PUBLICATION VERSION

Pilbara ISOCo Limited Application to the ACCC for Authorisation in respect of the Pilbara Electricity Networks regulatory regime

Supplementary information

17 February 2023

CONTENTS

1. The Company would like to provide further supporting information for its Application dated 7 November 2022 (**Application**), as follows.

Overview

2. In this submission, the Company:

   (a) provides information quantifying the costs of electricity supply disruption in the NWIS;

   (b) provides three confidential examples of why both grid security and access are facilitated by the Pilbara regime, through the establishment of a single, independent modelling and technical authority;

   (c) explains why the growth of wind and solar resources increases the need for independent, central modelling; and

   (d) explains why the Pilbara regime can be a material enabler of Pilbara decarbonisation.

Quantifying the consequences of supply disruption

Propositions from the Application

3. As noted in the Application,[1] an explicit goal of the Pilbara regime was to maintain and improve power system security in the NWIS. This is also an explicit function for the Company.[2]

4. At paragraph [269], the Application stated that:

> The financial consequences of a supply disruption can be extremely large, easily running to millions of dollars an hour, and the knock-on operational consequences for train and mine scheduling of even a relatively short outage can take days, and more millions of dollars, to resolve.

5. At paragraph [305], the Application highlighted the fact that the Company's role as a coordinating authority and sole, independent decision-maker is intended and expected to maintain and improve power system security.

Placing an indicative value on system security

6. In support of these propositions, the Company wishes to illustrate the economic value of NWIS reliability, in light of the fact that a very substantial portion of Australia's export revenue flows through the ports the NWIS powers.

7. Rio Tinto's, BHP's, FMG's and Roy Hills' port operations at Port Hedland, Cape Lambert and Dampier all depend on electricity sourced from the NWIS to power train unloading, ore stockpiling and reclaiming, conveyor belts and ship loading.

8. A supply disruption in the NWIS will disrupt those port operations, which has at least two significant consequences.

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[1] See paragraph [40] onwards.

[2] *Electricity Industry Act 2004*, section 120W(4)(a)

9. First, and most obviously, a stoppage in ship loading will disrupt export sales. The exact cost of such outages is a closely guarded commercial secret for each miner, but the Company understands from confidential discussions that the major miners are likely to cost outages in the millions of dollars per hour, possibly as much as $5 million or more per hour.

10. This can be supported using publicly available information. In 2021/22, iron ore exports from these three ports were: [3]

Port	Tonnage (mtpa)
Port Hedland	521
Cape Lambert	167
Dampier	127
TOTAL	**815**

16. The NWIS thus powers **815 mtpa** of iron ore exports – roughly **93,000 tonnes per hour**. The price of iron ore varies with market conditions and the grade of ore, of course, but allowing an arbitrary range of US$50 /tonne to US$150 /tonne.[4] Focussing on iron ore exporters, this produces a cashflow impact for a stoppage of between US$4.6 million and US$13.9 million per hour.[5]

17. Similarly, public sources estimated the per-day cost of BHP's train derailment on the Newman line to Port Hedland in 2018 as being in the order of $80 million revenue per day.[6]

18. The second impact of a power outage at the port is potentially even more substantial – operational disruption.

19. Modern mining operations involve careful management of the logistics chain from pit to port. Miners blend ores in various ways to produce a consistent product for export, such as Rio Tinto's "Pilbara Blend" and BHP's "Newman Blend".[7] This can include blending at the mine or a central hub, blending in the train (by part-loading a car with ore at one mine and completing the car's loading at another mine) and blending at the port stockpile by managing the sequence in which ore is delivered to the port and how it is transferred to, and reclaimed from, the stockpiles.[8,9] (The

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[3] Government of Western Australia, *Western Australia Iron Ore Profile – February 2022*, page 5, available here.

[4] The iron ore spot price averaged US$132.34 in 2021/22, and US$99.77 in the first month of FY 2022/23: Western Australian Treasury Corporation, *Market Highlights July 2022*, available here. The same source records that the WA State Budget forecasts iron ore prices to average US$77.50 /tonne in FY 2022/23.

[5] This is, at a minimum, a cashflow impact. Whether it is also a revenue impact will depend on how long the miners take to make up the lost production. Arguably, when the ports are running at or near capacity, a missed shipment is not actually made up until the end of the supply period. If so, then taking into account the substantial discount required to reflect the present value of that future revenue, there is a substantial revenue loss as well.

[6] *The West Australian*, 8 November 2018, "Costs, iron ore carriers mount up as BHP races to restock after runaway Pilbara train disaster", online article available here.

[7] In 2021 the WA Department of Water and Environmental Regulation described BHP's blending activities as follows:

> All ores are blended either at the Premises [BHP's Port Hedland facilities] or at the mining operations prior to delivery to the Premises. Therefore any ore stored at the Premises could have a varying mix of Brockman, Marra Mamba and Channel Iron Deposits depending on customer requirements, which change over time.

see Department of Water and Environmental Regulation, *Amendment Report, Application for Licence Amendment for Licence L4513/1969/18*, 6 September 2021. The Company understands other miners' blending activities to be similar.

[8] For high-level company information on Rio Tinto's blended products, see Rio Tinto website here.

[9] For helpful schematics and high-level information about BHP's integrated operations see this slideshow.

citations in footnotes 8 and 9 are recent and very high-level documents produced by BHP and Rio themselves. For an independent and much more detailed description, BHP's and Rio's processes are described in the Australian Competition Tribunal's 2010 decision on Fortescue's rail access application.[10])

20. For this blending to occur, train movements must be very carefully scheduled – it's essential that each ore train arrives at the correct location (the port, or another mine), with the correct ore on board and at the correct time to be blended. This also requires careful synchronised scheduling of all mine operations, to ensure that whenever a train arrives at a mine, the correct grade of ore has been mined and stockpiled, so that it is available to be loaded, depending on the train's scheduled destination and what ore the train may already have on board.

21. All of this must occur in circumstances where the rail networks have limited numbers of train paths for these massive trains, and by design are usually running at close to full capacity,[11] and where inefficiencies or delays in train operations, in addition to disrupting upstream and downstream schedules, can impact the trains' own fuel consumption and hence cost of production.

22. The result is that the scheduling impact of a port outage is much greater than just missed ship sailings. Because the ship loading schedule (and any ore blending in the port stockpile) depends on the correct train arriving at the correct time, a disruption in port operations means that trains may need to be delayed or rescheduled. This in turn ripples back up the supply chain, requiring mine stockpile and mining operations also to be rescheduled, and disrupting train operations everywhere across the constrained network. Once again, the precise implications of a given outage are usually confidential, but the Company understands that an ill-timed port outage of just one or two hours can have scheduling repercussions across the logistics chain that last 2 or 3 days.

The need for a single modelling and connection authority

Proposition from the Application

23. As stated above, the Pilbara regime is intended to improve NWIS security and reliability.

24. The Application explained that another explicit goal of the Pilbara regime was to facilitate access to covered NWIS networks.[12] And at paragraph [302], the Application indicated that one of the benefits flowing from the Pilbara regime would be this improved access.

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[10] The Tribunal's description is far more detailed than is required for present purposes, and the Company does not seek to rely on any specific facts or findings in the decision. It is cited only as an independent authority in support of the contention that mining operations involve a sophisticated and integrated logistical chain from pit to port. Although the precise pits, train movements, and ore qualities have changed somewhat in the intervening years, the Company understands that the description of the integrated logistics involved remains current. See Australian Competition Tribunal, *In the matter of Fortescue Metals Group Limited* [2010] ACompT 2, Summary of Reasons (available here), sections 3.2 to 3.4 [178 onwards] for BHP's operations and sections 4.2 to 4.8 [290 onwards] for Rio Tinto's operations.

[11] In its submission on Alinta's second coverage application (undated but probably about December 2017, available here), Rio explained it as follows (emphasis added):

> Rio Tinto operates its mine, rail, ports and power facilities in the Pilbara as a single integrated system. A key objective of this system is the reliable, efficient and economic production of iron ore which meets customer specifications at the ports of Dampier and Cape Lambert for loading onto ships for export to world markets. …
>
> Due to the capital intensive nature of iron ore production, **the Rio Tinto production system is deliberately constructed and operated in such a way that the capacity of each of its main components, including mine, rail, ports and power network are balanced to meet long-term system capacity requirements**. …

[12] See for example paragraphs [35] onwards of the Application.

25. This can also be expressed as a counterfactual. Without the ISO's central role in modelling and approving connections, access to NWIS network services would be materially harder, if not impossible, because there would be no central authority able and willing to undertake modelling or resolve technical disputes.

Case studies demonstrating how the regime improves access and connection

26. To help further establish these propositions, the Company sets out below three examples of why having a single entity responsible for modelling and decision-making in the connections process is vital both for grid security and for effective access, and is markedly better than the alternative.

27. The Company has asked the Commission to keep the case studies confidential, to preserve the commercially sensitive information discussed. In broad terms for publication, they are as follows:

(a) Case study 1 deals with a historical example, before the Pilbara regime was in place, in which technical issues arose regarding an access seeker's connection request.

(b) Case study 2 deals with a situation under the Pilbara regime, in which an access seeker sought certain technical exemptions.

(c) Case study 3 deals with a theoretical future scenario in which a fourth network may seek to interconnect with the NWIS.

28. The purpose of these examples is to illustrate the benefits that flow from the Pilbara regime providing a single, independent authority in respect of technical rules, modelling and connection matters, and a transparent, consultative process for any disagreements to be resolved.

CONFIDENTIAL INFORMATION OMITTED

Inverter-based resources require more rigorous scrutiny during the connections process

46. In the next section (from paragraph 65 below), the Company explains why it anticipates substantial growth in renewable connections to the NWIS. This section explains why that's significant.

47. For grid operators across the world, the transition to renewable energy brings with it operational challenges, arising in part from the use of "inverter-based resources" (**IBR**) such as solar farms, wind farms and batteries, in the place of conventional synchronous resources.

48. The AEMC explains it this way:

> **Synchronous machines** (including synchronous generators, motors and condensers) are electromagnetically coupled to the AC power system. This means that some interactions of the machine with the overall power system are dictated, and determined, by the physical characteristics of the machine. This includes kinetic inertial responses to a frequency disturbance, or a reactive current response immediately after occurrence of a fault. Synchronous machines also inherently contribute to maintaining the stability of the voltage wave form.[13]

[13] AEMC, *Efficient management of system strength on the power system*, Rule determination, 21 October 2021 ("AEMC System Strength Determination"), section 1.2, footnote 9, emphasis added.

49. In short, conventional synchronous machines contain a rotating shaft whose speed of rotation is synchronised to the grid's frequency, and this rotating shaft's physical inertia contributes to the grid's frequency stability.

50. The AEMC says that in contrast:

> **Inverter based resources (IBR)** refer to non-synchronous generators and loads that are connected to the power system through power electronics. A key characteristic of this form of generation is that many elements of how it interacts with the power system is related to how its digital control algorithms are programmed. This contrasts with synchronous generation, which is electromechanically connected to the grid and which tends to have a set of inherent physical interactions with the power system, based on the specific physical characteristics of each unit.[14]

51. In other words, unless the inverter is one of the newer "grid forming" units, the electronics in the inverter will take their frequency signal from the grid, so that if grid frequency falls, the inverter's output frequency will fall along with it. The inverter will not help the grid by resisting the fall. With a synchronous unit, because the physical inertia of the rotating shaft means that it takes time to slow down, the synchronous machine will in effect "push back" against the fall in frequency, slowing its decline. This is important because a slower rate of change of frequency (RoCoF) contributes to a more stable grid, and gives other systems more time to respond.

52. Describing the impact of the energy transition on the NEM, but in a way which is also directly applicable to the NWIS and other power systems, the AEMC summarised the position as follows:

> The … [NEM – and the NWIS] was designed around a generation fleet that consisted of a small number of large, synchronous, centrally located generators … [in the NWIS these are gas turbines].[15] However, as these generators leave the market or reduce their operations [or there is a proportionate growth of IBR], the supply of … essential system services — including inertia, system strength and reactive support — has reduced.
>
> Further, new IBR facilities, like generators, some loads, batteries and hydrogen facilities, can create a demand for system services, rather than supplying these services automatically as a by-product of their operation.[16]
>
> The combination of these two trends (decreasing supply [of system strength], increasing demand [for system strength]) means that new ways are needed to actively source these essential system services as the power system continues to transition away from traditional forms of generation.

53. In other words, as IBR penetration grows, the need for a system operator to manage essential system services increases.

54. Similar views have been expressed by CIGRE,[17] the global peak body for power systems operators:

> The ability of power system equipment to operate in a stable manner and for the system as a whole to recover intact from major disturbances, is influenced by the electrical 'strength' of the system at the point where equipment connects. …
>
> The power generation technology [being used in the grid] will have a major impact on system strength. Synchronous machines are generally a positive contributor to the system strength. Traditionally IBR have been generally considered as a negative contributor to system strength. However, the emergence of new technologies such as … grid-forming inverters is already making a

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[14] AEMC System Strength Determination, section 1.2, footnote 10, emphasis added.

[15] Footnote 9 of the AEMC's decision.

[16] AEMC System Strength Determination, section 1.2. The footnotes in this passage have been omitted, but are reproduced in para 30 above.

[17] Conseil International des Grands Réseaux Electriques, i.e. the International Council on Large Electric Systems

> positive impact. Other than the generation technology, the following are among the key factors influencing the overall system strength.
> - **IBR density**, being the concentration of multiple IBRs in close electrical proximity to each other.
> - **Synchronous unit scarcity**, being the lack of sufficient online synchronous machine support due to retirements or market forces.
> - **Network sparsity**, which reflects the electrical remoteness of the area in which IBRs are connected, i.e. how far they are to major generation and load centres and how meshed and/or interconnected that area of the network is.[18]

55. Once again, the point is that managing a grid with deep IBR penetration is more challenging, and the role of the ISO in managing system strength (through the connections process, and through ESS procurement and dispatch) also grows.

56. At least two, and if the expected growth in IBR occurs all three, of the characteristics listed by CIGRE apply in the NWIS.

57. The Company submits that the above is sufficient to support the conclusion that a material growth in wind and solar connections to the NWIS will present technical and operational challenges for the ISO and NSPs, as the growth of IBR make the task of managing system strength more challenging.

58. These challenges can be met. The point is simply that connecting large IBR facilities to the grid, especially if other IBR facilities are also planning to connect, is technically more complex, and potentially more controversial, than connecting conventional synchronous facilities. It requires more, and more complex, modelling. For example, a CIGRE article states:

> The use of appropriate and fit for purpose modelling and monitoring tools is fundamental to assessing and addressing the various system strength challenges [associated with IBR penetration] before they manifest during actual power system operation. Wide-area EMT modelling is required for assessing most aspects of system strength where phasor-domain modelling may be unable to, for example, reliably predict controller interactions and associated instabilities.[19]

59. At present in the NWIS, none of the three gentailer-NSPs' network models are capable of wide-area EMT modelling as described by CIGRE. Nor, at this stage, is the Company's whole-of-system model, because it has been assembled by combining those NSP models.

60. But the important point is this: absent the Pilbara regime, there would be no mechanism to require NSPs to add this (or any other IBR-ready) capability to their models, or to provide that modelling capability to assist access seekers seeking to connect to another NSP's network. Thus, if an IBR access seeker sought to connect to one network, and its NSP took heed of CIGRE's advice about the need for system-wide EMT modelling, there would be no way for the host NSP to ensure that that happened. The host NSP, and hence the access seeker, would be dependent on the goodwill of the other NSPs. In the NWIS, those other NSPs may very well have interests which are not aligned with the host NSP's, the access seeker's or their customers' interests.

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[18] CIGRE Reference Paper, *System Strength*, Electra magazine, Number 315, April 2021, accessed 13 February 2023 (available here), page 1 (**"CIGRE System Strength paper"**). CIGRE state in this paper:

> This Reference Paper is a very short summary of a longer and wider paper prepared by a small task force made up of members from SC C4 - System Technical Performance. This paper provides an overview of different aspects pertaining to system strength. Readers are encouraged to reach out and read the full journal paper in the flagship CIGRE Science & Engineering Journal's Volume No 20, February 2021 issue. (Unfortunately, the full journal paper is accessible by CIGRE members only).

[19] CIGRE System Strength paper, page 3.

61. Similarly, there would be no central authority tasked with monitoring system strength across the whole NWIS[20] and imposing whatever connection standards might be appropriate at the time of connection or subsequently, or managing the procurement and dispatch of ESS. The other NSPs and their network users would be reliant on the vigilance of the host NSP, and its commercial arrangements' effectiveness in managing the new IBR connection.

62. Conversely, with the Pilbara regime in place, the ISO has the role of monitoring and developing the whole-of-system model to ensure that it is adequate for the task of preserving system security, and also publishing modelling standards (in the form of the "power system modelling procedure")[21] that will require the NSPs to keep their respective models up to date, in the correct form and with requisite functionality. With this coordinated approach to model development and management, whole of system impacts are more likely to be properly understood, which should reduce security risks and increase investment certainty. Likewise, the ISO manages the specification and procurement of ESS, to ensure the system remains secure whatever may be connected to it.

Other sources addressing the importance of an overarching independent technical authority for the Pilbara

63. The position without the Pilbara regime was addressed by a Task Force established by the Minister for Energy in July 2015, to address the then-recent situation in which Alinta and Horizon had each applied for coverage of the other's network.[22] The Task Force concluded that one of the problems requiring reform was that:

> … there is no single, final and agreed set of technical requirements for electricity generation and network operations that applies consistently across the NWIS. Rather there is a perception that technical requirements for network connections can be negotiated and that Horizon Power uses technical rules for its own commercial advantage.[23]

64. The Task Force proposed that to address this:

> … [t]he Pilbara System Operator could … be the custodian of a new set of Technical Rules and system operation rules. [24]

65. When Alinta applied to have Horizon Power's network covered, its application made it very clear that the lack of clear, authoritative, independent and accountable technical rules was hindering its ability to access Horizon's part of the NWIS.[25]

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[20] The ISO's functions do not specifically mention system strength, but they do not need to. The ISO's system security function (*Electricity Industry Act 2004* section 120W(4)(a), PNR rule 32(1)) encompasses managing system strength.

[21] See PNR rule 121(1)

[22] The Task Force was established as part of an agreed outcome in which the two coverage applications were withdrawn: see the timeline set out in Figure 2, section 2.3 of Alinta's second coverage application: Alinta Energy, *Coverage Application under the Electricity Networks Access Code 2004 (WA)*, August 2017 (**"Alinta's Second Coverage Application"**), available here.

[23] Government of Western Australia, *Pilbara Electricity Infrastructure Project – Stage One Report*, July 2015 (**"PEIP Report"**), available here, page 12.

[24] PEIP Report, page 16.

[25] Alinta Energy, *Coverage Application under the Electricity Networks Access Code 2004 (WA)*, 24 October 2014 (**"Alinta's First Coverage Application"**), available here, pages 17-18. The Company does not seek to rely upon Alinta's specific statements – its application is cited merely as evidence of an access seeker's perspective on the access process in the absence of properly regulated, independent technical rules and associated connection process.

66. And of course the WA Government has recognised this need, by implementing the Pilbara regime as described in the Application.[26]

How the Pilbara regime can facilitate decarbonisation

Propositions from the Application

67. In paragraph [249] of the Application, as part of the counterfactual, the Company stated that without the regime's formal framework for cooperation and a single ISO, the three NSPs would find an influx of intermittent and non-synchronous generation difficult to manage, which may be a barrier to decarbonisation.

68. In paragraph [264], the Company stated that new projects are expected to meet customers' decarbonisation objectives.

69. In paragraphs [306] and [307], the Company listed improved opportunities for decarbonisation projects as one of the public benefits arising from the proposed conduct.

Explaining the rationale for these assertions

70. The Company is sensitive to the ACCC's and other regulators' present focus on the making of unsubstantiated claims regarding decarbonisation, and wishes to set out the basis on which it made these statements.

71. With the exception of Woodside's announced Maitland solar farm, the Company is not in a position to describe specific renewable energy projects planned for NWIS connection.

72. Rather, for the reasons set out below, the Company considers that there is at least a credible possibility that large scale investment in renewable energy will be proposed for the Pilbara.

73. If this happens, then the Company submits that the Pilbara regime will facilitate that investment by facilitating the connection, interconnection and management of that renewable generation. Counterfactually, if such investment were to be proposed in the absence of the Pilbara regime, the Company considers that the barriers for entry for that generation would be materially higher.

74. In this sense, the Company considers that the Pilbara regime is a necessary but not sufficient condition for large scale investment in renewable energy in the Pilbara, should that investment come about.

A credible prospect of substantial investment in renewable generation

75. It is not a function of either the Company or the Pilbara regime to promote investment in renewable generation *per se*.[27] Rather, the Company's role is to facilitate grid access including new

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[26] For the Technical Rules, the task is not fully complete. The Harmonised Technical Rules published in 2021 were acknowledged to be an interim measure, and at present are being supplemented by informal unregulated arrangements. Work is required to ensure that NWIS access is governed by a single consistent and contemporary set of rules, appropriately governed.

[27] The "Pilbara electricity objective" in section 119(2) of the *Electricity Industry Act 2004* does not contain an explicit sustainability objective, unlike the corresponding objective inserted into in section 2.1(c) of the WA *Electricity Networks Access Code 2004* (available here) in 2020, and the present proposal to add such a limb to the national energy objectives.

connections, while preserving and improving system security.[28] But if access requests come from renewable generators, then by facilitating their connection, the Company will necessarily be facilitating those generators' customers' decarbonisation.

76. The Company expects substantial investment in renewable generation in the Pilbara for the reasons set out below.

77. First, the Company expects decarbonisation to be a continuing and growing focus for Pilbara businesses:

(a) The IPCC has indicated that to avoid the most extreme consequences of climate change, the world needs to decarbonise its economy by mid-century.[29] Australia has ratified the Paris Agreement,[30] and has recently legislated regarding its commitments under that agreement.[31]

(b) The mining industry in the Pilbara is currently carbon intensive.[32]

(c) Pilbara miners have variously published corporate decarbonisation objectives that cannot sensibly be achieved without substantial decarbonisation investment in the Pilbara. The **Appendix** to this submission summarises some of these public statements.

(d) Further, both State and Federal Governments have decarbonisation targets and if these are to be pursued, the Company anticipates continued legislative reform to incentivise or force miners and other large consumers to begin and continue decarbonising.

78. Second, decarbonising the mining industry will likely involve a substantial increase in consumption of renewable electricity:[33]

(a) to replace existing fossil-fuelled power generation; and

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[28] *Electricity Industry Act 2004* section 120W(4), read with other provisions including sections 119(1) and (2) and the *Pilbara Networks Access Code*.

[29] See for example IPCC AR6 WG1 SPM here.

[30] See announcement here.

[31] *Climate Change Act 2022* (Cth)

[32] Mining companies are very sensitive about publishing site- or location-specific energy consumption or emissions data, because it could be used by competitors to back-calculate their cost of production – which is highly sensitive strategic information. However, the Company submits that there is ample circumstantial evidence to support this assertion, for example:

- recent NGER data (see *Corporate emissions and energy data 2020-21*, available here) show that the combined Scope 1 and 2 emissions for Rio Tinto, BHP Group, FMG, Hancock Prospecting and CITIC Pacific (Australia-wide) is roughly 24.6 million t CO_2-e/a and the net energy consumed is roughly 273 PJ/a. For each of these companies, at least a substantial portion of this activity occurs in the Pilbara.
- the CEFC-MRIWA report *The compelling case for decarbonisation*, volume 1 in the *Mining in a low-emissions economy* series, 2022 (available here) (**"CEFC-MRIWA Volume 1"**), page 12, stated (citations omitted):

> In 2019, mining represented 6.2 per cent of Australia's energy demand and 9.5 per cent of greenhouse gas (GHG) emissions. …
>
> … the growth in mining-related emissions outpaced that of other sectors from 1990 to 2019.

[33] "Electricity is widely considered the leading medium to achieve zero-carbon mining, with decarbonisation determined by the degree to which an activity, technology, or process can be electrified." CEFC-MRIWA, Technology solutions for decarbonisation, volume 2 in the *Mining in a low-emissions economy* series, 2022 (available here), page 13. (The CEFC-MRIWA paper does not suggest that electrification is the ***only*** pathway.)

(b) to displace the diesel currently being consumed by small and large vehicles and other machines[34] - either directly through use of batteries, or indirectly through the production and use of green hydrogen.

79. Putting these elements together, the Company considers there to be at least a credible prospect that through a combination of their own corporate objectives and the pressure of legislation, Pilbara miners will be looking to develop, and interconnect, large renewable generation projects, within the next decade.

80. There have as yet been no definitive studies of the scale of renewable generation which would be required to decarbonise the Pilbara, but by any sensible calculation it would be substantial. For example , the CEFC-MRIWA 2022 report indicates that 41% of a magnetite mine's energy consumption is in the form of diesel.[35] Even assuming per-kW parity, displacing this would almost double a mine's existing electricity consumption.

The role of the grid

81. It is in the nature of renewable energy that in addition to each site requiring a large physical footprint, one of the optimum ways to mitigate the variability of wind and sun is to have the generation as widely geographically distributed as possible.[36] This makes electricity transmission networks an essential component of the renewable solution.[37]

82. Further, it has been suggested that the more interconnected renewable facilities are, the more they may be able to share in essential system services such as spinning reserve and services designed to maintain system strength, offering a more cost-effective way to achieve system security than if individual miners developed their own solutions independently.[38]

83. Once again, it is not for the ISO to promote grid-connected solutions, but rather to be ready to assist and regulate applicants who have decided to adopt such solutions. Without the Pilbara regime, the ISO would not be there to do this, and for the reasons discussed above, the applicants' paths would be more challenging.

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[34] CEFC-MRIWA Volume 1, definition of "mining diesel" on page 12.

[35] CEFC-MRIWA Volume 1, figure 7, page 13.

[36] In AEMO's inaugural *Integrated System Plan* in 2020 (available here) (**"ISP 2020"**), page 51, AEMO described this factor as follows:

> An important consideration for large-scale development of renewables in a concentrated area such as a REZ is the diversity of renewables within the REZ and across the NEM. High diversity (low correlation) between REZs is valuable because it results in a more consistent generation output overall, which requires less energy storage to support the need for firming.

[37] In ISP 2020, page 6, in comments which focused on the NEM but apply equally in the NWIS, AEMO summarized this as follows (emphasis added):

> The crucial role of transmission:
>
> The projected portfolio of new resources involves substantial amounts of geographically dispersed renewable generation, placing a **greater reliance on the role of the transmission network. A much larger network footprint with transmission investment will be needed to efficiently connect and share these low fuel cost resources**.
>
> Increased **investment in an interconnected grid provides** the **flexibility, security, and economic efficiency** associated with a power system designed to take maximum advantage of existing resources, integrate variable renewable energy, and support efficient competitive alternatives for consumers. …

[38] See for example Engie, *Interconnectivity Key To Unlocking Pilbara's Renewable Energy Potential*, undated online article, perhaps late 2022, accessed 14 February 2023 (available here).

The role of the ISO

84. As described above, renewable generation poses particular challenges for a grid operator – its variability and intermittency make it harder to dispatch, and its lack of synchronous inertia means it may make less contribution to system strength.

85. These challenges can be managed, but it generally requires closer technical cooperation between the NSP and connection applicant, alternatively closer technical supervision of the connection applicant by the NSP, than might traditionally have been the case with dispatchable and synchronous plant.

86. But as with any other major new connection, the impacts of variable, non-synchronous renewable generation may be felt anywhere in the interconnected system, not limited to the network to which the IBR plant is being connected.

87. Without the Pilbara regime:

(a) for a host NSP seeking to ensure that the connection does not jeopardise system security, there is no formal mechanism to seek and secure consent from the other NSPs, or to secure their cooperation in modelling the impact of the IBR on their systems or the NWIS as a whole, or designing the standards with which the IBR must comply – this will make it harder for even a willing host NSP to say "yes" to an applicant; and

(b) conversely, if a non-host NSP or other system user is concerned that a host NSP may be permitting IBR to connect in a way which may jeopardise stability within the non-host NSP's system, it may have limited ability to intervene, despite the fact that for the reasons set out earlier in this paper it may regard this as a very substantial business risk, and if it does find a way to intervene, the resulting contention or disputes will create cost and risk for all concerned, and certainly will not make life easier for the would-be new renewable generator; and

(c) in either case, if a disagreement were to arise there is no independent umpire to referee the outcome.

88. History has shown that conflicts between NSPs can arise even regarding dispatchable synchronous plant.

Conclusion on decarbonisation

89. In summary then, the Company does not assert that the Pilbara regime, of itself, will promote decarbonisation of Pilbara industries. Rather, the Company submits that if decarbonisation is to occur, as seems likely or at least credible, then effective and independent grid management and access will be a critical enabler.

90. Counterfactually, the Company submits that if, as it expects, an optimum pathway to decarbonisation will involve very large and geographically dispersed wind and solar farms, then the task of interconnecting those farms through an expanded NWIS would be at best extremely difficult, and quite likely seriously hampered and delayed, if the Pilbara regime was not in place, and as a result companies' decarbonisation could well be harder, slower and more expensive.

Appendix – Decarbonization objectives of large Pilbara stakeholders

1. The Company recognizes that many companies with large-scale operations in the Pilbara have set ambitious decarbonization targets. For example, in respect of scope 1 and scope 2 emissions:[39,40]

   (a) BHP has set targets of reducing GHG emission by: [41]

      (i) at least 30% compared to 2020 levels by 2030; and

      (ii) achieving net zero by 2050.

   (b) Rio Tinto has set targets of reducing GHG emissions by:[42]

      (i) 15% compared to 2018 levels 2025;

      (ii) 50% compared to 2018 levels by 2030; and

      (iii) achieving net zero by 2050.

   (c) FMG has set the target of reaching real zero terrestrial emissions by 2030.[43,44]

   (d) Woodside has set the target of reducing GHG emissions by:[45]

      (i) 15% below base line[46] by 2025;

      (ii) 30% below base line by 2030; and

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[39] The targets set out for BHP, Rio Tinto and FMG relate to each company's mining operations and for Woodside relate to direct emissions (scope 1 & scope 2 emissions). While the Company recognizes most also have targets in respect of their scope 3 emissions (targets relating to, for example, shipping and upstream processing), the achievement of those targets is unlikely to impact the Company's operations or the NWIS.

[40]The Company understands scope 1, 2 and 3 emissions to generally mean:

- 'scope 1' emissions are those occurring as a direct result of a business' activities. E.g., emissions from business vehicles or in manufacturing / industrial processes. This includes any self-generation of electricity (e.g. by onsite generators).
- 'scope 2' emissions are a business' indirect emissions from the generation of purchased energy from a utility provider. This covers all the business' electricity use (lights, computers, air conditioning, machinery, conveyors, etc.). Emissions from electricity the business generates itself will be scope 1.
- 'scope 3' emissions are a business' indirect emissions from all other sources besides purchased energy. This captures emissions in the business's upstream and downstream supply chains. E.g., a steel producer's scope 3 emissions will include emissions from the mining, processing and transporting of the iron ore it imports.

[41] 2030 objective: BHP ASX market announcement, 'Social value update' (28 June 2022), attachment page 12 (available here); 2030 & 2050 objective: BHP decarbonisation strategy (July 2022), page 2 (available here)

[42] Rio Tinto climate change report 2021, page 16 (downloadable here).

[43] FMG Limited, ASX release, 'Fortescue Announces Execution Plan for Industry Leading Decarbonisation' (20 September 2022), page 1 (available here).

[44] FMG describes "real zero" as "no fossil fuels and wherever possible no offsets. Offsets must only be used a temporary solution while the technology or innovation required to completely decarbonize is developed" (Ibid, page 3). The objective refers to "terrestrial emissions", which appears to exclude scope 1 shipping emissions (Ibid, attachment page 4).

[45] Woodside climate strategy (November 2020), page 7 (available here).

[46] Woodside's base line is "the average equity scope 1 and 2 emissions over 2016 – 2020 and may be adjusted for potential equity changes in producing or sanctioned assets with FID prior to 2021" (Ibid, page 7, footnote 3).

(iii) achieving net zero by 2050 or sooner.

2. The Company acknowledges that the above objectives are merely statements of intent and cannot be relied on in isolation as evidence that meaningful steps towards their achievement will in fact be taken. However, some of the above companies have already started to take steps towards their achievement in ways that will or might utilize the NWIS. For example, the process for environmental approval in respect of the following has begun:

(a) Woodside is proposing the development of a 500 MW solar farm in Maitland, 15km southwest of Karratha, in part purposed to supply power to its Pluto LNG facility located on the Burrup peninsula.[47]

(b) FMG is proposing the development of a 5.4 GW renewable energy hub comprised of solar, wind and battery infrastructure on the Uaroo and Emu Creek pastoral stations, 120km south of Onslow, purposed to power FMG's mining operations in the Pilbara.[48]

3. Additionally, the Company notes that:

(a) Rio Tinto has announced an intention to develop a 34 MW solar farm to power the Gudai-Darri mine site. Rio Tinto also claims that it is undergoing studies to assess decarbonization opportunities at its other mines.[49]

(b) While the Company is not aware of any plans BHP has in the Pilbara region (or involving the NWIS), BHP is currently building two solar farms in the Goldfields region: a 27.4 MW solar farm at its Mt Keith Nickel Operation, and a 10.7 MW solar farm and a 10.1 MW battery at its Leinster Nickel Operation.[50]

4. The Company recognizes that the achievement of the above stated objectives are in very early stages. However, the Company believes that steps taken so far indicate that it is likely that real attempts to achieve those targets will be made. Decarbonization of these companies' operations in the Pilbara will almost inevitably require large-scale and interconnected renewable generation. As such, the Company believes that those companies' stated decarbonization objectives cannot be achieved without significant investment in, and modification of, the NWIS and other Pilbara networks (be they presently existing or to be developed in the future).

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[47] Environmental Protection Authority (WA), Woodside Solar Facility (last updated 7 February 2023) (available here); Woodside, 'Information Sheet – Proposed Solar Power Facility Environment Referral' (available here).

[48] Environmental Protection Authority (WA), Uaroo Renewable Energy Hub (last updated 22 May 2023) (available here).

[49] Rio Tinto's website, 'Our first solar plant to power new iron ore mine' (available here).

[50] BHP's website, 'Solar panels begin installation in northern Goldfields' (available here).