separate articles' references to S Hub, a CCS consortium formed by Shell and ExxonMobil:

> The Government is partnering an industry consortium formed by ExxonMobil and Shell, known as S Hub, to evaluate the technical and economic feasibility of cross-border CCS projects. (24.9)

> The Government has been working with an industrial consortium to evaluate the technical and economic feasibility of cross-border carbon capture projects. (25.2)

The fact that these statements are almost identical apart from the naming of ExxonMobil and Shell suggests that the second statement's exclusion was likely a deliberate choice. A comparison of the articles' contexts provides further insight. The first article had the function of promoting the EMA's grant call seeking proposals for deploying CCS on natural gas power plants (24.9). Correspondingly, the article included statements such as "the Republic is likely to continue relying on fossil fuel over the next few decades", providing assurance to power generation companies that business-of-usual would largely persist for the foreseeable future (24.9). In contrast, the second article, titled "S'pore sets out plan to meet 2030 climate targets; energy imports, carbon capture among key efforts", had an explicit focus on Singapore's climate change mitigation efforts (25.2). Although this article mentioned CCS extensively, it divorced the technology from Shell and ExxonMobil, anonymising them as "an industrial consortium" (25.2). It can be inferred from this exclusion that ST is implicitly aware of the contradiction of the state collaborating with Shell and ExxonMobil—two of the world's largest oil companies with a documented history of organising climate change denial (Dunlap & McCright, 2011; van Beek et al., 2020)—in Singapore's climate mitigation efforts. By omitting their names, ST might appear to resolve this contradiction discursively, but at the cost of giving readers a sanitised picture of Singapore's climate strategy.

This example was emblematic of a broader contradiction between the state's commitments to bold climate action, and its commitments to the fossil fuel industry at events such as the opening ceremonies of Shell (21.28) and ExxonMobil plants (25.5), the Singapore International Energy Week (20.4) and its sub-event the Asia LNG and Gas Markets Conference (21.21). At such events, state ministers assured fossil fuel companies that "Natural gas is a critical element in the global energy transition, so there is a continued need to invest in liquefied natural gas (LNG) infrastructure" (21.21) and that "Singapore is seen as a natural hub for LNG" (20.4). Crucially, ministers also invoked low-carbon solutions and sustainability while setting ambitious visions of growth for fossil fuel companies:

> The plan envisages Singapore's energy and chemical (E&C) sector increasing its output of sustainable products by four times from 2019 levels, as well as achieving more than six million tonnes of carbon abatement per annum from low-carbon solutions by 2050. (21.28)

> This is the kind of investment – forward-aligned, capability-enhancing and sustainability-aligned – that will underpin the next phase of growth for the sector (25.5)

Although ST articles reproduced and attempted to reconcile the state's dual commitments by the state to climate change mitigation and fossil fuel expansion, these commitments are fundamentally incompatible. Singapore's commitment to the Paris Agreement (21.13) implies an obligation to align its policies with a 1.5 °C warming limit, yet its active efforts to expand the LNG industry run counter to scientific evidence that staying below 1.5 °C requires governments to "not only cease licensing and development of new fields and mines, but also to prematurely decommission a significant portion of those already developed" (Trout et al., 2022).

Through the descriptive and interpretive dimensions of CDA, I have shown that ST's low-carbon discourses are ideologically laden in ways that advance state and fossil fuel industry interests while misleading the public. The next section illustrates how these discourses affect the social sphere through infrastructural and technological lock-in and institutional lock-in.

5.4 Reinforcing Carbon Lock-In

In this final section, I argue that both infrastructural and technological lock-in and institutional lock-in are constituted by ST's low-carbon discourses. Infrastructural and technological lock-in appeared most clearly in the legitimisation of new hydrogen-compatible natural gas power plants in Singapore, with an additional potential risk of extending lock-in to other countries involved in cross-border hydrogen projects. Institutional lock-in was present in the increasing economic and political leverage gained by fossil fuel companies through their expanding role in Singapore's energy governance through low-carbon solutions, and the creation of new political and academic institutions specifically to develop low-carbon solutions. However, an exceptional institution was ST itself, which demonstrated potential to challenge dominant discourses and disrupt institutional lock-in.

5.4.1 Infrastructural and Technological Lock-In

ST attempted to legitimise long-term LNG dependency by emphasising their planned integration with low-carbon solutions (23.2, 23.3, 24.7, 24.9). Several articles established a causal logic: CCUS and hydrogen are needed because Singapore "is likely to continue relying on fossil fuel over the next few decades" (24.7, 24.9). This premise was justified by a follow-up statement about natural gas representing over 90% of Singapore's current electricity mix (24.7, 24.9). However, ST's assumption that current natural gas dependency implies future long-term dependency is undermined by the fact that natural gas' predecessor, oil, was Singapore's dominant electricity source in 2000, but was quickly

overtaken by gas by 2003 and dropped to below 1% of electricity generation by 2014 (IEA, 2026). Singapore's past departure from oil dependency[8] reveals that the future of natural gas is equally precarious,[9] contrary to ST's characterisation. Nonetheless, long-term natural gas dependency remains a necessary premise for the legitimisation of CCUS and hydrogen projects connected to natural gas infrastructure.

This was most evident in the state's plan to build nine new "hydrogen-compatible" natural gas power plants (24.7), with the regulation that "all new and upgraded natural gas power plants must be able to run on at least 30 per cent hydrogen and be retrofitted to run on 100 per cent in the future" (24.9). As ST emphasises that these plants have the potential to run partially on hydrogen, it detracts from two important details: first, that Singapore's fossil fuel industry has expanded with nine new power plants; and second, these plants have no obligation to run on hydrogen, making natural gas the default fuel. Yet, through the naming choice of "hydrogen-ready power plant" (23.2), ST foregrounds the potential use of hydrogen and excludes the actual use of natural gas, demonstrating that low-carbon solutions have, in this case, directly legitimised rather than reduced Singapore's fossil fuel dependency. This connects to a wider pattern of cleaner low-carbon solutions serving as a political "wedge", legitimising dirtier but infrastructurally compatible fuels as a stepping stone (Gibson & Kay, 2025).

Singapore's new hydrogen-compatible natural gas power plants reinforce infrastructural and technological lock-in in two ways. The first can be directly inferred: as long-term energy infrastructure projects, investments that have already been made will require years to recoup and turn into profits, deterring the possibility of early replacement (Seto et al., 2016). A second, more subtle mechanism of lock-in involves *asset specificity*, which describes "inputs that cannot be readily used by other systems because the investments are unique to a particular task" (Seto et al., 2016, p. 428). Although Seto et al. (2016) discuss asset specificity in relation to fossil fuel-supporting infrastructure, not directly emitting infrastructure, the concept is relevant to the power plants in question because their hydrogen-compatible feature was implicitly framed as a solution to asset specificity. Compared to the obvious lock-in of dedicated natural gas power plants, the new generation of power plants unlocks a pathway to hydrogen as an alternative to natural gas—this can appear to mitigate the lock-in concern of a specific asset foreclosing alternative inputs (Seto et al., 2016). However, the crux is that all other

[8] This is only in relation to electricity generation. Oil remains the largest source of Singapore's total energy supply (IEA, 2026).

[9] Recent disruptions to global oil and LNG supply have already produced discursive shifts around LNG in Singapore's media (Chew, 2026; Liang, 2026), although a detailed analysis is beyond the scope of this study. My data collection ended before 28 February 2026, when the U.S. and Israel launched airstrikes on Iran, triggering the war that is ongoing at the time of writing.

alternatives, including renewables, are locked out from resources of land, capital, and connectivity to Singapore's broader energy system, which must also be kept or made compatible with natural gas and hydrogen, thus constituting lock-in (Seto et al., 2016).

These dynamics reflect what Szabo (2021) calls the "natural gas-hydrogen nexus": fossil fuel companies and power plant operators embrace hydrogen as it requires minimal change to existing infrastructure (both are gases), and enables natural gas systems to be recast as sustainable. Furthermore, the natural gas-hydrogen lock-in present in Singapore has implications beyond its shores, as the growth of hydrogen in Singapore depends on the establishment of a "global hydrogen economy" (21.14, 22.12) and "global hydrogen value chains" (21.22, 22.7). The state's development of local hydrogen infrastructure must therefore also be understood as an active attempt to expand and accelerate hydrogen markets and infrastructure at the global scale (22.12, 22.7). Through the creation of new dependencies between countries and "a new class of exporters" (Van de Graaf et al., 2020, p. 3), natural gas-hydrogen lock-in in Singapore has the potential to influence lock-in in other countries it seeks to trade with. However, other countries may take divergent paths, creating opportunities to both reinforce and break trajectories of infrastructural and technological lock-in.

5.4.2 Institutional Lock-In

In addition to infrastructural and technological lock-in, institutional lock-in arose through the coevolution of multiple institutions towards the common goal of establishing low-carbon solutions (Seto et al., 2016). Although it is difficult to attribute institutional lock-in back to a single cause (Seto et al., 2016), the rise of low-carbon solutions in Singapore can be understood as the convergence of the existing interests of fossil fuel companies and the state. For decades, multinational fossil fuel companies have invested in and framed low-carbon solutions as a panacea for achieving their decarbonisation goals without phasing out fossil fuel production (Megura & Gunderson, 2022; Trencher, 2023). As to why the Singaporean state is readily cooperating with fossil fuel companies to advance low-carbon solutions, several factors are at play. Ideologically, the techno-optimism that characterises fossil fuel companies' emphasis on low-carbon solutions aligns closely with the state's technocratic model of environmental governance: both demonstrate a strong faith in technological solutions and an effort to minimise disruptions to existing systems of production and consumption (V. Koh, 2025; Maher et al., 2025; Megura & Gunderson, 2022). A second factor is the historical coevolution of multinational fossil fuel companies and Singapore since its colonial era in the 19th century, through which both have achieved significant economic growth and power (Ng, 2012). Given that the state and fossil fuel companies have cooperated for over a century, it is likely that their

"norms, rules, actors, processes, and logic [have] increasingly [come] to favor reproductive over disruptive changes" (Seto et al., 2016, p. 434) during this time, shaping the current economic and political incentives favouring low-carbon solutions over alternative energy pathways.

Although Singapore's institutional lock-in predates low-carbon solutions by over a century, the present moment remains significant because it risks consolidating fossil fuel interests further, but also reveals potential leverage points to break lock-in. While ST often named fossil fuel companies as the state's "partners" (21.23, 22.5, 24.6, 24.7, 24.9, 25.1, 26.1), this neutral framing obscures the inherent instability of such power relations. Cases like Texaco/Chevron in Ecuador and Shell in Nigeria are evidence that with sufficient leverage over states, fossil fuel companies have operated with corporate impunity to produce severe social and environmental harm (Boele et al., 2001; Pellegrini et al., 2020). Singapore is not inherently immune to such power asymmetries. As I argued in section 5.3.1, it is a co-constructed myth by Shell and ST that Shell Singapore is an autonomous entity more closely aligned to its Singaporean workers than its parent company. Through their financial and operational involvement in low-carbon solution projects (22.5, 24.9, 25.2), companies such as Shell and ExxonMobil will only gain economic and political leverage as Singapore increases its reliance on low-carbon solutions.

Another driver of institutional lock-in was the state's deployment of public research institutions to develop low-carbon solutions. ST articles highlighted the instrumental role of research groups within the country's largest universities, NUS[10] and NTU,[11] in achieving CCUS and hydrogen breakthroughs (22.5, 22.9). The research and development of low-carbon solutions was further accelerated through the state's creation of new research institutions, programmes, and funding schemes, often with fossil fuel industry collaboration or funding (22.12, 22.5, 22.6, 25.5). A notable example is the NUS Centre for Hydrogen Innovations (CHI), through which the state aims to "create a talent pipeline such that workers can contribute to different components of the hydrogen economy, by introducing courses for both adult learners and undergraduates" (24.6). Even with its overt technological focus, CHI's curriculum will likely extend the techno-optimistic paradigm of hydrogen from fossil fuel companies and the state into the educational sphere, demonstrating lock-in through coevolution (Seto et al., 2016). An additional driver of lock-in is the speed at which low-carbon solutions-oriented research institutions and projects have emerged. As novel technologies inevitably give rise to "winners" and "losers", the state's urgency—while appropriate given the urgency of the climate crisis—may rush or exclude the "slow, deliberative processes (e.g., stakeholder negotiations, participatory discussions)

[10] National University of Singapore
[11] Nanyang Technological University

historically used to mitigate such conflicts" (van Wijk & Fischhendler, 2025, p. 2). In Singapore, lock-in through the exclusion of deliberative processes as described by van Wijk and Fischhendler is not only a matter of speed. Rather, it reflects the state's top-down and non-participatory approach to environmental governance, where stakeholders are often informed but not allowed to challenge predetermined plans (Han, 2017). Singapore's developmental legacy is therefore a factor in the current institutional lock-in of low-carbon solutions and fossil fuels.

Yet, a potential pathway to challenging institutional lock-in emerged from an unlikely source: ST itself. Despite its prevailing function of mediating state and fossil fuel industry narratives around low-carbon solutions, several outlier articles took a critical stance and explicitly foregrounded their pitfalls (24.2, 24.5). In these articles, ST's journalists also played a "watchdog" role by acting on behalf of the public instead of the state (Richardson, 2007). In the first, the author asked the Ministry for Trade and Industry "whether it would put in place safeguards to ensure that ExxonMobil and Shell do not use CCS for enhanced oil and gas recovery in projects in the region" (24.2). In the second, amid a detailed critique of CCS, the author subtly held the state accountable by noting that it "has long considered CCS as a potential climate solution" (24.5). However, these two articles did not signify a genuine shift in ST's low-carbon discourses, as critical elements were absent from subsequent articles. Rather, they can be interpreted as efforts by ST to represent "both sides" of the debate around low-carbon solutions (Boykoff & Boykoff, 2004). Regardless of their motivation, these critical outliers illustrate that media institutions—even tightly controlled ones like ST—have the potential to disrupt the dominant discourses that underpin the other types of lock-in (Buschmann & Oels, 2019).

6 Conclusion

> In the last minutes of Greek tragedy, as the action headed towards inevitable catastrophe, the deus ex machina (a theatrical device meaning 'god from a machine') would descend from on high to resolve the unresolvable, reconcile strife, and bring harmony from disorder. A year of fieldwork among the sustainability managers of oil companies points to a new wave of techno-optimism, a deus ex machina that promises to descend from the innovation labs of R&D engineers, and reconcile irreconcilable imperatives. (Rajak, 2020, p. 474)

Rajak's (2020) analogy of *deus ex machina* aptly captures how low-carbon solutions have been deployed by the Singaporean state and fossil fuel industry in their collective attempt to reconcile ambitious decarbonisation commitments with continued fossil fuel dominance. Through CDA, this study has revealed the significant role of discourses in consolidating these interests by foreclosing alternative energy pathways, both discursively and materially. It is crucial to recognise that ST is not a passive conduit for information, but a social institution with considerable power of its own. While the state and fossil fuel industry may leverage their political and economic dominance to influence the direction of ST's discourses, it is ultimately ST's journalists who produce the texts consumed by the public—and who can therefore shift perceptions of actors and technologies through the subtlest of word choices. In this regard, the articles which adopted a critical stance towards low-carbon solutions are significant as they raise questions that may guide future research towards breaking carbon lock-in. For instance, such research might seek to identify the social conditions under which countervailing perspectives can emerge within low-carbon discourses already in a state of lock-in, or examine how low-carbon discourses vary across different news outlets and whether they interact to disrupt or mutually reinforce one another.

A second avenue for future research could examine the influence of low-carbon solutions and discourses on behavioural lock-in. Behavioural lock-in was excluded from my analysis, which primarily focused on the national-scale implications of low-carbon solutions and discourses. However, the articles revealed a consistent underlying premise of indefinite energy demand growth, a pattern with potential implications for behavioural lock-in through the implicit normalisation of high-consumption lifestyles. Future research could explore how this subtle premise is discursively constructed and naturalised, and whether challenging it might create opportunities for demand-side alternative pathways—such as energy sufficiency and degrowth—to enter mainstream public discourse.

This study contributes to the carbon lock-in literature by demonstrating that CDA can effectively uncover how discursive lock-in constitutes other types of lock-in. Notably, this mechanism mirrors the

relationship between Fairclough's second and third dimensions of analysis—wherein discursive practices constitute and reproduce broader social practices. Furthermore, this case study adds to the emerging critical literature on the risks of carbon lock-in carried by low-carbon solutions, introducing variables in the form of Singapore's distinctive authoritarian press control regime and position as one of the world's largest refining and petrochemicals hubs for the fossil fuel industry. My hope is that greater critical attention on low-carbon solutions will create opportunities to decouple these technologies from fossil fuel interests and reorient them towards pathways that genuinely complement renewables and demand-side alternative pathways. This shift will ultimately require new discourses capable of producing the conditions for a "carbon lock-out".

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Appendix

Table A1. List of Articles.

Code	Date	Author	Title
19.1	30.10.2019	Audrey Tan	Natural gas to remain Singapore's key energy fuel for 50 years
20.1	15.04.2020	Sue-Ann Tan	Keppel signs $10 million partnership with the Energy Market Authority to find new energy solutions
20.2	02.07.2020	Audrey Tan & Jessie Lim	S'pore moves to tackle climate change by developing technologies to capture carbon for storage or other uses
20.3	24.10.2020	Audrey Tan	Separating carbon from fossil fuel emissions
20.4	27.10.2020	Timothy Goh	S'pore shifting to cleaner alternatives, but LNG to remain primary energy source for now
20.5	09.11.2020	Choo Yun Ting	Singapore's Pavilion Energy signs 10-year LNG agreement with Qatar Petroleum
20.6	11.11.2020	Ovais Subhani	Pandemic hastened Shell's transition towards greener energy
20.7	11.11.2020	Ovais Subhani	Shell to cut jobs as it halves capacity on Bukom
20.8	26.11.2020	Audrey Tan	Singapore may tap region's low-carbon energy sources in future
20.9	27.11.2020	Fabian Koh	Wind turbine at Pulau Semakau can power about 35 flats
20.10	30.11.2020	Sue-Ann Tan	Shell Singapore and union launch upskilling council to ready staff for future roles
20.11	11.12.2020	Audrey Tan	Cutting carbon a new focus area for Singapore under five-year research masterplan
20.12	12.12.2020	Audrey Tan	Focus on low-carbon alternatives to position industries for the future
21.1	10.02.2021	Rei Kurohi	Singapore's Green Plan offers new jobs and economic growth
21.2	03.03.2021	Choo Yun Ting	ExxonMobil to cut 300 jobs in Singapore, citing 'unprecedented market conditions' due to Covid-19
21.3	15.04.2021	Choo Yun Ting	Temasek's Pavilion Energy imports Singapore's first carbon-neutral LNG cargo
21.4	21.04.2021	Clement Yong	Shell trial of hydrogen fuel cell for ships among projects planned for maritime decarbonisation
21.5	25.05.2021	Justin Ong	S'pore and Gulf countries can be partners in fight against climate change: Grace Fu
21.6	15.06.2021	Audrey Tan	Help workers and companies transition to a green economy: President Halimah
21.7	17.06.2021	Clement Yong	Shell and JTC plan solar farm the size of 112 football fields on Semakau Island
21.8	23.06.2021	Audrey Tan	S'pore exploring hydrogen, carbon capture technologies in decarbonisation goal
21.9	08.07.2021	Audrey Tan	Singapore and EU can collaborate on research, green finance to tackle climate crisis
21.10	12.07.2021	Shabana Begum	Singapore's public sector sets new targets to bring down carbon emissions
21.11	17.08.2021	Prisca Ang	Product development jobs, carbon services to emerge from S'pore's sustainability push: EDB chairman
21.12	19.08.2021	Cheryl Tan	Sembcorp, Exxon Mobil find innovative ways to meet environmental sustainability targets
21.13	23.08.2021	Grace Ho	S'pore, US to launch climate partnership, collaborate on sustainable development and low-carbon solutions
21.14	12.09.2021	Teh Shi Ning	Hope for green future also rests on harnessing hydrogen, trapping carbon dioxide
21.15	19.09.2021	Teh Shi Ning	Asean power grid — option for S'pore to source green energy
21.16	11.10.2021	Choo Yun Ting	Firms have huge part to play in Singapore's transition to climate-resilient economy: Grace Fu
21.17	19.10.2021	Nadine Chua	PUB on global hunt for zero-emissions solutions with $6.5m in prize money

21.18	19.10.2021	Syarafana Shafeeq	Solar power, imported cleaner energy among focus of Singapore's low-carbon future: Gan Kim Yong
21.19	25.10.2021	Audrey Tan	S'pore pledges $10m in new funds, making more investments in low-carbon technology
21.20	25.10.2021	Audrey Tan	Singapore plans to import 30% of energy from low-carbon sources by 2035
21.21	26.10.2021	Cheryl Tan	Investing in LNG infrastructure needed as natural gas is critical to clean energy transition: Low Yen Ling
21.22	26.10.2021	Cheryl Tan	Singapore to strengthen regional collaboration in clean electricity and hydrogen trading: Tan See Leng
21.23	02.11.2021	Adeline Tan & Cheryl Tan	EMA Can Now Own and Operate Power Infrastructure under Changes to Law
21.24	02.11.2021	Cheryl Tan	EMA to set green standards for power generation companies to reduce S'pore's carbon footprint
21.25	18.11.2021	Toh Ting Wei	CAAS and Airbus to look into Changi Airport hydrogen hub as part of push for sustainable aviation
21.26	19.11.2021	Prisca Ang	Singapore keen to partner European businesses in low carbon solutions, green finance: Gan Kim Yong
21.27	23.11.2021	Ovais Subhani	Shell breaks ground on Asia's largest plastic waste to chemical feedstock plant
21.28	23.11.2021	Ovais Subhani	Singapore to transform Jurong Island into a sustainable energy and chemicals park
22.1	13.01.2022	Grace Ho	No one succeeds until everyone succeeds in S'pore's low-carbon transition
22.2	17.01.2022	Shabana Begum	Scope for Singapore to collaborate with UAE on low-carbon technologies: President Halimah
22.3	17.02.2022	Toh Ting Wei & Clement Yong	RSAF, SIA Engineering Company take delivery of sustainable aviation fuel
22.4	28.02.2022	Audrey Tan	Firms in Singapore move to shrink emissions and carbon tax bill with plans for solar, low-carbon tech
22.5	07.03.2022	Cheryl Tan	NUS researchers find way to store CO2 beneath the ocean floor
22.6	08.03.2022	Audrey Tan	Budget debate: Sustainability research institute opens on Jurong Island
22.7	29.03.2022	Cheryl Tan	NTU consortium aims to accelerate commercial usage of hydrogen in Singapore
22.8	04.04.2022	Cheryl Tan	Low-carbon hydrogen fuel tech in S'pore could be fully commercialised in 2030
22.9	06.04.2022	Cheryl Tan	NTU scientists find way to convert plastic waste into low-carbon hydrogen fuel
22.10	20.04.2022	Ng Wei Kai	NUS Kent Ridge campus to become living lab for low-carbon technology
22.11	30.05.2022	Sue-Ann Tan	Keppel saved $73m in 2021 from energy-efficient initiatives, aims to make sustainability its business
22.12	04.07.2022	Cheryl Tan	Singapore eyes green hydrogen as energy source with $25m institute
23.1	20.04.2023	Wu Xinyi	Keppel, ExxonMobil to collaborate on low-carbon energy solutions in Singapore
23.2	19.07.2023	Cheryl Tan	New hydrogen-ready power plant to be built by 2026 as S’pore seeks greener energy generators
23.3	30.07.2023	Lynda Hong	S’pore study on fitting incineration plants with carbon capture tech set to be completed by Q2 2024
23.4	23.10.2023	Cheryl Tan	Singapore a step closer to using low-carbon ammonia for bunkering, power generation
24.1	16.01.2024	Goh Yan Han	Consistent, coherent govt policy key for successful transition to low-carbon economy: WEF panel
24.2	15.04.2024	Cheryl Tan	Carbon capture can help with reducing S’pore’s emissions but is no silver bullet

24.3	15.04.2024	Cheryl Tan	Mining carbon dioxide from the air: The CO2 journey
24.4	26.04.2024	Cheryl Tan	New $60m lab in S'pore to drive R&D in carbon capture, biofuels and hydrogen
24.5	24.06.2024	David Fogarty	Is South-east Asia storing up trouble with carbon capture and storage hubs?
24.6	25.07.2024	Cheryl Tan	New NUS lab to take hydrogen research from lab to real-world settings
24.7	11.08.2024	Cheryl Tan	EMA to study laws, policies for S'pore to adopt low-carbon hydrogen when it becomes viable
24.8	21.08.2024	Cheryl Tan	Singapore, Japan sign agreement to collaborate on carbon capture and storage tech
24.9	21.10.2024	Cheryl Tan	Singapore launches grant call for natural gas power plants to study carbon capture and storage
25.1	19.01.2025	Shabana Begum	Norwegian CO2 carrier ship in S'pore offers glimpse of future carbon capture in region
25.2	19.01.2025	Shabana Begum	S'pore sets out plan to meet 2030 climate targets; energy imports, carbon capture among key efforts
25.3	14.07.2025	Chin Hui Shan	Three power firms get co-funding to study carbon capture, storage to help Singapore decarbonise
25.4	30.10.2025	Chin Hui Shan	Clean tech like carbon capture, hydrogen can scale up with state support, blended finance: Panel
25.5	16.12.2025	Ovais Subhani	Singapore is committed to high-value, low-carbon energy and chemicals manufacturing: DPM Gan
26.1	12.02.2026	Shabana Begum	Budget 2026: Weak global climate action may keep 2030 carbon tax at lower end of $50 to $80 range

Table A2. Semantic Categories of "Low-Carbon".

Meaning	Combination	Articles
Energy source or technology	low-carbon technologies	20.3, 21.14, 21.15, 21.19, 21.20, 21.24, 21.28, 22.1, 22.2, 22.4, 22.6, 22.10, 24.1, 24.4, 24.6, 25.5
	low-carbon energy (sources)	20.4, 20.6, 20.9, 21.9, 21.14, 21.18, 21.19, 21.20, 21.24, 22.5, 22.7, 22.8, 23.1, 23.4, 25.5
	low-carbon hydrogen	21.1, 21.8, 21.14, 21.22, 22.2, 22.6, 22.7, 22.8, 22.9, 22.12, 23.1, 24.6, 24.7
	low-carbon solutions	21.13, 21.19, 21.26, 21.28, 22.6, 22.11, 23.1, 25.5, 26.1
	low-carbon alternatives	20.1, 20.11, 20.12, 21.8, 21.14, 21.23, 21.24
	low-carbon electricity (imports)	21.18, 21.19, 21.20, 25.2, 26.1
	low-carbon ammonia	23.4, 24.1, 26.1
	low-carbon options	21.19, 22.4
Social and economic scenario	low-carbon future	20.11, 20.12, 21.5, 21.18, 21.10, 21.26, 21.28, 25.3
	low-carbon (global) economy	21.10, 21.16, 21.27, 22.1, 24.1, 24.7