Collective transitioning of a heavy industrial area towards ‘Net Zero Carbon’: the critical role of Governance in delivering Enterprise action

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Abstract. Industrial enterprises around the world are grappling with greenhouse gas emission reduction expectations, whether being driven by respective government policy for climate change or by shareholders to drive corporate sustainability through maintaining access to their ‘net zero’-demanding markets. In some instances, the enterprises co-located within complex industrial areas are coming together to face the common carbon reduction challenge as a collective. The Kwinana Industrial Area in Perth, Western Australia is well regarded on the world’s stage as a successful integrated heavy industrial precinct, presenting as an extensive, complex, and broad-based example of Industrial Symbiosis. In earlier papers, the authors have posited a novel four-dimensional framework to expand the definition of Industrial Symbiosis to be used to understand why one industrial precinct may be more successful for its resident industries to operate within than another, and for application in the design of new industrial areas. The four dimensions are described as Materials Exchange, Skilled Workforce, Support Industry, and Governance. Through the lens of climate change literature and policy frameworks, we investigate the governance dimension and industry’s response to the contemporary climate challenge. The outputs of the paper include a literature review of the governance dimension, and a description of the cascading nature of climate change policy from global through to the enterprise level. We illustrate how climate change governance is enhanced in practice by detailing how the enterprises in Kwinana collectively responded to the global requirement for carbon reduction, achieved through the facilitative governance-based intervention of their industry association, the Kwinana Industries Council. Exploring this in-practice example helped to consolidate the hypothesis that successful industrial symbiosis is about positive relationships across several dimensions building towards improved Circular Economy outcomes.

Keywords: Carbon reduction / climate change / industrial symbiosis / circular economy / Kwinana industrial area / KIC4

1 Introduction

Globally, representative organisations have been developing climate change policy since the Earth Summit held in Brazil in 1992. The Summit resulted in the birth of the United Nations Framework Convention on Climate Change (UNFCCC) [1]. In response, sovereign nations have accepted various levels of ‘commitment to action’ on climate change, and international momentum is growing [2]. The requirements placed upon exporters of products that are supplied into many international markets to demonstrate the content of carbon in their products are increasing [3,4]. “The novel Carbon Border Adjustment Mechanism (CBAM) proposes a levy on imports of specific products. The system is complex, but it also brings the European Union (EU) a step closer to fully pricing in carbon, as it creates a level playing field for EU producers in specific sectors”. It is essential, therefore, that industry responds to this from the perspective of maintaining their markets and thus their corporate sustainability. It is useful to observe how the individual enterprises within a complex industrial area can work together as a collective to lay down a plan under the broad umbrella of Industrial Symbiosis (IS) to achieve the common goal of carbon reduction. Using

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the principles of IS, where it is the value of the inter-relationships that generate the compounding benefits, an enterprise’s individual governance ambitions can align with the broader governance ambitions of the cluster, of a nation, and indeed, the world. Our analysis demonstrates that where there are multi-layered ambitions, and even where differing motivations exist, these can be brought into alignment using the principles of good governance processes to achieve corporate-based economic sustainability, which translates to Circular Economy (CE) advances at the broader levels of governmental and international policy. Within the Kwinana Industrial Area (KIA), which is located within the larger industrial area referred to as the Western Trade Coast (WTC) in Perth Western Australia (WA), the Board of the Kwinana Industries Council (KIC), the industry association drawing its membership from within the clustered enterprises, formally resolved to work collectively to confront this issue, having previously had positive experiences with their collegiate approach to collegiate problem resolution.

This paper consists of a comprehensive review of the literature associated with the governance dimension of the posited four-dimensional model (KIC4) for IS. We have supplemented this with a practical demonstration of how the cascading climate change policy framework (from global through to local) was applied to a major industrial area (Kwinana) despite a lack of policy leadership from some important policy actors.

A multi-dimensional framework for IS was posited by Oughton et al. [5], and was referred to as the KIC4 Framework for IS. It presented the following hypothesis:

A significant element in the development of a long-term competitive advantage to be enjoyed by an industrial enterprise relies on the extent to which the alignment of four key dimensions (of IS) match the defined dimensional characteristics of the actual industrial area within which the enterprise has chosen to locate itself [5].

The four dimensions of IS referred to were Materials Exchange (D1), Skilled Workforce (D2), Support Industries (D3), and Governance (D4), and in that paper the writers observed that the presence of a favourable combination of the four dimensions of IS may greatly enhance the broad economic and environmental sustainability of a given industrial precinct. In particular, the governance synergy was referred to as being a dimension where the industrial enterprises interact from within their own governance frameworks to externals such as government (international to local), and through representative corporate bodies such as the KIC. In concluding that a favourable governance environment directly influences the competitive potential of the enterprises within an industrial precinct, it was surmised that an enterprise’s competitive position is improved when governance functions are delivered efficiently and effectively. Additionally, that the interaction of the collective enterprises within Kwinana through their industry association (KIC) with the public sector managers of policy frameworks, is a relationship that exhibits synergistic characteristics. The writers singled out a reference to climate change policy as being an example of a governance policy environment under which there will be a myriad of collegiate opportunities and challenges that are largely outside the control of any individual enterprise. This paper responds to the suggestion that further research be directed towards assessing the efficacy of the Governance Dimension, and its role in the broader understanding of IS in the KIA.

Over several years, enterprises in WA have implemented substantial carbon reduction initiatives through energy and process water re-use, through introduction of renewables into their energy mixes, and through the increased focus on by-product reuse and waste reduction strategies [6–9]. Oughton et al. provided an analysis of the latest exchanges which can be found on the KIC website [10,11]. The updated exchanges schematic depicted shows more than 170 product and by-product exchanges between 38 enterprises located within the KIA. Currently there are eight direct carbon dioxide (CO2) exchanges between sending and receiving enterprises [12]. The development of IS in Kwinana has been periodically tracked for 30 years, and is summarised in the SKM Western Trade Coast Integrated Assessment (2014) report [9].

The KIC has been facilitating the achievement of the cluster’s reduced carbon profile, with materials, energy and water efficiencies forming part of its agenda since mid-2000s. For example, as early as 2007, the SKM (2007) Integrated Assessment report identified industry as being very pro-active and interested in achieving an industry-wide co-ordinated CO2 emission reduction goal [8,9]. According to SKM (2014), industry recognised the opportunity to establish baseline emissions (to air) data in order to record the history of the effects of emissions reduction strategies. (This monitoring would later extend beyond simply CO2 to include the Australian government’s reportable greenhouse gas emission levels). During its extensive interviewing process, SKM (2014) [9] also captured numerous respondent suggestions about the needs of the KIA in respect to its future transition to renewable energy sources including:

- Investigate ways to reduce unit cost of gas and improve availability of supply.
- Investigate ways to reduce unit cost of electricity for industry.
- Explore renewable energy supply as an alternative to fossil gas and electricity.

In addition, the report stated that the majority of the heavy industrial enterprises had individually initiated and implemented many energy-efficiency measures within the past five years. As international and sovereign policy has become clearer and more directive, KIC members recognised the importance and strength of what a collective effort can bring in achieving their individually-mandated corporate carbon reduction targets. In acknowledging that there are emerging opportunities to further pursue, and via a decision of its Board of members, KIC conceived and implemented its ‘Carbon Reduction KIA’ (CRKIA) project. This decision created a novel policy position for an industrial cluster, in that its resident enterprises took on a policy implementation role as a collegiate, to take it toward achieving the internationally adopted climate policy framework. It is important to recognise that the work of the KIC, in its own governance role, cannot replace
the climate policy governance positioning of any individual member, but may work to facilitate the roll out of agreed collective strategies.

Traditionally IS has related to the exchange of products, by-products and utilities within a geographically connected industrial precinct. The underpinning principle of IS is that the combined efforts of the enterprises acting together as a collegiate, will be greater than the sum of individual efforts. As recognised by the World Economic Forum, IS has the potential to transition industries to target and achieve net zero carbon [13]. We posit that this is achieved through a cascading hierarchy of climate change policies, and that at the industrial precinct level, this may be described as the fourth dimension of IS under the KIC4 framework for IS.

Motivation of the research

Van Beers (2006) observed that there had never been a formal strategic plan for the development of the KIA, it being amongst the world’s most successful integrated industrial complexes [14]. In WA, the responsibility for the KIA falls across numerous government departments, and it is well understood that their traditional silo-structured approach has resulted in the evolutionary creation of a number of avoidable constraints impacting on the sustainability of the precinct [15]. It is within this public sector governance environment that the Kwinana enterprises have to act to respond to the emergence of global carbon reduction policy direction, and to Australian’s national ‘greenhouse gas (GHG) equivalent’ reporting requirements.

In the context of the economic sustainability of the individual enterprises located in Kwinana, it was clear that each has the internally-mandated imperative that their carbon footprints be reduced to align with the requirements of their (mainly) international customers [9]. But how can an individual enterprise located within a complex industrial cluster with no overarching clear or practical governmental policy guidance for carbon reduction, achieve a carbon profile to satisfy its customers’ carbon content benchmarks? It seems reasonable to assume that carbon reduction technologies that can be applied concurrently to multiple enterprises will probably tend to deliver more competitive outcomes than those that can be only individually applied. The outcome of the self-directed approach by the enterprises in Kwinana where they are responding to the global policy environment was novel when it was conceived [9]. It is an approach that ‘lifts the ship’ by facilitating a collective approach to implementing carbon reduction initiatives that assist them to achieve their individual carbon reduction goals.

The objective of this paper is to demonstrate the role of governance in the translation of global Climate Change policy to responsive action at the enterprise level within an industrial precinct by:

- describing the governance frameworks that drive climate change action from the high-level global settings through to those of individual industrial enterprises.
- illustrating how this cascading of policy operates in practice by detailing how the industrial enterprises in Kwinana have collectively responded to the global carbon reduction imperative, and
- providing further evidence that successful industrial symbiosis is based firstly upon positive relationships across several dimensions, and secondly that it builds towards improved Sustainability (S) at the micro-level, and improved CE outcomes at the macro level.

2 Methodology

This section has two parts. The first is a search of the literature associated with CE in association with carbon reduction governance. The literature and policy reviews for this paper were of the comprehensive type. The accumulation of evidence and its synthesis into a comprehensive account of the governance environment for carbon reduction broadly followed the eight-step standardised qualitative methodology set down by Okoli. Rousseau et al. [16,17] posit that literature reviews can be a “comprehensive accumulation, transparent analysis, and reflective interpretation of all empirical studies pertinent to a specific question” [17,18]. The comprehensive research of the relevant literature and policy environments has been used to synthesise, assemble, analyse, and, importantly, interpret evidence gathered in a “highly reflective fashion”. An additional category of literature review is referred to as ‘standalone’, which Fink [18] writes is distinguished by its scope and rigor leading it to become a reference point or a clear outline of the literature for researchers undertaking a new investigation. This standalone review summarises the existing evidence, identifies gaps in current research, and provides a framework for positioning future research endeavours. Reviews of this type are valuable in informing policy and supporting practice [19].

The second part, and once characterised through the literature review, we then overlaid any impacts with Climate Change governance (policy) directives cascading through the global, international, national (Australian), State/Province (WA), and boardroom decisions of the individual GHG-emitting enterprises. This provided an applied interpretation of the results of the literary and policy research, overlaid on a practical illustration of how the KIC on behalf of its members, and through the application of climate change governance frameworks, approached the complex task of reducing the carbon profile of the Kwinana precinct. We utilised the secondary research data provided by the KIC to achieve this.

2.1 Literature search

The traditional understanding of IS was built on it being the exchange of materials — products, by-products and utilities between enterprises usually closely co-located [20,21]. The idea that the traditional view of IS and its sustainability orientation may be expanded into areas as
yet not associated with IS was potentially presented by Lombardi and Laybourn (2012) and Branson (2016) [22, 23]. They brought in aspects of enterprise eco-innovation, and other less-definable aspects of IS such as culture change, and thought that irrespective of theoretical perspectives, ultimately what happens in practice under the traditional IS framework, is what determines sustainability.

2.1.1 The role of circular economy for carbon reduction

Morsoletto (2020) has described CE as an economic model directed toward the efficient uses of resources through waste minimisation, long term value retention, reduction of primary resources, and closed loop of products, product parts, and materials within the boundaries of environmental protection and socioeconomic benefits [24]. Much of the literature defining CE is quite recent in its origins and yet it is expanding rapidly. Walker et al. concluded from their research that there was a lack of clarity in understanding the differences between the more established (older) concept of Sustainable Development, and CE [25, 26]. Their two primary conclusions were that sustainability was a higher order concept than CE in the minds of industrial enterprises (both however presenting pathways to sustainability), and that it was not considered a priority what name was attributed to their work (a pathway to a more sustainable world), only that they were taking steps to strive towards it. The intent of the United Nations (2015) Resolution 70/1 in 2015 is world-wide sustainable development [27]. It itemised 17 Sustainable Development Goals, and associated targets. In analysing these goals, Cecchin et al. (2020), identified seven where IS could make a contribution [28]. In their conclusions, they group IE, ecological modernisation and the green economy within the higher-order CE framework, itself fitting within the sustainable development framework.

The European Union, as a policy leader, provided a useful definition of CE. “In a circular economy the value of products and materials is maintained for as long as possible; waste and resource use are minimised, and resources are kept within the economy when a product has reached the end of its life, to be used again and again to create further value” [29]. Following this, the definitional ‘boundaries’ of CE became somewhat unclear as they extended into the business management and social dimensions. Murray et al. wrote “The CE is an economic model wherein planning, resourcing, procurement, production and reprocessing are designed and managed, as both process and output, to maximize ecosystem functioning and human well-being” [30]. In 2009, Chinese law promoting CE materials flows came into force, promoting circular, as opposed to the characteristically linear, movement via IS. This provided considerable momentum to the emergence of scholarly research investigating this new field of study. In resisting this extension, Moreau et al. (2017) posited that whilst CE was gaining momentum in the promotion of closed materials cycles, product re-use, and the promotion of production and supply chains to improve resource efficiency, it didn’t extend into the higher level economic institutional dimensions [31]. They further posited the problem that CE does not venture into the labour and governance dimensions, and they asked who, beyond the enterprises, should bear the associated costs.

In further strengthening of the link between governance, IS and CE, Moreau and Alvarez & Ruiz-Puente (2016) and observed that the European Union Data Centre on Waste was reporting under achievement of policy targets, and that efforts were being directed toward identifying new waste re-use policy (governance) targets and means by which these could be achieved [31, 32]. Several obstacles to the development of IS projects in Europe were identified by Domenich (2019), including the provision of weak economic incentives (IS exchanges are often low margin), geographic variations on incentives and drivers, varying policy frameworks (taxes and levies), and difficulty in navigating geographic boundaries (bureaucracy) [33]. Again, referring to Morsoletto, it was suggested that the practice of governance was a common way, or requirement, in the transition to CE by way of the setting of cascading policy targets [24]. In their review of the literature relating to the fields of CE and S, Nikolaou et al. (2021) and Walker (2021) identified there was significant and accelerating growth in the published material over the past decade [26, 34]. In their paper, Nikolaou identified a growing connectivity between the literature relating to CE and S, along with an increasing focus on activity at the macro-economic level (over the micro and meso-levels of research) where the implementation of governmental policy and projects have influence at the regional or national level. They further observed that whilst much of the literature was theoretical, science-based research from within the engineering and management scientific fields, the majority of the articles included in their research were to be found in the engineering/natural sciences fields of research. In their paper, they concluded that future research could be directed towards the links between CE and S at the micro, meso, and macro levels of analysis, between CE and the social dimension, and a more multi-disciplinary focus which hones in on the intersection of the fields of engineering/natural sciences and the economic/management sciences.

In their paper Oughton (2022) observed that Nikolaou had revealed that the more recent and emerging literature is moving society towards a future where CE and S are integrated fields of study and practice, and where the economic sustainability of an enterprise is interconnected to that of a cluster of enterprises which in turn is interwoven into the economic policies of a region or country [5]. Oughton posited that this future appears to be a new paradigm within which the evolutionary trajectory of IS falls into being simply a part of a much broader context where activity (human and corporate) aligns towards ‘replenishment’ where the focus appears to be moving in favour of carbon reduction (Fig. 1). The KIC4 as described appears to align within Nikolaou’s conclusions, and it may, in addition to its assumed application at the local industrial area level, be an analysis tool with the potential to be applied at higher (regional, national, and beyond) economic levels to support industry’s drive towards higher-order economic and environmental sustainability – towards a ‘replenishment society’. It was further
observed that CE is emerging as the contemporary overlying framework for IS and for several other ‘sustainability’ frameworks. Whilst CE is considered to operate at a broader geographic scale than S, several of the reasons for this can be attributed to the same issues that occur at the local geographic level where sustainability of current production patterns means a more likely achievement of long-term economic competitiveness [35].

2.1.2 Governance, as a dimension of IS
According to Graedel et al. in their contribution to ‘The handbook on industrial ecology’ (IE) [36], (IE: governance, laws and regulations p.60) the industrial ecologist needs to be comfortable with the basic disciplines of the field, but also willing to consider these within the overlay of the cultural and legal contexts [37]. They refer to these contexts as dimensions, and notes their inter-relatedness to other contexts including the economic and policy dimensions. The key observation here is that governance, as a dimension, assists in the description of IE, of which IS is a subset. Velenturf (2016) stated “the effects of governance on the implementation of IS have remained under-explored” [38]. She proceeded to recommend strengthening regulatory integration and flexibility, regulators building stronger relationships between the tiers of government, and investment in the upskilling of regulatory actors. In an earlier paper, Velenturf and Jensen (2016) concluded that the promotion of IS by governments was limited, and in Europe, under-developed [39]. They suggested that this could be improved by increasing integration and flexibility within the regulatory ‘landscape’, ranging from across governmental departments to improving the interconnection between national and regional level governmental organisations. The authors suggested that these recommendations should contribute to restoring the balance between regional capacity and the national ambitions to promote sustainability initiatives, indicating the effectiveness of a hierarchical cascading of policy governance. Tao et al. (2019) developed a model to assist with the development of efficient policy support mechanisms thus leading to better IS outcomes, again supporting the idea that policy (being an aspect of governance), is being thought of as a component part of IS [40]. In making the observation, Oughton (2022) concluded that the contemporary research appears to be increasingly accepting of the idea that IS is multi-dimensional, and has moved well beyond its original concept of materials exchanges [35]. The presence of a strong overarching governance role in respect to an industrial complex is seen as a necessity, and it has been described in the context of a dimension in the literature. Aside from the broader environmental and social benefits derived as a result of the exchanges, it is clear that for their long-term sustainable operations, enterprises remain primarily focused on improving their competitiveness. This pragmatic view is pervasive, and underlines that their reason for being in business is to make a profit or to create wealth for shareholders. Successful product and by-product material exchanges improve profitability, and from the perspective of business, if participation in IS can improve relative competitiveness, then it will be, and has been, embraced by industry. The research showed an expansion of the basic tenant of IS (the exchange of materials for mutual benefit) into deeper aspects of this, including, for example the social, economic, and environmental aspects. Novel aspects were considered in the context of CE, S and IS etc. These expanded the body of knowledge into areas such as government regulation and policies, government facilitation of industrial areas and identification of prospective new industry entrants and ‘anchor tenants’, service industries, knowledge, innovation and technology.

2.2 Climate policy governance search
We begin with the analysis of the global framework for Climate Change, and in doing so, analyse the policy environment which defines the Governance Dimension within which Kwinana’s carbon reduction strategy emerges. This policy overview is structured to describe the cascading contemporary framework of policies and legislation beginning with the global settings, moving through the international, Australian and WA settings, through to the local carbon reduction strategy work being delivered by the enterprises in Kwinana.
2.2.1 Carbon reduction: The global framework

Statements about climate change by peak global organisations, such as the United Nations, that represent multiple sovereign nations have established the governance framework for member nations to choose to embrace. The UNFCCC constitutes the foundational climate agreement that has provided the platform for most of the international agreements such as the Kyoto Protocols and Paris Agreement. The birth of UNFCCC (1992) was at the United Nations Conference on Environment and Development (UNCED) or otherwise known as Earth Summit in Rio de Janeiro, Brazil [1]. Article 2, states the objective of the agreement as given below:

"The ultimate objective of this Convention and any related legal instruments that the Conference of the Parties may adopt is to achieve, in accordance with the relevant provisions of the Convention, stabilization of GHG concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system. Such a level should be achieved within a time frame sufficient to allow ecosystems to adapt naturally to climate change, to ensure that food production is not threatened and to enable economic development to proceed in a sustainable manner" [1].

The Paris Agreement became the most recent agreement within the UNFCCC on climate change mitigation, adaptation and finance [41]. On 12th of December 2015, this Agreement was adopted by 196 countries at the 21st Conference of Parties (COP21) to the UNFCCC in Paris, France, and enacted this agreement on 4th November 2016, nine months later [38]. It was designed primarily for negotiating an international agreement to limit GHG emissions. The UNFCCC describes “the Paris Agreement (2015) as “a legally binding international treaty on climate change”. Some argue it is not binding, and that it is simply “a fluid agreement” [42]. At the global level, then, the strength of the policy framework as described in the Paris Agreement is somewhat unclear. The recently held Glasgow COP26 (2021) [43] and the latest Intergovernmental Panel on Climate Change (IPCC) [44,45] urged all economies to reduce emissions to keep the increase of temperature well below 2 °C. This latest IPCC sixth assessment report, which assessed the literature on scientific, technological, environmental, economic and social aspects of mitigation of climate change, recognised that there is huge potential for sectors such as industry and transport to reduce global CO2 emissions to net zero and hence to limit warming to 2 °C before 2050. Its modelled pathways project global GHG emissions for 2030, 2050 and 2100, presenting scenarios where the establishment of national policies, and their implementation, are required if the global targets are to be met. The impacts of international emissions based upon global policy shifts are modelled and demonstrate how, with coordinated effort, a temperature increase limited to 1.5 °C could be achieved by 2030.

The framework in Figure 2 reflects the aspirational global policy target of 1.5 °C that could be achieved by 2030, and presumes that strategies targeting a lesser change (than 1.5 °C) are CE rejuvenating strategies, and those where actions or inactions are likely to result in a higher temperature change, may be classified as Climate Change inducing strategies.

As per this IPCC report, in 2019 approximately 24% (14 GtCO2-eq) of the global total net anthropogenic GHG emissions from industry were identified as Scope 1. When addressing the indirect emissions (Scope 2), it reports that 90% come from electricity and heat production in the industry and building sectors, both accounting for 10% each. Hence emissions (Scope 1 and 2) produced by the industrial sector account for 34% of this total. The report also revealed that the average annual emissions from 2010 to 2019 have reduced for both the energy supply sector (2.3% to 1%) and from the industry sector (from 3.4% to 1.4%).

The International Energy Agency (IEA), in its “Energy Technology Perspective Series” report stated that “even with the challenges the world faces today, energy systems around the world could be transitioned onto sustainable pathways with the right technologies” [46]. The report identified that for the removal of CO2, Carbon Capture, Utilisation and Storage (CCUS) is the only group of technologies that can contribute to net reduction of
emissions directly from the key emission-generating sectors to balance emissions that cannot be avoided [46–48]. Strategies recommended by the IEA also included the development of carbon negative technologies such as Carbon Capture and Utilisation (CCU) [48]. The development and implementation of CCU technologies has been on the rise globally due to its potential for assisting with meeting net zero targets in the heavy industrial sector [46]. According to this report, from 2030 onwards, an average of around 75 CCUS plants and 20 electrolytic hydrogen as low carbon hydrogen plants are being added each year [46]. This may be viewed as industry taking policy direction from the long-emerging global governance framework, and there is no doubt that these technologies will play a key role in the transitioning of the global industry sector towards a net zero future, albeit to the extent that countries and emitting industrial enterprises embrace the framework and its objectives.

In addition to implementing renewable energy, energy efficiency, and IS [38, 49–51] to capture and utilise carbon, there are other solutions that industries can participate in, both improving the biodiversity and the climate change targets. For example, nature-based solutions by UNFCCC in its report ‘Race to Zero Dialogues’ recommends its pivotal role in the fight against climate crisis where industries can play a part as leaders in addition to reducing GHG emissions at the local level [52]. Nature based solutions will improve biodiversity and carbon stocks. The report shows that coordinating priority areas to conserve both biodiversity and carbon stocks is key to meeting ambitious goals for both nature and climate. It highlights areas where global conservation action can deliver the most to achieve biodiversity goals and mitigate climate change.

Observation: From this part of the governance overview, it can be seen that in the global context, the development of overarching policy occurred over a period of at least three decades. This is global circular economy thinking translated into a macro-governance framework, which is well and good, indeed it is necessary, if governance directives are to be adopted by countries and translated into national policy, and if that policy is then reflected in the policies of individual industrial enterprises. Without this transition from global, through national, to corporate governance, there seems little prospect of the agreed macro-level global GHG targets and time horizons being achieved.

2.2.2 Carbon reduction – the International framework

We observe that where there are commonly held interests, countries from around the world decide to create agglomerative entities. One such entity, the EU, has been recognising the threat to the planet that climate change is bringing and have made commitments to climate goals aligning under the Paris Agreement. At the UN Climate Action Summit in 2019 in New York, over 77 countries committed to cut greenhouse gas emissions and to achieve the goal of Net Zero Carbon (NZC) by 2050 [53]. During the event, another 70 countries announced that they will either boost their national action plan by 2020 or will have started the process of moving towards it. The notable point was India’s pledge to increase renewable energy capacity by 175Giga Watts GW by 2022 and to further increase this to 475 GW [54]. The international Solar Alliance, with partners from 80 countries also made significant announcements [55]. In addition, over 100 business leaders delivered concrete actions to align with Paris Agreement targets by speeding up transitions from a grey to a green economy [53].

According to the United Nation’s Secretary General [53] “The Climate Action Summit reinforced the global understanding that 1.5 °C is the socially, economically, politically and scientifically safe limit to global warming by the end of this century, and to achieve this, the world needs to work to achieve net zero emissions by 2050. The Summit also demonstrated the need to urgently update and enhance their short-term commitments by 2020, and the mid-term commitments by 2030, that will be captured in their national climate plans, known as Nationally Determined Contributions to the Paris Agreement” [53].

By 2020, countries such as Japan and South Korea, announced their plan to reach NZC by 2050 [56, 57], while China has pledged to reach NZC by 2060 [58]. When one of the highest emitters of the developed world, the USA, also became one of the team members in 2021 [59], it aligned with others to reach the ambitious target and signed the agreement.

The United Nations Environment Program’s latest report ‘Strengthening Synergies: How action to achieve post-2020 global biodiversity targets can contribute to mitigating climate change’, specifies the interconnected-ness of climate change and biodiversity loss crises and encourages application of the Nature-Based Solutions process which is based on inclusive decision making. This approach recognises that the land-rights of indigenous peoples and local communities are crucial to effectively address climate change and bio-diversity loss. For example, the report finds that conserving 30% of land in strategic locations could safeguard 500 giga tonnes of carbon stored in vegetation and soils [60].

Observation: This part of the policy overview demonstrates the transition of the broad global governance framework into those of growing groupings of individual countries. The enterprises operating in, for example, the industrial sector, in formulating and adopting their response to the global policy settings, are in essence responding to the higher order policy framework.

2.2.3 Carbon reduction – Australian national framework

In response to world leadership on emissions reduction policy, and relative to many countries in the world, it appears the Australian Federal government has been relatively slower in adopting formal policy positions on climate change targets, and it is observed that industry-led mitigation strategies have been advancing well ahead of the national policy positions. The Australian policy framework utilises a set of national definitions for representing emissions in respect to their sources, these being scopes 1, 2, and 3, and are briefly described below as the two new
SGM references as well, one CER website and the other DCCCEEW [61–63].
- Scope 1 emissions are generally defined as all direct emissions from an entity under its control. This Scope includes emissions from manufacturing, fugitive emissions such as methane emissions from a coal mine, fuel combustion, on site such as gas boilers, air-conditioning leaks and fleet vehicles, emissions from burning diesel fuel in trucks or production of electricity by burning coal.
- Scope 2 emissions are indirect emissions from electricity, heat or steam purchased and used by the reporting entity.
- Scope 3 emissions are all other indirect emissions from the activities of an organisation, occurring from the sources that they do not own or control but within the value chain.

In 2019, the Australian Government stated its interim policy target of 26–28% emission reduction (from 2005 levels) by 2030, and later revised to 35% before COP26 in 2021 [64]. In response to the international policy framework calling for countries to transition to a low to zero carbon economy by 2050 as established in the Paris Agreement and the subsequent Climate Actions Summit 2019, Australia has not demonstrated particularly strong policy leadership in this area until more recently. As Australia is made up of a federation of states and territories, each is able to achieve compliance with the national policy framework in its own way. It is mandated that commercial enterprises operating in Australia with baseline Scope 1 emissions in the range of 100,000 t CO2-e or more [61,64,65], are bound to comply with National Policy to fulfil their obligations under the Australian Government’s Safeguard Mechanism (SGM) [63,66], and to report their emissions into the National Greenhouse and Energy Reporting System (NGERS). In May 2022, Australia held its federal election, which saw the power shift from the 3-term (9-year) conservative coalition to the (left of centre) Labor Party. That Party’s campaign achieved a Lower House majority and focused on three main policy areas, including Climate Change and the Greenhouse Gas Emissions Reporting System (NGERS). In 2030 [67]. On September 13th 2022, the new Labor government assented the Climate Change Act 2022, an Act setting out the climate governance framework for the State, was expected to be introduced into the Parliament in 2020 [71]. There have been delays in introducing the Bill into the Parliament, and this is now expected to occur in late 2023 [72]. The Bill describes the State’s interim (at least 50% of the 2005 levels by 30 June 2030) [71] and long term (nett zero by 30 June 2040) GHG emissions targets, a climate change strategy, and the establishment of a Climate Change Council. The guiding principles of this Bill are based on three principles;
- Precautionary Principle; where there are threats of serious or irreversible damage to the environment, lack of full scientific certainty should not be used as a reason for postponing measures to prevent that damage.
- Intergenerational Equity Principle; where present generation should ensure that the health, diversity and productivity of the environment is maintained or enhanced for the benefit of future generations.
- Social Equity Principle; where the benefits and burdens on individuals and communities from the transition to a net zero emissions economy are allocated and distributed according to the contribution to greenhouse gas emissions and the capacity to pay.

The KIA is one of WA government’s several formally-designated strategic industrial areas [73]. All are similarly managed under a large number of government departments, each with governance authority over an aspect of these industrial areas. Under this governance framework, there is not yet a clear climate change policy direction that the industrial enterprises can look to for leadership. The objectives of the Bill are being applied to any new enterprises seeking environmental approval for their
projects, and proponents are being required to demonstrate their commitment to carbon reduction through the technologies they will employ through their internal GHG reduction plans [74]. A similar approach is being applied to any future ‘on-site’ development that initiates the requirement for an environmental approval. The Bill also serves to encourage enterprise boards to adopt carbon reduction targets.

2.2.5 Carbon reduction — at the enterprise level in the Kwinana Industrial Area

Individual enterprises in the KIA have been heeding the international carbon reduction signals from the global policy makers and from their customers for several years. One such signal is the European Union indicating that for products being sold into that region, they must be demonstrably carbon neutral or face a tariff/t CO2-e by 2026 [3,4]. This policy announcement alone has driven the enterprise boards toward the creation of business policy designed to direct their organisations to achieve carbon neutrality [75]. Policy direction from the federal and state governments has been absent until recently, so they were not the driver for this awareness, it included the threat of tariffs on carbon content and business continuity.

2.2.6 Carbon reduction — governance coordination delivered by an industry association

In this section Climate Change governance at the precinct level is explored. At this level, an industry association, in this case the KIC, interprets higher-level policy direction and communicates the knowledge to its membership, a precinct-based collective of enterprises. Note that in Figure 2 we have not included the industry association in the hierarchy, and this is because the association does not implement policy, it can only interpret and communicate it. The KIC’s governance framework is designed to facilitate its membership toward achieving a reduced carbon profile.

To deliver on this role, the KIC Board created its CRKIA project, the goals of which were to coordinate the carbon reduction efforts of its members, to identify collegiate strategies, to source and add the benefit of external technological intelligence, and to bring these together to assist the members in the achievement of their own board-mandated carbon reduction targets. This of itself was a complex governance-related initiative deserving of exploratory information to assist in the understanding of this.

The KIC: Governance, function and role

The KIC is the incorporated (1991) industry association geographically focused for its membership from within Western Trade Coast (WTC), the State’s Premier Industrial Area [9,73] and within which KIA is located (Fig. 3). The WTC is located on the coast within the Perth metropolitan area and abuts deep water industrial port infrastructure. To provide a scale indication, there are some 30,000 workers (direct and indirect) who attribute their employment to the WTC, and it generates an economic contribution to the State of WA of around AUD $16Bn pa [9]. Today, the KIA has matured into a complex industrial cluster comprised of many enterprises engaged in advanced manufacturing and refining. There have been many academic papers written about the cluster over the years, and it is widely regarded as being amongst the world’s outstanding examples of traditional IS [6,76–78]. All of the major enterprises located within the KIA are members of the KIC [79].

In being acknowledged as a respected voice of industry, the purpose of KIC is to advocate in the collegiate interests of its 51 member companies (as of June 30th 2023), and it does this under a formal governance structure, being its Board of Members, its Executive Committee, several specialist committees, and a small operational team (Fig. 4) [80].

Under the framework of IS, industry in the KIA has been identifying and implementing waste reduction, energy conservation, and efficiency measures for decades on the basis of scientific process improvement, with the goal of improved corporate economic sustainability. In 2019, the Board [81] identified that essentially all of its members were individually working on identifying and addressing climate change goals within their respective organisations [75]. The Board understood the commonality of the members’ climate transition goals [82], and the KIC’s strong track record of achieving collegiate improvements for its members. With strategies facilitated by KIC to assist members to align their individual corporate strategies with the Paris Agreement, the members could more efficiently and effectively make the progress being required by their own boards.

At this point it is useful to focus on the KIC’s CRKIA project to converge the emergence of governance as a dimension of IS with the cascading hierarchy of Climate Change policy.

In 2019, and taking its lead from growing global and international policy pressures to transition to a net zero carbon future, KIC positioned itself on the Rejuvenating Strategies side of the Climate Change Governance Framework (Fig. 2). The Board formally resolved to initiate its CRKIA project, thus leading the development of a collegiate approach to achieving the global and international policy compliance expectations of its members. CRKIA was required to build on the objective principles of science and economics, and to advance the collegiate interest of members to reduce the net carbon outputs from the KIA, and to identify pathways for members to achieve their own carbon neutrality goals.

It emerged as a project that created a consolidated inventory of the total greenhouse gas emission position of all members, that detailed the steps needed to advance the collective interests of members regarding their carbon footprint reduction, and that would also consider any external funding and research requirements that may be available to support the KIC initiative. All members had adopted company-centric policies directed toward achieving ‘net zero carbon’ by certain dates, with all of these being by or before 2050. Some members are part of large global
corporations which are expected to comply with overarching company policies to align their businesses with international trends and market expectations. Several of the KIC members had published their 'net zero' commitments, including the new-entrant battery precursor materials manufacturers. Furthermore, new industries in the renewable energy sector who were also planning to establish their operations in the WTC were also showing interest in following this path to align with the interests of the KIC membership. The goal of achieving ‘net zero’ or a reduced carbon emissions profile for the industrial area aligned with industry’s move to reducing emissions which had been driven by the very long-term commercial reality of using IS to drive down the use of energy and production of waste, and the costs associated with these. SKM (2014) reported that 70–80% of the (enterprise) respondents agreed at that time that the energy audit (part of the SKM report) played an important role in directing attention toward a thorough analysis of energy demand, and possible energy saving measures [8]. Any implementation of these measures generated reductions in GHG emissions and were therefore pursued on a basis which was, importantly to members, economically rational.

**The CRKIA three-phase project**

Phase One was completed in December 2021 and delivered two datasets, these being an inventory of GHG emissions, and the second being an inventory of KIC member commitments to carbon reduction. The emissions data sourced from a review of the nationally-reported emissions data of the six enterprises classified as Reporting Entities under the NGERS. It also included the total Scope 1 and 2 emissions data for all other non-reporting KIC members. Table 1 shows emissions data collected from the national Clean Energy Regulator’s website [61–63,82]. It records the annual emissions of SGM-reporting enterprises located in the KIA. All are members of KIC. This annual data was then presented as a 5-year cumulative record. Note the tracked reduction of around 1.8 million t CO₂ e over the period since the SGM process was introduced in 2016.
Table 1. Annual net emission data (Scope 1) KIC SGM members.

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<tbody>
<tr>
<td>Cockburn Cement (Cement)</td>
<td>1,839,661</td>
<td>1,093,801</td>
<td>1,020,189</td>
<td>947,905</td>
<td>979,493</td>
<td>1,044,918</td>
</tr>
<tr>
<td>CSBP (Fertilizer, mining chemicals)</td>
<td>1,319,204</td>
<td>615,658</td>
<td>601,148</td>
<td>722,204</td>
<td>888,136</td>
<td>697,197</td>
</tr>
<tr>
<td>Alcoa</td>
<td>1,309,104</td>
<td>1,282,994</td>
<td>1,250,831</td>
<td>1,258,124</td>
<td>1,272,256</td>
<td>1,292,269</td>
</tr>
<tr>
<td>Tronox (Titanium dioxide)</td>
<td>324,572</td>
<td>309,154</td>
<td>311,838</td>
<td>311,503</td>
<td>315,606</td>
<td>301,915</td>
</tr>
<tr>
<td>BP (oil refining)</td>
<td>739,256</td>
<td>660,542</td>
<td>727,543</td>
<td>711,680</td>
<td>663,005</td>
<td>413,542</td>
</tr>
<tr>
<td>BHP Nickel west (Nickel)</td>
<td>181,233</td>
<td>162,531</td>
<td>161,594</td>
<td>164,078</td>
<td>156,593</td>
<td>170,612</td>
</tr>
<tr>
<td>Totals</td>
<td>5,713,030</td>
<td>4,124,680</td>
<td>4,073,143</td>
<td>4,115,494</td>
<td>4,275,089</td>
<td>3,920,453</td>
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<tr>
<td>Annual reduction</td>
<td></td>
<td>1,588,350</td>
<td>51,537</td>
<td>-42,351</td>
<td>-159,595</td>
<td>354,636</td>
</tr>
<tr>
<td>5-year reduction</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1,792,577</td>
</tr>
</tbody>
</table>

The inventory of member carbon reduction targets was obtained from various sources, but mainly from company sustainability reports [82]. Anecdotally in almost all instances since the inventory was built in 2020, members’ published year for reduction targets has been shortened, and the percentage reduction target has been increased. This is an indication of an intensifying approach by many of the companies to their reduction targets, as opposed to a linear approach. KIC has undertaken to biennially review the emissions data to support trend tracking.

The Phase One report drew the attention of the World Economic Forum (WEF), and consequently KIC was asked to present to the WEF ‘Transitioning Industrial Clusters to Net Zero’ project at COP26, as the first industrial cluster signatory (of four) in the world to sign the WEF Aspiration Statement [83]. At the invitation of Accenture on behalf of the IEA, KIC was similarly asked to present an update at COP27, at which time the number of signatory clusters had grown to 15. These invitations occurred well in advance of the Australian government sectors legislating their national and WA carbon reduction commitments. The KIA cluster was well and truly on the international stage because of its leadership in direct response to global and WA carbon reduction commitments. The KIC Working Group has tasked KIC with align itself with the WA government’s new Climate Change Bill and to seek their support.

3 Results and discussion

3.1 What the literature revealed

The findings from the review of the academic literature illuminated the presence of governance as a dimension of IS and traced its emergence to where it, in its constructive form, is being considered as a fundamental requirement for the successful operation of any given complex industrial precinct. Novel aspects were considered in the context of S, IS, and CE, and these have expanded the body of knowledge into areas such as government regulation and policies, government facilitation of industrial areas and the identification of prospective new industry entrants, service industries, knowledge, innovation and technology.

Through our review of the literature and the exploration of the governance frameworks associated with climate change, and supported by the Kwinana CRKIA project, we found alignment with previous findings signalling that the traditional definition of IS can be expanded to include the role of governance dimension, one of the four dimensions of the KIC4 model underpinning IS [5].

3.2 What the Climate Change governance framework review revealed

The review of the Climate Change policy framework was focused on the governance dimension of the KIC4 framework, with its basis in the deeper aspects of IS including, for example the social, economic, and environmental aspects of CE. We presented a cascading set of governance settings (Fig. 2) related to Climate Change,
beginning at the global level where public sector organisations in their leadership roles had been establishing the policy frameworks for adoption in the international context. Countries have shown variable responses to this global leadership, with some pursuing climate rejuvenation strategies that seek to achieve reductions at or below the 1.5 °C global target, and those with strategies that will add to the inducement of temperature rise in excess of this target. Whilst we observed that Australia had taken a conservative policy approach to carbon reduction targets, we also saw that enterprises within the Kwinana cluster had taken the initiative to rise above the Australian climate change policy framework, preferring to align with the global framework to maintain their economic sustainability. Through the analysis we demonstrated how these individual enterprises had harnessed the governance role of their industry association, the KIC. On their behalf, KIC developed a decarbonisation strategy built on the basis of its strong track record around the application of the principles of IS, with recognition for this manifesting in an invitation to present its novel process to the COP26 conference in 2021 [84], and COP27 in 2022.

3.3 What the Carbon Reduction project revealed

In response to the global climate change policy framework, the KIC members had all established and publicly disclosed their individual carbon reduction goals [9]. Major emitters were formally reporting their annual emissions data into the national data repository (NGERS). Due to the KIC4 D1 IS materials exchanges in Kwinana, all enterprises were found to be connected in some way through their Scope 1, 2, and 3 emissions, and thus held a common interest in the improved collective GHG emission profile. The challenge the KIC members experienced was how to move the collective enterprises to a position where they were willing to share information on the carbon reduction technologies they were considering, or to even change their policy positions on the basis that they would all stand to gain if they agreed to participate in a process that would improve the overall GHG profile of the KIA.

The underlying principle of IS governance is that the combined efforts of the enterprises to act together as a collegiate will be greater than the sum of their individual efforts, as demonstrated through their KIC collective approach to resolving their commonly-held key strategic issues [11]. This translated into their confidence that KIC could facilitate a process to enable the achievement of GHG reduction opportunities for the benefit of the individual enterprises within the collective. When this is overlaid with internationally important statements such as that from the...
WEF reinforcing that IS brings opportunities to reduce emissions among an industrial cluster, and between clusters [85], achieving the alignment is compelling.

The CRKIA project brought together and consolidated the framework under which the enterprises located in the KIA could meet their individual carbon reduction commitments. Members both individually and collectively identified applicable technologies for prioritised implementation. Each member had a clear understanding of their individual carbon profiles and were independently working to achieve their internal policy commitments. Through the long-term activities of their industry association, they confidently understood that combining their efforts could deliver an economically sustainable approach to achieve their climate change goals. They committed to the ongoing monitoring of the cluster’s emissions profile under the CRKIA project, and agreed that the most effective technologies to employ will be common-user in nature. The KIC, with its members, had to identify which of the cascading levels of climate policy governance frameworks were going to deliver the required policy leadership. They determined that WA and National Australian policy did not provide this, and turned toward the higher-order global and international frameworks, including moving toward being ready for CBAM and its associated supply chain challenges. The approach to carbon reduction by Kwinana’s complex industrial cluster appears to be well in advance of any other in Australia. That the CRKIA project continues to advance under the less than adequate Australian climate change leadership, is a statement about the strength of governance provided by KIC to its members, and to the members’ governance in responding to the global policy challenges that have been laid down in front of their future commercial sustainability. The case study provided strong evidence of individual enterprise-level efforts to create and to publicly state company climate change corporate targets. It is suggested that it is likely the individual efforts of industrial enterprises will not be sufficient even in the context of global and international climate change policy, to create the GHG reductions required to meet the global targets.

4 Conclusion

In undertaking the comprehensive review of the literature related to governance within the context of IS, we found evidence to support its extension well beyond the traditional confines of the exchange of products, by-products and utilities. We saw that relationships are the basis upon which traditional IS is built [5,10,35], where senders and receivers of products and by-products form commercial (governance-based) relationships to facilitate the transactions. We observed through the CRKIA project in Kwinana that in the same way, symbiotic relationships formed the basis of the cooperation between the members, where the KIC brought them together to synthesise their CRKIA project.

The significance of the role the global policy framework plays in assisting industrial enterprises with overcoming national and provincial political climate change conservatism to adopt the global targets. In our analysis we observed that in Australia there are policy forces that can be on a continuum of strategies that range from CE rejuvenating to Climate Change inducing strategies. We identified that the KIC as an incorporated industry association in representing the interests of its members, sits within the Enterprise strata of the Climate Change Policy Framework (Fig. 2), much as a ‘department for climate change’ sits within a government stratum. If the KIC (its members) were to be allocated a position within the horizontal dimension of the Framework, it would be placed within the ‘rejuvenating strategies’ to the left of the mid-range 1.5°C benchmark global target. Based on observed commitments at the end of 2022, the Australian (Federal) and Western Australian (Provincial) governments would have been located on the ‘climate change inducing’ area to the right of the 1.5°C global target. This policy position appears now to be moving to the left toward rejuvenating strategies.

From a practical perspective we detailed how the industrial enterprises in Kwinana collectively responded to the combined global and international carbon reduction imperative. In circumventing the (then) lagging national and provincial governments, they directed their industry association to successfully lead a collective approach to their individual carbon reduction imperatives. In doing so, the KIC relied on the governance directive from its Board, and then on the maturity of the interrelationships between its members. The evidence is clear in relation to the Kwinana enterprises’ industry association (KIC) assumed a leadership role in bringing its members together to agree on a collective public and individual corporate commitment plan for carbon reduction, and to facilitate the process. The exploration showed how, when these structures come together, the process can bridge directly from local governance to associate directly with the higher order frameworks. Also evident was the important, perhaps driving role that corporate economic sustainability played in aligning company governance toward global climate change targets.

The analysis highlighted the point that in Kwinana, the enterprises have the mature relationships built up over time through working collectively to resolve commonly-held issues. It was interesting to observe that the KIC members through their carbon reduction shopping process identified technologies that were characteristically able to be implemented by the collective. The cooperation of the Kwinana enterprises at the local (micro) level in identifying the carbon reduction technologies that will improve the overall sustainability of not only the directly affected enterprises, but through the current product and by-product synergies, will benefit the broader cluster and once implemented, the sustainability of the whole cluster improves. When this occurs, Western Australia itself benefits because of Kwinana’s contribution to the CE of the State. Further improvements will accrue as other industrial clusters within the State begin to improve their local sustainability metrics.

In conclusion, we postulate that the ‘bottom up’ governance approach demonstrated in Kwinana, where under the governance of the KIC, member enterprises have attached themselves directly to the global policy frameworks,
is a benchmark example of S at the local level summing up to CE at the national to the global level, with the goal being the achievement of NZC and the possible use of rejuvenation strategies that could result in a ‘better than’ the 1.5 °C global target for WA being achieved. The presence of the four dimensions as originally posited (KIC4) have been further consolidated in this literature and climate policy review paper. There will be further development and study emanating from this work, and possibly further dimensions found as a result. So, to this end, and for clarity, we provide an expansionary interpretation of the KIC4 framework building on the descriptions to provide a clear foundation for future researchers. We suggest that the exploration of further study opportunities in this field will deliver a up a new and rich field for future research.

Abréviations

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Description</th>
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<tbody>
<tr>
<td>CBAM</td>
<td>Carbon Border Adjustment Mechanism</td>
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<tr>
<td>CCUS</td>
<td>Carbon Capture, Utilisation and Storage</td>
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<tr>
<td>CCU</td>
<td>Carbon Capture and Utilisation</td>
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<td>CE</td>
<td>Circular Economy</td>
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<td>COP</td>
<td>Conference of Parties</td>
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<td>CO₂</td>
<td>Carbon dioxide</td>
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<tr>
<td>CRKIA</td>
<td>Carbon Reduction KIA (project)</td>
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<tr>
<td>D1, 2, 3, 4. Dimension 1 etc</td>
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<tr>
<td>EU</td>
<td>European Union</td>
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<td>GHG</td>
<td>Greenhouse Gas</td>
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<td>GW</td>
<td>Giga Watt</td>
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<td>IE</td>
<td>Industrial Ecology</td>
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<td>IEA</td>
<td>International Energy Agency</td>
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<td>IPCC</td>
<td>Intergovernmental Panel on Climate Change</td>
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<td>IS</td>
<td>Industrial symbiosis</td>
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<td>KIA</td>
<td>Kwinana Industrial Area</td>
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<td>KIC</td>
<td>Kwinana Industries Council</td>
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<td>KIC4</td>
<td>Four-dimensional model</td>
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<td>NGERS</td>
<td>National Greenhouse and Energy Reporting Scheme</td>
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<td>NZC</td>
<td>Net Zero Carbon</td>
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<td>S</td>
<td>Sustainability</td>
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<td>SGM</td>
<td>Safeguard Mechanism</td>
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<td>UNFCCC</td>
<td>United Nations Framework Convention on Climate Change</td>
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<td>WA</td>
<td>Western Australia</td>
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<td>WTC</td>
<td>Western Trade Coast</td>
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<td>WEF</td>
<td>World Economic Forum</td>
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Conflicts of interest/Competing interests

Mr. Oughton (lead author) is employed as the Director of Kwinana Industries Council.

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