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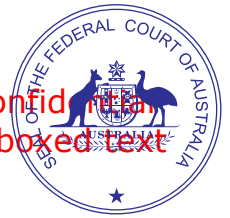
Sia Lagos

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Important Information

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Form 59
Rule 29.02(1)

Affidavit

NSD of 2024

Federal Court of Australia
District Registry: New South Wales
Division: General

FORTESCUE LIMITED (ACN 002 594 872) and others

Applicants

ELEMENT ZERO PTY LIMITED (ACN 664 342 081) and others

Respondents

Affidavit of: **Ms Susanne Monica Hantos**
Address: Ground floor, 6 Bennett Street, East Perth, WA, 6004
Occupation: Registered Australian Patent and Trade Marks Attorney
Date: 1 May 2024

Contents

Document number	Details	Paragraph	Page
1	Affidavit of Ms Susanne Monica Hantos in support of application for a search order, affirmed on 30 April 2024	1–68	1–13
2	Annexure SMH-1, being copy of the curriculum vitae of Susanne Monica Hantos	8	3
3	Annexure SMH-2, being copy of printouts of the particulars of each of the Fortescue Applications on AusPat	28	5
4	Annexure SMH-3, being bundle of emails of interest identified by Susanne Monica Hantos in Bartłomiej Kołodziejczyk's Fortescue email account	55	10

Filed on behalf of (name & role of party) Fortescue Limited and others, the Applicants
Prepared by (name of person/lawyer) Paul Alexander Dewar, Principal Lawyer
Law firm (if applicable) Davies Collison Cave Law
Tel (02) 9293 1000 Fax (02) 9262 1080
Email PDewar@dcc.com
Address for service Level 4, 7 Macquarie Place, Sydney NSW 2000
(include state and postcode)

I SUSANNE MONICA HANTOS, Ground floor, 6 Bennett Street, East Perth, WA, 6004, Registered Australian Patent Attorney (Technical field Chemistry and Biochemistry), affirm:

1. I am employed by the Third Applicant, FMG Personnel Services Pty Ltd, as a Registered Australian Patent Attorney. My current role at Fortescue is Technology Intelligence Counsel.
2. In this affidavit I refer to the Applicants collectively as **Fortescue**.
3. I set out my qualifications and experience in this regard at **Part A**, below.
4. I am authorised to make this affidavit on Fortescue's behalf.
5. The evidence I give in this affidavit is based on my personal knowledge, unless stated otherwise, or the business records of Fortescue to which I have had access in the course of my employment and which I have read and identified where relevant. Where my evidence is provided on information and belief, I identify the source of that information and I believe it to be true and correct. My opinions set out in this affidavit are wholly or substantially based on my specialised knowledge and experience gained from the training, study and experience set out in **Part A**, below.
6. In this affidavit, I refer to documents in each case by a reference based on my initials, for example **Annexure "SMH-1"**, "**SMH-2"**, and so on. In each case, the particular document or item is produced and shown to me and marked as I have described at the time of making my affidavit.
7. My affidavit adopts the following structure:

A.	My Background and Expertise	3
A.1	Education	3
A.2	Relevant work experience	3
B.	Patent applications generally	4
B.1	Publication of patent specifications	4
B.2	Disclosure required in a provisional patent specification	5
B.3	Disclosure required in a complete patent specification.....	5
C.	Fortescue's Direct Electrochemical Reduction patent applications.....	5
D.	Element Zero's patent applications	5
E.	Risk of disclosure of Fortescue's confidential information	7

Susanne M. Hantos

F.	My analysis of the Element Zero PCT Application.....	8
G.	My review of Dr Kolodziejczyk's emails.....	9
H.	My review of the Sharepoint Folder with Dr Anand Bhatt	13

A. My Background and Expertise

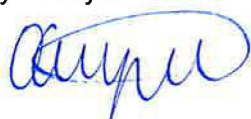
- My curriculum vitae is annexed and marked **Annexure SMH-1**.
- I have been registered as an Australian Patent Attorney under the *Patents Act 1990* (Cth) (**Act**) since 2007. I have extensive experience in the fields of chemistry and biochemistry.

A.1 Education

- In 1996, I graduated from the University of Guelph, Ontario, Canada with a Bachelor of Science Honours degree in Applied Chemistry. As part of my degree, I completed two co-operative placements during which I worked as a research chemist for an agrochemical company. During my undergraduate studies I was a Canada Scholar and I was awarded the Analytical Biochemistry Prize, the Honours Applied Chemistry Award, the Society of Chemical Industries Prize in Applied Chemistry and the Chemical Institute of Canada Silver Medal, which is presented to the top students at each Canadian university entering their final year of chemistry, biochemistry or related programs.
- In 1998, I graduated from the University of Ottawa, Ontario, Canada with a Master of Science degree in organic chemistry. During my postgraduate studies, I was a Natural Science and Engineering Council (NSERC) scholar and I was also awarded the University of Ottawa Excellence Scholarship.
- In 2001, I graduated from the University of Western Ontario, Canada with a Master of Library and Information Science degree. During my postgraduate studies, I was awarded the Laura Colvin Cataloguing Prize, an Ontario Graduate Scholarship, the Elizabeth Dafoe Scholarship from the Canadian Library Association, the Lucille Wert Chemical Information Award from the American Chemical Society and the Imperial Order of the Daughters of the Empire Fellowship in Library Science.

A.2 Relevant work experience

- From 2001 to 2003 I was employed by the intellectual property law firm Bereskin & Parr in Toronto, Ontario, Canada where I trained to become a registered Canadian Patent Agent.
- From 2003 to 2005 I worked for a pharmaceutical company, Biovail Corporation, in Mississauga, Ontario, Canada as a registered Canadian patent agent and Senior Intellectual Property Analyst. In that role, I routinely prepared, prosecuted and analysed



Susanne M. Hantes

pharmaceutical related patent specifications as part of managing the company's patent portfolio and assessing potential patent acquisition targets.

15. From 2005 to 2021, I worked at Davies Collison Cave Pty Ltd (**DCC**). In 2007, I attained registration as an Australian Patent Attorney, and was employed by DCC as such. I became a Senior Associate of DCC in 2011, and was the Manager of the Patent Intelligence Services division of DCC from December 2007 to November 2021.
16. Since December 2021, I have been employed by Fortescue as a Technology Intelligence Counsel. This role is a senior intellectual property counsel position where I am required to use my knowledge and experience as an Australian Patent Attorney on a regular basis.

B. Patent applications generally

17. Typically, from my experience, Australian applicants file (a) an Australian provisional application that establishes a priority date and (b) a later-filed international patent application under the Patent Coordination Treaty (**PCT**) and/or a national patent application within the Paris Convention period of 12 months (**Paris Convention Deadline**). Some countries are not PCT contracting states (**Contracting States**), so if patent protection is to be sought in such countries, a national patent application needs to be filed within 12 months of the earliest priority date claimed.
18. An international PCT patent application is a bundle of patent applications in Contracting States and regional groupings of some states.

B.1 Publication of patent specifications

19. Publication of a PCT patent application or a national patent application typically occurs shortly after 18 months from the earliest priority date claimed by the PCT application or national patent application, unless expedited publication is requested by the applicant.
20. Publication does not occur exactly on at 18 months because of administrative steps required to publish a PCT application or a national patent application. Publication will systematically occur, unless the PCT applicant or national patent applicant withdraws the application in writing before the administrative steps of publication commence.
21. The PCT system allows applicants to defer incurring the costs associated with initiating the national or regional phase of the international PCT patent application in Contracting States for a period of up to 30 months or 31 months calculated from the earliest priority date of the claims of a PCT application. In Australia, the relevant period is 31 months.
22. After entering the national or regional phases of a PCT application, each national/regional application is examined by the respective national/regional Patent Offices.



Suzanne M. Hartes

B.2 Disclosure required in a provisional patent specification

23. Pursuant to *Patents Act 1990* (Cth) s 40(1), a provisional specification must disclose the invention in a manner which is clear enough and complete enough for the invention to be performed by a person skilled in the relevant art.

B.3 Disclosure required in a complete patent specification

24. Pursuant to *Patents Act 1990* (Cth) s 40(2)(a)–(aa), a complete specification must: disclose the invention in a manner which is clear enough and complete enough for the invention to be performed by a person skilled in the relevant art; and disclose the best method known to the applicant of performing the invention.
25. Further, the claim(s) in the complete application must be clear and succinct and supported by matter disclosed in the specification.

C. Fortescue's Direct Electrochemical Reduction patent applications

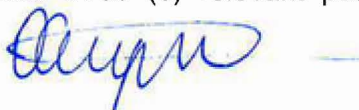
26. From inspecting Fortescue's internal records to which I have access in my role, I know that Fortescue has filed Australian patent applications on a direct electrochemical reduction process, including with Dr Bjorn Winther-Jensen and/or Dr Bartlomiej Kolodziejczyk named as inventors (**Fortescue Applications**).
27. The particulars of the Fortescue Applications are contained in the table below.

	Application type	Title	Applicant	Inventor(s)	Filing Date
Australian provisional patent application no. 2021901547	Provisional	Apparatus and process for producing iron	Fortescue Future Industries Pty Ltd	Not Given	24 May 2021
Australian standard patent application no. 2021215184	Standard	Apparatus and process for producing iron	FORTESCUE FUTURE INDUSTRIES PTY LTD	KOŁODZIEJCZYK, Bartłomiej Piotr ; WINTHER-JENSEN, Bjorn	11 August 2021

28. Shown to me and marked **Annexure SMH-2** are printouts of the particulars of each of the Fortescue Applications on AusPat.

D. Element Zero's patent applications

29. I was instructed by Davies Collison Cave Law Pty Ltd (**DCCL**), solicitors for the Applicants, to conduct searches for Australian and PCT patent applications filed in the name of Element Zero Pty Ltd (**Element Zero**).
30. I conducted searches of the Australian patent register using IP Australia's online platform AusPat, which revealed three (3) relevant patent applications filed by Element Zero



Suzanne M. Hantes

(**Element Zero National Applications**). The data for these searches is current as at 30 April 2024.

31. I conducted searches of the WIPO Patentscope website and found a PCT application with International Application Number PCT/AU2023/051041, entitled "METHOD OF ORE PROCESSING" in the name of Element Zero Pty Limited (**Element Zero PCT Application**). The priority application for the Element Zero PCT Application is Australian provisional patent application no. 2022903090. The Element Zero PCT Application was published on 25 April 2024 as WO 2024/082020 A1.
32. I refer to the national applications and the PCT application together as the "**Element Zero Applications**". The particulars of the Element Zero Applications are contained in the table below.

	Australian provisional patent application no. 2022903090 (090 Application)	Australian provisional patent application no. 2023902103 (103 Application)	Australian provisional patent application no. 2023903979 (979 Application)	International Application Number PCT/AU2023/051041 (Element Zero PCT Application)
Application type	Provisional	Provisional	Provisional	International application under the PCT
Status	LAPSED	FILED	FILED	Published
Title	METHOD OF ORE PROCESSING	ORE PROCESSING METHOD FOR METAL RECOVERY	ELECTROWINNING FROM MOLTEN SALT	METHOD OF ORE PROCESSING
Applicant	Element Zero Pty Ltd (WA 6019 Australia)	Element Zero Pty Ltd (WA 6019 Australia)	Element Zero Pty Ltd (WA 6019 Australia)	Element Zero Pty Limited
Inventor(s)	WINTHER-JENSEN, Bjorn; KOLODZIEJCZYK, Bartlomiej	Winther-Jensen, Bjorn; Newling, Paul; Clements, Jonathon; Baxter, Ken	WINTHER-JENSEN, Bjorn	WINTHER-JENSEN, Bjorn; KOLODZIEJCZYK, Bartlomiej
Filing Date	2022-10-20	2023-06-30	2023-12-08	2023-10-19 (International Filing Date)
Paris Convention deadline (1)	2023-10-20	2024-06-30	2024-12-08	Not applicable
Anticipated OPI date (2)	2024-04-20 (On or after)	2024-12-30 (On or after)	2025-06-08 (On or after)	25 April 2024 as PCT application claims priority from the 090 Application
National Phase Deadline (3)	2025-05-20	2026-01-30	2026-07-08	2025-05-20 as PCT application claims priority from the 090 Application



Susanne M. Hartes

- (1) Deadline by which to file PCT patent application or national patent application within Paris Convention period
- (2) Anticipated Open for Public Inspection (OPI) date if priority claimed from provisional Australian patent application listed in this table
- (3) Deadline by which to initiate national phase in Australia if a PCT patent application is filed that claims priority from the provisional Australian patent application listed in this table

33. It is inconclusive at this stage whether a PCT application or Australian complete application claiming priority from the 103 Application or 979 Application in the table above was filed.
34. The 090 Application has a status of LAPSED as at 30 April 2024.
- (a) The Paris Convention Deadline lapsed on 20 October 2023.
- (b) The Element Zero PCT Application has an International Filing Date of 19 October 2023.
- (c) The Element Zero PCT Application claims priority from the 090 Application.
35. The 103 Application has a status of FILED as at 30 April 2024.
- (a) There is a Paris Convention Deadline of 30 June 2024 to validly file a convention application that claims priority from the 103 Application.
- (b) From my search conducted on 30 April 2024, I was not able to find any record of a filed PCT application or Australian complete application claiming priority from the 103 Application. The lack of a record does not necessarily mean that a Paris Convention application claiming priority from the 103 Application has not already been filed or will not be filed on or before 30 June 2024.
36. The 979 Application has a status of FILED as at 30 April 2024.
- (a) There is a Paris Convention Deadline of 8 December 2024 to validly file a convention application that claims priority from the 979 Application.
- (b) From my search conducted on 30 April 2024, I was not able to find any record of a filed PCT application or Australian complete application claiming priority from the 979 Application. The lack of a record does not necessarily mean that a Paris Convention application claiming priority from the 979 Application has not already been filed or will not be filed on or before 8 December 2024.

E. Risk of disclosure of Fortescue's confidential information

37. As discussed above at **Part B**, Australian law imposes certain disclosure requirements on patent applicants filing either provisional or complete specifications.
38. Due to the publication of the Element Zero PCT Application, the specification of the 090 Application has been published. Following publication, any member of the public is now



Suzanne M. Hartes

entitled to inspect the specification of the 090 Application (for example by using The World Intellectual Property Organization's Patentscope portal).

39. I am informed by Adrian Huber, Fortescue Senior Legal Counsel, that Fortescue is concerned that the Element Zero PCT Application (and therefore the specification of the 090 Application) may contain Fortescue's confidential information. If that is correct, then as a result of the publication of the specification of the 090 Application, any of Fortescue's confidential information contained in that specification has now been made available to the public.
40. Similarly, if any of Fortescue's confidential information is contained in the specification of the 103 Application or the 979 Application, then that confidential information will be made publicly available:
- (a) on or after 30 December 2024, once the convention patent application claiming priority from the 103 Application is published; or
 - (b) on or after 8 June 2024 once the convention patent application claiming priority from the 979 Application is published.

F. My analysis of the Element Zero PCT Application

41. The Element Zero PCT Application discloses a process for extracting a metal from a metal containing ore.
42. At paragraph [0027], it is stated that the metal can be iron, nickel, aluminium, gold, manganese, lead, zinc, cobalt, uranium, copper, or silver.
43. Under the disclosed process, the metal containing ore is dissolved at a temperature of between 160-400°C, preferably 200-300°C, more preferably 250°C to 350°C in a eutectic mixture of two metal bases, sodium hydroxide (NaOH) and potassium hydroxide (KOH), to form a chemical solution (see paragraphs [0035] to [0037]).
44. This chemical solution can then be fed to a beneficiation process such as an extractive metallurgical process to remove the metal from the solution (see paragraph [0042]).
45. Paragraph [0008] explains that extractive metallurgy techniques include hydrometallurgy, pyrometallurgy, ionometallurgy and electrometallurgy.
46. Paragraph [0012] defines ionometallurgy as using ionic liquid or eutectic melts to extract and or convert metals and minerals.
47. Paragraphs [0102]-[0105] in Example 8 (which was not disclosed in the priority document, the 090 Application), describes a two-step process.
48. In step 1, iron ore, having silica and aluminium impurities is dissolved in a mixture containing sodium hydroxide and a thickener and heated to 370 °C to form two fractions.

Suzanne M. Hartos

The first fraction contains the iron oxide of the iron ore while the second fraction contains the impurities. The first fraction is referred to as an iron rich intermediate in paragraph [0102].

49. In step 2, a mixture of sodium hydroxide (NaOH) and potassium hydroxide (KOH) is melted at a temperature between 220°C to 310°C to form a eutectic melt to which is added the iron rich intermediate. The iron rich intermediate dissolves in the eutectic melt to form a chemical solution. Electrical current is passed through the chemical solution to separate iron from iron oxide and the resulting iron is deposited on an electrode thereby physically separating the iron from the remaining solution. This process is known as electrodeposition.

G. My review of Dr Kolodziejczyk's emails

50. From 15 to 24 April 2024, I undertook a searching and review process of Dr Kolodziejczyk's Outlook account, bkolodziejcz@fmgl.com.au, under the instruction of DCCL. I was instructed to find emails relevant to an electrochemical reduction process that utilises an ionic liquid electrolyte and is operated at low temperature.
51. To the best of my calculation, the total amount of emails, calendar invites, deleted emails, deleted calendar invites and other miscellaneous outlook documents on the Fortescue IT system that are related to Dr Kolodziejczyk's Outlook account, bkolodziejcz@fmgl.com.au is approximately 47,000. These documents are stored on the Fortescue IT system in folders labelled as "Recoverable Items" (which includes a subcategory called "Purges"), "sent" and "inbox" and cover the date range of 25 March 2019 to 30 July 2022. Approximately 8,000 out of the total of 47,000 items are stored in the Purges subfolder.
52. I have been informed by a Fortescue IT staff member named Paul Waldin on 22 April 2024 that the Purges subfolder works as follows:
- (a) after an e-mail is deleted it goes into Deleted Items.
 - (b) when the Deleted Items folder is emptied (either by the user of the Outlook account or automatically by the system), the deleted email will be inaccessible from the user's e-mail box (that is, it will be "purged"), but recoverable using the processes employed by the Fortescue IT team. Once it is recovered, that email will appear in the Purges subfolder.
53. Additionally, based on my review, I observed that once an email is drafted and left as a draft for a pre-determined period of time, the system automatically saved a draft copy. Then, when Dr Kolodziejczyk sent the email, the draft copy was either purged by him or by the system.



Susanne M. Hantke

54. During the period 15 to 24 April 2024, I undertook three separate reviews in relation to Dr Kolodziejczyk's Fortescue email account. The details of each review is set out in sections G.1, G.2, and G.3 below. I estimate that I spent, cumulatively, in excess of 40 hours on these reviews.
55. Following these reviews, I located the emails on the following dates that were of interest in Dr Kolodziejczyk's Fortescue email account. I have provided a summary of the content of those emails in the third column below. Copies of these emails are annexed in the bundle marked **Annexure SMH-3**.

No	Email date	Summary of email
1	5 Aug 2020	Dr Kolodziejczyk requests an introductory call with ██████████ stating that Fortescue are exploring "various low-emission technologies".
2	21 Sep 2020	Dr Kolodziejczyk receives a standard non-disclosure agreement from ██████████ to begin discussions between ██████████ and Fortescue.
3	22 Sep 2020	Dr Kolodziejczyk requests Tamahra Dempsey, legal counsel at Fortescue, to send a non-compete NDA [non-disclosure agreement] to ██████████ for the purpose of discussions on, among other things, "low-temperature oxide (predominantly iron ore) reduction technology" and ██████████
4	13 Oct 2020	Dr Kolodziejczyk sends an executed NDA to ██████████ and ██████████
5	21 Oct 2020	Dr Kolodziejczyk promises to prepare and send to ██████████ a "quick overview of preliminary work that we have done in ionic liquids and low temperature iron ore reduction".
6	6 Dec 2020	Dr Kolodziejczyk tells Andrew Forrest, the former CEO of Fortescue Metals Group (FMG), that he will be setting up a testing facility in Perth that will convert iron ore to iron using "low-temperature processing from ionic liquids".
7	15 Dec 2020	Dr Kolodziejczyk tells Michael Masterman and Andrew Forrest that iron ore will be converted to iron "at low temperature using ionic liquids as iron ore solvents".
8	22 Dec 2020	<p>Dr Kolodziejczyk tells Andrew Forrest and Michael Masterman that "[w]e need to have working electrolysers and low-temperature electrochemical iron ore processing plants. Testing in Pilbara to commence in late 2021". At Mr Forrest's request, he accepts an earlier deadline "By May we will definitely have a good idea and working prototype in our Perth facility".</p> <p>Dr Kolodziejczyk also tells Mr Forrest and Mr Masterman that he is working on a patent application for "our low temperature electrochemical ores reduction in ionic liquid electrolytes", and that the patent application is based on his "initial work done a couple of years ago".</p>
9	22 Dec 2020	<p>Dr Kolodziejczyk sends a patent assessment form regarding "low-temperature electrochemical ores reduction in ionic liquids" to Robert Grant, who I understand from the form was his manager, stating that "The technology is proven. [He has] developed this method and tested in a small scale laboratory setting".</p> <p>The form states: as to the status of the invention (p 1), "The concept has been tested in a laboratory setting and is intended to be scaled up to a commercial system in 2021"; as to the objective of patenting the invention (p 2), "The objective</p>

 Susane M. Hartes

No	Email date	Summary of email
		<i>is to protect the initial invention and enable further scale-up and commercial deployment in Pilbara and elsewhere"; and as to whether the invention has been publicly disclosed (p 3), "No, invention has not been publicly disclosed. All information related to this invention is kept internally within Fortescue Future Industries".</i>
10	23 Dec 2020	Dr Kolodziejczyk tells Julie Shuttleworth, the former CEO of Fortescue Future Industries (FFI), that the development of two green steel technologies are being proposed: "low-temperature electrochemical ore reduction in ionic liquids"; and "electrolysis of iron ore in molten carbides."
11	6 Jan 2021	Dr Kolodziejczyk explains to Michael Masterman that he is looking at "using solvents capable of dissolving iron ore at low temperatures <300 deg C and/or using molten carbonate electrolyte".
12	6 Jan 2021	Dr Kolodziejczyk explains to Shanta Barley of Munderoo Foundation that "We are working internally at Fortescue on alternative processes that would utilise lower temperatures and direct electrochemical reduction of iron ore into iron and further steel. The electrochemical reduction is done in a liquid phase. Hence iron ore has to be dissolved in the electrolyte prior to being electrolysed. High temperature helps iron ore dissolution but poses certain technical challenges, especially when running the intermittent power supply process. With the intermittency of wind and solar energy supply, it becomes challenging to maintain the high temperature of the process. We are working to overcome this issue."
13	22 Jan 2021	Dr Kolodziejczyk states to Ashlee Crabbe, media and corporate affairs employee at Fortescue, in response to an enquiry by AFR about Mr Forrest's Boyer Lecture, that Fortescue is developing a process that will apply renewable energy to electrochemically reduce iron ore "dissolved in a unique electrolyte" and that the "selection of electrolyte, electrode material, and other materials used in the process is [...] Fortescue's trade secret".
14	22 Jan 2021	Dr Kolodziejczyk sends a draft Board paper, file name "7.3 Green Steel_v1 (BK).docx" to Michael Masterman. Page 3 of draft Board paper states, "The Fortescue team has done an initial evaluation of various suitable electrolytes [viz., suitable to dissolve iron ore at significantly lower temperatures]. Further laboratory desktop studies will be undertaken at FFI's manufacturing precinct in February/March 2021. The R&D roadmap is currently being developed with the intention to trial this technology in Pilbara in 2021".
15	27 Jan 2021 5:29pm	Dr Kolodziejczyk states that "using molten carbonate or ionic liquids" are potential future options.
16	27 Jan 2021 5:42pm	Dr Kolodziejczyk states to Dr Winther-Jensen that he "looked at water, ionic liquids and molten carbonate" as options for the electrolyte.
17	23 Feb 2021	Dr Winther-Jensen sends to Dr Kolodziejczyk a draft research plan that states (at pp 7-8) that he has not found any "convincing reports" that ionic liquids can dissolve iron ore, and suggests considering Professor Haarberg's work on molten salt and molten carbonate systems.
18	24 February 2021	Dr Winther-Jensen informs Dr Kolodziejczyk that he "cannot commit" to producing "solid iron samples made by electrochemical reduction of FMG iron ore [...] by the end of June 2021".

56. As a result of the extensive searching I describe below, I have located no other documents contained in Dr Kolodziejczyk's Outlook relating to an electrochemical

Susanne M. Hartes

reduction process that utilises an ionic liquid electrolyte and is operated at low temperature work, during the period 25 March 2019 to 5 November 2021.

G.1 First Review

57. I initially reviewed 3075 items (including attachments) from Dr Kolodziejczyk's Fortescue Purges subfolder. The 3075 items comprised emails, deleted emails and deleted calendar invitations between the date range of 26 March 2019 and 5 November 2021. I am informed that Dr Kolodziejczyk's employment with Fortescue concluded on 5 November 2021.
58. I manually considered the subject title of each of the 3075 items. If I considered the subject title of an item to be relevant, I then opened it and reviewed it (as well as any attachments).
59. Following this initial review, I identified twelve (12) emails as relevant to an electrochemical reduction process that utilises an ionic liquid electrolyte and is operated at low temperature.
60. Those emails of interest are listed as documents 5 to 11, 13 and 15-18 in the above table, and cover the three month period from 21 October 2020 to 24 January 2021. I am informed that Dr Kolodziejczyk commenced employment with Fortescue on 25 March 2019.

G.2 Second Review

61. From the emails located in my First Review, it is apparent that during at least the period of 21 October 2020 to 24 January 2021 Dr Kolodziejczyk was developing an electrochemical reduction process that utilises:
 - (a) an ionic liquid electrolyte that is capable of dissolving iron ore at low temperatures (<300°C); and/or
 - (b) a molten carbonate electrolyte, which would allow the dissolution of iron ore at temperatures ranging between 700 and 800°C.
62. To search for further emails relating to one of these two processes, I searched for the phrase "ionic liquids" or "molten carbonate" across the remaining approximately 43,000 items in Dr Kolodziejczyk's Fortescue inbox and sent folders. In addition to the emails numbered as 5 to 11, 13 and 15-18, the emails numbered as 12 and 14 in the above table were identified by these keyword searches.
63. I have not been able to locate any other emails that mention "ionic liquids" or "molten carbonate".



Susan M. Hartes

G.3 Third Review

- 64. Finally, I undertook a further search in relation to the interaction between Dr Kolodziejczyk and [REDACTED] [REDACTED] which search uncovered the emails numbered 1 to 5, in the above table.
- 65. In respect of the email numbered as 5 above, Dr Kolodziejczyk stated that he would draft and send "a quick overview of preliminary work that we have done in ionic liquids and low temperature iron ore reduction". Upon reading this, I conducted additional searches for such an 'overview', and did not find any subsequent document or email.


H. My review of the Sharepoint Folder with Dr Anand Bhatt

- 66. I am informed by Mr Huber that Dr Winther-Jensen and Dr Kolodziejczyk were members of the 'Green Iron' team while employed at Fortescue.
- 67. On or around 8 April 2024, I worked with Dr Anand Bhatt (an Electrochemist and Materials Scientist at Fortescue) to undertake searches of an archived SharePoint site used by the Fortescue 'Green Iron' team to identify documents in the SharePoint folder relevant to the development of a pilot plant using direct electrochemical reduction. This involved preparing a list of search terms on or around 8 April 2024, and conducting searches of the SharePoint site on 9 to 12 April 2024.
- 68. I have been provided with a near final draft of Part H of Dr Bhatt's affidavit sworn 1 May 2024 in which he describes the search of the Sharepoint site, and I agree that it is an accurate description of the search undertaken.

Affirmed by Susanne Monica Hantos)
 at Balcatta)
 in Western Australia)
 on 1 May 2024)
 Before me:)



Signature of Susanne Monica Hantos



Signature of witness

Olivia Campana
 An Australian legal practitioner within the
 meaning of the Legal Profession Uniform Law (WA)

No. NSD of 2024

Federal Court of Australia
District Registry: New South Wales
Division: General

FORTESCUE LIMITED (ACN 002 594 872) and others

Applicants

ELEMENT ZERO PTY LIMITED (ACN 664 342 081) and others

Respondents

ANNEXURE SMH-1

This is the annexure marked **SMH-1** produced and shown to **SUSANNE MONICA HANTOS** at the time of affirming her affidavit on 1 May 2024.

Before me:


Olivia Campana

Susanne M. Hantos

Ground floor, 6 Bennett Street,
East Perth, WA 6004

EDUCATION & QUALIFICATIONS

2020-Present	Qualified Patent Information Professional (Registration No. 20200061100289)
2007-Present	Registered Trans-Tasman Patent and Trade Marks Attorney
2006-2007	Master of Industrial Property, MIP •University of Technology, Sydney, NSW Australia.
2004-Present	Licensed Canadian Patent Agent (License No. P11344)
1999-2001	Master of Library and Information Science, MLIS •University of Western Ontario, London, Ontario, Canada.
1996-1998	Master of Science, M.Sc. (Organic Chemistry) •University of Ottawa, Ottawa, Ontario, Canada.
1991-1996	Bachelor of Science, B.Sc. (Honours Applied Chemistry) •University of Guelph, Guelph, Ontario, Canada.

AWARDS

Chemistry: Canada Scholar, Natural Science and Engineering Council (NSERC) Industrial Undergraduate Student Research Awards, Analytical Biochemistry Prize, Honours Applied Chemistry Award, Chemical Institute of Canada Silver Medal, Society of Chemical Industries Prize in Applied Chemistry, NSERC Postgraduate Scholarships and the University of Ottawa Excellence Scholarship.

Library & Information Science: Laura Colvin Cataloguing Prize, Ontario Graduate Scholarship, Elizabeth Dafoe Scholarship (Canadian Library Association), Lucille Wert Chemical Information Award (American Chemical Society) and the Imperial Order of the Daughters of the Empire Fellowship in Library Science.

PROFESSIONAL EXPERIENCE

2021-Present	<p><u>Technology Intelligence Counsel</u> Fortescue, Perth, Western Australia.</p> <ul style="list-style-type: none"> •Providing advice on patent validity, infringement and freedom to operate issues. •Reviewing invention disclosure statements and advising on patentability and the state of the technical art in mining and energy related innovation. •Conducting inventor interviews and preparing, reviewing and arranging the execution of patent assignments. •Preparing and maintaining IP Registers and monitoring IP developments including patenting activity of joint venture partners and competitors. •Completing intellectual property due diligence in support of potential IP portfolio acquisitions or licensing of technology. •Advising on the filing and prosecution of patent applications in Australia and overseas. •Supporting contentious intellectual property disputes. •Providing in-house intellectual property training.
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Susanne M. Hantos
page 2

PROFESSIONAL EXPERIENCE

- 2005-2021** **Senior Patent Counsel (2020-2021)/Manager, Patent Intelligence Services (2007-2021)** Davies Collison Cave, Sydney NSW Australia.
- Provided advice on patentability, validity, infringement, state-of-the-art and freedom to operate issues.
 - Managed the firm's internal and external patent search and patent alert related workflow including delegation of workload.
 - Prepared and prosecuted Australian, international Patent Cooperation Treaty (PCT) patent applications and foreign national patent applications.
 - Completed due diligence, competitive intelligence and IP audit reports.
 - Served as an expert witness in my capacity as a patent attorney and as a patent information professional before the Federal Court of Australia.
- 2003-2004** **Registered Canadian Patent Agent/Senior Intellectual Property Analyst**
May-Nov. Biovail Corporation, Mississauga, Ontario, Canada.
- Conducted searches, analyzed prior art and provided advice related to patentability, validity, infringement, state-of-the-art and freedom to operate issues.
 - Prepared and prosecuted CA, US, EP and PCT patent applications concerning chemical related inventions.
 - Conducted intellectual property due diligence in support of potential acquisitions or licensing of technology.
 - Monitored competitor patenting activities and presented the results to senior management as a weekly electronic bulletin.
- 2001-2003** **Canadian Patent Agent Trainee/Technical Consultant**
May-Apr. Bereskin & Parr Intellectual Property Law Firm, Toronto, Ontario, Canada
- Assisted in the preparation and prosecution of CA, US, EP and PCT patent applications.
 - Conducted prior art searches and assisted in the preparation of patentability, validity, infringement and freedom to operate opinions.
 - Consulted on technical matters related to patent impeachment and infringement legal proceedings.
- 2000-2001** **Knowledge Centre Assistant (Contract position during MLIS study)**
Sept-Apr. Labatt Brewing Company, London, Ontario, Canada
- Conducted literature searches and catalogued technical and brewing periodicals, books, manuals, and in-house documents.
- 2000** **Legal Researcher (Summer contract position during MLIS study)**
May-Aug. Bereskin & Parr Intellectual Property Law Firm, Toronto, Ontario, Canada
- Conducted legal research concerning Canadian and United States patent law and pharmaceutical litigation matters.

Susanne M. Hantos
page 3

INVITED SPEAKING ENGAGEMENTS & PEER REVIEWED PUBLICATIONS

- Hantos, S.M.** Who's responsible for inaccurate search results? Is it the source, the searcher or the stakeholder? *Patent Information Users Group Annual Conference*, Alexandria, Virginia, USA (7 May 2019) and also at the *Confederation of European Patent Information Users Group Conference*, Milan Italy, (10 September 2018).
- Hantos, S.M.** Patent Search Fundamentals seminar, *Davies Collison Cave*, Singapore (11 September 2017).
- Hantos, S.M.** What is necessary for a good freedom-to-operate search?, *European Patent Office Patent Information Conference*, Madrid, Spain (10 November 2016).
- Hantos, S.M.** Chemistry patent searching for determining freedom to operate, *State Intellectual Property Office of China 7th Patent Information Annual Conference* Beijing, China (20 September 2016).
- Hantos, S.M.** Using patent information to help you in your research, *University of Technology*, Sydney, New South Wales, Australia (28 April 2016).
- Hantos, S.M.** Current developments in the future certification of patent information professionals, *Patent Information Users Group Annual Conference*, Chicago, Illinois, USA (5 May 2015).
- Hantos, S.M.** Editorial: Will the English language become the officially recognized lingua franca of the global patent industry? *World Patent Information* 2015, 40: 1.
- Hantos, S.M.** Communicating patent information to the Board of Directors, *European Patent Office Patent Information Conference*, Warsaw, Poland (6 November 2014).
- Hantos, S.M.** An elusive pursuit: the odyssey of tracking patent ownership, *European Patent Office Patent Information Conference*, Warsaw, Poland (5 November 2014).
- Hantos, S.M.** Do you have the freedom to operate? *Manufacturer's Monthly* (November 2014).
- Hantos, S.M.** Using patent information to help direct R&D strategy, *University of Technology*, Sydney, New South Wales, Australia (3 June 2014).
- Hantos, S.M.** Reaching the golden age of legal patent status information to facilitate better business decisions, *European Patent Office Patent Information Conference*, Keynote Speaker, Bologna, Italy (22 October 2013).
- Hantos, S.M.** IP due diligence for business development managers, *Deakin University*, Geelong, Victoria, Australia (27 July 2012).
- Hantos, S.M.** One step closer towards a certification scheme for the patent information professional, *Patent Information User Group Annual Conference*, Denver, Colorado, USA (2 May 2012).
- Hantos, S.M.** A proposed framework for the certification of the patent information professional, *World Patent Information* 2011, 33: 352.
- Hantos, S.M.** Keeping the lights on: how open innovation will provide the first step towards enduring energy solutions, *Australian Solar Energy Society Conference*, Sydney, New South Wales, Australia (1 December 2011).

Susanne M. Hantos
page 4

INVITED SPEAKING ENGAGEMENTS & PEER REVIEWED PUBLICATIONS (continued)

- Hantos, S.M.** Making the best use of time when searching non-commercial patent databases, *TECH IP Seminar*, Melbourne, Victoria, Australia, (22 August **2011**).
- Hantos, S.M.** Helping others acquire, license or invest in patents with confidence- A guide for patent searchers to patent due diligence, *World Patent Information* **2010**, 32:188.
- Hantos, S.M.** Freedom to operate searching issues relevant to universities, *TECH IP Seminar*, Melbourne, Victoria, Australia, (22 November **2010**).
- Hantos, S.M.** International certification scheme for patent information professionals, *Patent Information User Group Newsletter*, March **2010**.
- Hantos, S.M.** Patent due diligence searching for biotechs: why, when and how, *BioMelbourne Network Workshop*, Melbourne, Victoria, Australia, (9 June **2009**).
- Hantos, S.M.** PIUG update on patent searcher certification initiative, *Patent Information User Group Annual Conference*, Baltimore, Maryland, USA (via video-link) (2 May **2009**).
- Hantos, S.M.** Freedom to operate searching: issues for clients and practitioners, *TECH IP Seminar*, Melbourne, Victoria, Australia, (25 June **2008**).
- Hantos, S.M.** A patent attorney's perspective on patent due diligence, *Patent Information User Group Annual Conference*, Washington DC., USA, (21 May **2008**).
- Hantos, S.M.** Mastering intellectual property competitive intelligence, *Canadian Pharmaceutical Patents Conference*, Toronto, Ontario, Canada, (15-17 October **2003**).
- Hantos, S.M.** Looking for Chemical Patents on the Internet for Free? *Canadian Chemical News* **2002**, 54(5): 22.

PROFESSIONAL ASSOCIATIONS & EXTRACURRICULAR ACHIEVEMENTS

- **Council Member** of International Federation of Intellectual Property Attorneys (FICPI)-Australia Association (May **2020-2021**);
- **FICPI CET5 Member** of FICPI International (April **2019-2021**);
- **Member** of the FICPI Australia (July **2018- 2021**);
- **Vice Chair and Co-founder** of the International Standards Board for Qualified Patent Information Professionals, The Netherlands (**2018- present**)
- **Editorial Advisory Board Member** for *World Patent Information* -a peer-reviewed journal published by Elsevier (**2016- present**);
- **Co-Editor-in-Chief**, *World Patent Information* (**2014-2016**);
- **Immediate Past President** of the Patent Information Users Group Inc. (PIUG), the International Society for Patent Information (**2014-2016**);
- **President** of the Patent Information Users Group Inc. (PIUG), the International Society for Patent Information (**2012-2014**);

Susanne M. Hantos
page 5

PROFESSIONAL ASSOCIATIONS & EXTRACURRICULAR ACHIEVEMENTS

- **Chair** of the PIUG Patent Information Professional Certification Committee (2008-2020);
- **Coordinator and drafts person** of the Patent Information Professional Certification Exams for chemistry (a joint initiative of the Patent Documentation Group and the Confederacy of European Patent Information User Groups (2008-2018);
- **Recipient of the PIUG 2016 Board Appreciation Award** in recognition of my service as the President and Immediate Past President of the Patent Information Users Group Inc. (PIUG), 2012- 2016;
- **Peer review referee** for *World Patent Information* (2009-present);
- **Recipient of the PIUG 2011 Volunteer Service Award** in recognition of my service as the Education and Training Task Force - Certification Working Group Chair, 2008-2011;
- **Associate Member** of the Australian Library and Information Association (2008-2021);
- **Member** of the Special Libraries Association (2001-2021);
- **Fellow** of the Institute of Patent and Trademark Attorneys of Australia (member from 2007- present);
- **Member** of the Intellectual Property Society of Australia and New Zealand (2005-present);
- **Member** of the International Association for the Protection of Intellectual Property (AIPPI) (2011-2021);
- **Associate Member** of the Intellectual Property Institute of Canada (member from 2001-2021);
- **Chartered Chemist Member** of the Royal Australian Chemical Institute (from 2008-2021); and
- **Member** of the American Chemical Society (from 2001-present).

Federal Court of Australia
District Registry: New South Wales
Division: General

FORTESCUE LIMITED (ACN 002 594 872) and others

Applicants

ELEMENT ZERO PTY LIMITED (ACN 664 342 081) and others

Respondents

ANNEXURE SMH-2

This is the annexure marked **SMH-2** produced and shown to **SUSANNE MONICA HANTOS** at the time of affirming her affidavit on 1 May 2024.

Before me:


Olivia Campana

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Application Details

2021901547

: *Apparatus and process for producing iron*

BIBLIOGRAPHIC DATA

Application details

Australian application number	2021901547	Patent application type	Provisional
Application status	LAPSED		
Currently under opposition	No	Proceeding type(s)	
Invention title	Apparatus and process for producing iron		
Inventor(s)	Not Given		
Agent name	Davies Collison Cave Pty Ltd	Address for legal service	VIC 3000 Australia show full address
Filing date	2021-05-24		
Associated completes	2021215184		

Applicant details

Applicant	Fortescue Future Industries Pty Ltd	Applicant address	WA 6004 Australia
Old name(s)			

EDOSSIER

The case file for this application is not available in AusPat

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LIFECYCLE DETAILS

Extension of time

Status	Type
From date	To date
Application filing date	Application published date
Allowance date	Allowance published date

Conversion details

Date converted			
From application number		Application type	
To application number		Application type	Application status

FEE/PUBLICATION HISTORY

Publication history

Vol/Iss	Publication date	Publication action	Reason	Document kind
35/23	2021-06-10	Provisional Applications Filed		

OWNERSHIP DETAILS

Change of ownership

New name		Old name	
Date of request		Date of allowance of name change	
Date published		Reason	

OPPOSITIONS, DISPUTES & AMENDMENTS

Voluntary amendments

Status	Request date	Request published date
Allowance date	Allowance published date	

Current Oppositions and Disputes

Completed Oppositions and Disputes

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Application Details

2021215184

: *Apparatus and process for producing iron*

BIBLIOGRAPHIC DATA

Application details

Australian application number	2021215184	Patent application type	Standard	Serial number	
Application status	FILED	Paid to date	2025-08-11	First IPC Mark	C25C 1/06 (2021.01)
Currently under opposition	No	Proceeding type(s)			
Invention title	Apparatus and process for producing iron				
Inventor(s)	KOLODZIEJCZYK, Bartlomiej Piotr ; WINTHER-JENSEN, Bjorn				
Agent name	Davies Collison Cave Pty Ltd	Address for legal service	VIC 3000 Australia	show full address	
Filing date	2021-08-11	Australian OPI date	2022-12-08	OPI published in journal	2022-12-08
Effective date of patent	2021-08-11	Expiry date	2041-08-11	PSO Completed date	
Additional/Divisional application number		Additional/Divisional relationship			

Applicant details

Applicant	FORTESCUE FUTURE INDUSTRIES PTY LTD	Applicant address	WA 6004 Australia
Old name(s)			

IPC details

Int Cl.	Version	First Mark
C25C	1/06 (2021.01)	Y
C25C	7/06 (2021.01)	N
C22B	5/00 (2021.01)	N

PCT details

PCT number		WIPO number	
National phase entry date		WIPO publication date	

Priority details

Earliest priority date	2021-05-24	Filing date		Priority date	
Type	Number				

Associated Provisional	AU2021901547	2021-05-24
------------------------	--------------	------------

Associated provisional(s)

Provisional number	Title	Filing date
2021901547	Apparatus and process for producing iron	2021-05-24

SPECIFICATION/E-REGISTER

History of Published Specifications: Download Specification(AU-A1)

Explanation of Specification Codes

An extract from the Register of Patents is not available for this application.

EDOSSIER

Document Date	Document Title	Document Type	Document Status	File Size (KB)
2022-11-25	Abstract OPI.pdf	ABSTRACT	FILED	95
2021-09-21	Application Complies with Formalities 21-09-2021	CORRO OUT	FILED	120
2021-09-20	Cover Sheet Formalities Response 20-09-2021 AMCZ-2110461739	OTHER	FILED	5
2021-09-20	Formalities Response 20-09-2021 AMCZ-2110461739	OTHER	FILED	129
2021-08-16	Formalities Report 16-08-2021	CORRO OUT	FILED	134
2021-08-16	Standard Patent Application Filing Receipt 16-08-2021	CORRO OUT	FILED	157
2021-08-11	Abstract 11-08-2021 AMCZ-2110351834	ABSTRACT	FILED	26
2021-08-11	Claim 11-08-2021 AMCZ-2110351834	CLAIM	FILED	137
2021-08-11	Cover Sheet App Std 11-08-2021 AMCZ-2110351834	OTHER	FILED	5
2021-08-11	Description 11-08-2021 AMCZ-2110351834	DESCRIPTION	FILED	688
2021-08-11	Drawing 11-08-2021 AMCZ-2110351834	DRAWING	FILED	302
2021-08-11	Patent Request 11-08-2021 AMCZ-2110351834	PATENT REQUEST	FILED	5

LIFECYCLE DETAILS

Early termination details

Status Reason	Date applied	Published date
---------------	--------------	----------------

Exam details

Prior art documents			
Direction date		Deferment date	
Exam request filing date		Request type	Exam request status
First report date		Examination section	Further report date
Acceptance postponed	No		

Acceptance details

Acceptance postponed	No	Final acceptance date	
Acceptance date		Acceptance published date	Amendments considered up to item no.

Granting details

Deferment of granting	Granting date	Granted published date
------------------------------	----------------------	-------------------------------

Extension of term

Status	Final expiry date
Therapeutic goods approval date	Pharmaceutical name
Application filing date	Request published date
Acceptance date	Acceptance Published Date
Refusal date	Refusal published date
Withdrawal of application date	Withdrawal of application published date
Granted date	Granting published date

Extension of time

Status	Type
From date	To date
Application filing date	Application published date
Allowance date	Allowance published date

Conversion details

Date converted			
From application number	Application type		
To application number	Application type	Application status	

Restoration details

Status	Application filed date	Application published date
Restoration date	Restoration published date	

FEE/PUBLICATION HISTORY

Continuation/Renewal fee history

Date paid	Paid to date	2025-08-11	Next fee due	4	Fee Table
Last agency address					

Publication history

Vol/Iss	Publication date	Publication action	Reason	Document kind
36/49	2022-12-08	Applications OPI		AU-A1
35/34	2021-08-26	Complete Applications Filed		

OWNERSHIP DETAILS

Change of ownership

New name	Old name
Date of request	Date of allowance of name change
Date published	Reason

Licence details

Licence status	Type of licence	Term of licence
Licensee(s)		

Mortgage details

Mortgage status	Mortgagee(s)
-----------------	--------------

OPPOSITIONS, DISPUTES & AMENDMENTS

Voluntary amendments

Status	Request date	Request published date
Allowance date	Allowance published date	

Current Oppositions and Disputes

--

Completed Oppositions and Disputes

--

Re-examination

--

Court ordered amendments

Court order date	Court name and order number
------------------	-----------------------------

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This data is current as of **2024-04-30 18:00 AEST**.

No. NSD of 2024

Federal Court of Australia
District Registry: New South Wales
Division: General

FORTESCUE LIMITED (ACN 002 594 872) and others

Applicants

ELEMENT ZERO PTY LIMITED (ACN 664 342 081) and others

Respondents

ANNEXURE SMH-3

This is the annexure marked **SMH-3** produced and shown to **SUSANNE MONICA HANTOS** at the time of affirming her affidavit on 1 May 2024.

Before me:


Olivia Campana

Susanne Hantos

From: Bart Kolodziejczyk
Sent: Wednesday, 5 August 2020 3:58 PM
To: [REDACTED]
Subject: [REDACTED]

Dear [REDACTED],

By way of introduction, Fortescue Metals Group Ltd (Fortescue) is a global leader in the iron ore industry, recognised for our culture, innovation, and industry-leading development of world-class infrastructure and mining assets in the Pilbara, Western Australia.

Fortescue is one of the largest global iron ore producers and is focussed on a vision of being the safest, lowest cost, most profitable mining company. Consistently shipping around 170 million tonnes of iron ore per annum, Fortescue is the lowest cost provider of seaborne iron ore to China with revenues last year reaching US\$10.0 billion and a net profit of US\$3.2 billion.

In addition to growing our iron ore business, Fortescue is diversifying domestically and internationally into other mineral resources. As part of our commitment to decarbonise our operations, we are exploring various low-emission technologies.

I came across your project titled [REDACTED].
Would you have time for an introductory call to briefly discuss this project and its current TRL? I am available next week if this suits you.

Best regards,

Bart Kolodziejczyk
Fortescue Metals Group Ltd
Level 2, 87 Adelaide Terrace East Perth WA 6004

Mobile: +61 437 947 164 **Web:** www.fmgl.com.au
Twitter: @FortescueNews | www.fmgl.com.au



Susanne Hantos

From: [REDACTED]
Sent: Monday, 21 September 2020 11:50 PM
To: Bart Kolodziejczyk
Cc: [REDACTED]
Subject: [REDACTED]
Attachments: [REDACTED]

Hi Bart,

We received a request for an NDA to begin discussions between [REDACTED] and Fortescue Metals. Please find our standard NDA attached for your review. If you have any questions or edits, please direct them to my attention for review.

We look forward to engaging with you and your colleagues.

Thanks,

[REDACTED]

[REDACTED]

Susanne Hantos

From: Bart Kolodziejczyk
Sent: Tuesday, 22 September 2020 8:28 PM
To: Tamahra Dempsey
Cc: Julie Shuttleworth; Emily Ward
Subject: [REDACTED]
Attachments: [REDACTED]

Hi Tamahra,

Under Chairman's request, I have approached a team at [REDACTED] to explore opportunities for [REDACTED] and low-temperature oxide (predominantly iron ore) reduction technology.

Can you please email Fortescue Non-Compete NDA to [REDACTED]? Having a non-compete NDA in place is of the highest importance to our Chairman.

The approved purpose for this NDA would be:

[REDACTED]

Thank you,
Bart

From: [REDACTED]
Sent: Monday, 21 September 2020 11:50 PM
To: Bart Kolodziejczyk <bkolodziejcz@fmgl.com.au>
Cc: [REDACTED]
Subject: [REDACTED]

Hi Bart,

We received a request for an NDA to begin discussions between [REDACTED] and Fortescue Metals. Please find our standard NDA attached for your review. If you have any questions or edits, please direct them to my attention for review.

We look forward to engaging with you and your colleagues.

Thanks,
[REDACTED]

[REDACTED]

This message and any attached documents contain information which may be confidential. These materials are only for the use of the intended recipient. Delivery of this message to any person other than the intended recipient shall not compromise or waive such confidentiality.

Susanne Hantos

From: Bart Kolodziejczyk
Sent: Tuesday, 13 October 2020 5:34 PM
To: [REDACTED]; Emily Ward
Cc: [REDACTED]
Subject: [REDACTED]
Attachments: [REDACTED]

Hi [REDACTED],

Please find attached executed NDA. Apologies again for delays.

[REDACTED], would you have time for another call this or next week to discuss project(s) scope?

Best regards,
Bart

From: [REDACTED]
Sent: Wednesday, 30 September 2020 2:38 AM
To: Emily Ward <eward@fmgl.com.au>
Cc: [REDACTED]; Bart Kolodziejczyk <bkolodziejcz@fmgl.com.au>
Subject: [REDACTED]

Hi Emily,

[REDACTED] executed NDA attached.

Thanks,
[REDACTED]

From: Emily Ward <eward@fmgl.com.au>
Sent: Sunday, September 27, 2020 10:00 AM
To: [REDACTED]
Cc: [REDACTED]; Bart Kolodziejczyk <bkolodziejcz@fmgl.com.au>
Subject: [REDACTED]

Hi [REDACTED],

I have attached an updated version of our Agreement.

I have been able to accept most changes as you will see. Where a change has not been accepted, I have simply rejected the mark-up.

I will explain to our team that all correspondence and discussions will need to be prefaced with a statement or note identifying whether the contents are confidential.

Does the University have a legal entity name?

Many thanks,

Emily.

From: [REDACTED]
Sent: Thursday, 24 September 2020 5:56 PM
To: Emily Ward <eward@fmgl.com.au>
Cc: [REDACTED]; Bart Kolodziejczyk <bkolodziejcz@fmgl.com.au>
Subject: [REDACTED]

Hi Emily,

Please find my requested edits in the attached.

Thanks,

[REDACTED]

[REDACTED]

From: Emily Ward <eward@fmgl.com.au>
Sent: Wednesday, September 23, 2020 4:43 AM
To: [REDACTED]
Cc: [REDACTED]; Bart Kolodziejczyk <bkolodziejcz@fmgl.com.au>
Subject: [REDACTED]

Dear [REDACTED],

Further to your discussions with my colleague Bart Kolodziejczyk, please find attached a Confidentiality Agreement for your review and signature.

If you have any questions, please do not hesitate to ask.

Many thanks,

Emily Ward
Legal Manager – International Operations
Fortescue Metals Group Limited
Level 2, 87 Adelaide Terrace
East Perth WA 6004

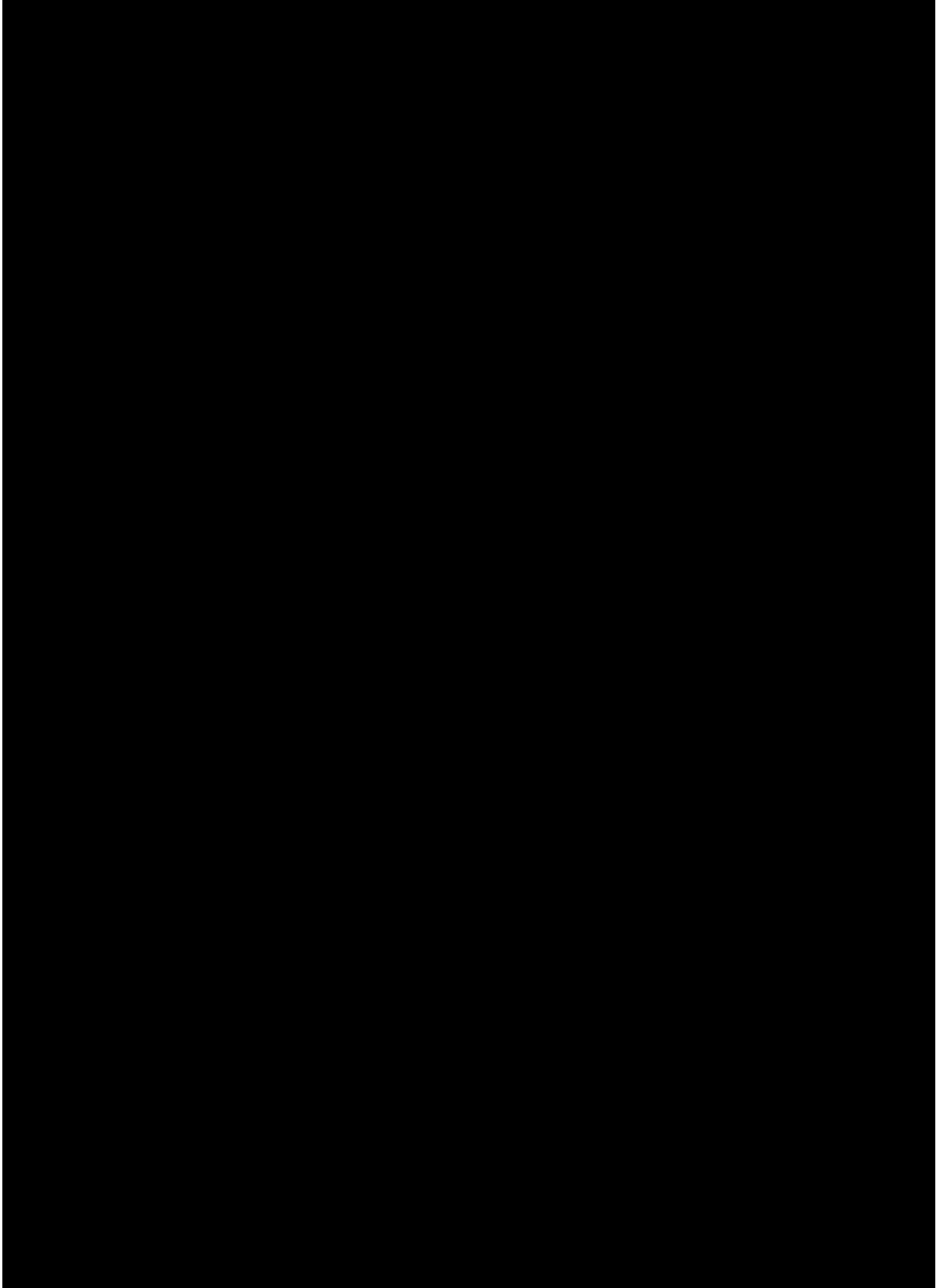
Direct: +61 8 6218 8 [REDACTED]
Mobile: +61 40 277 6 [REDACTED]

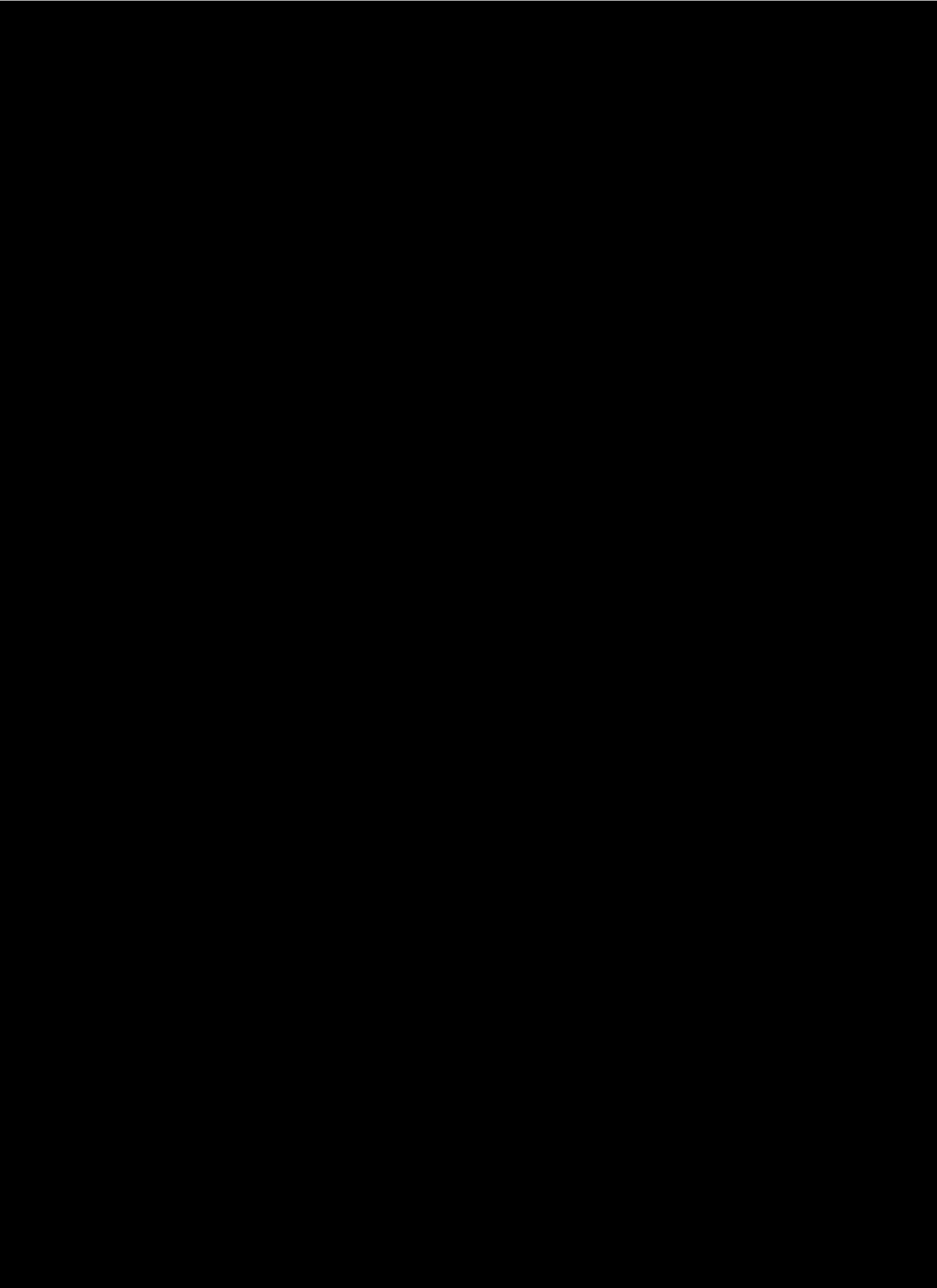
Main: +61 8 6218 8888

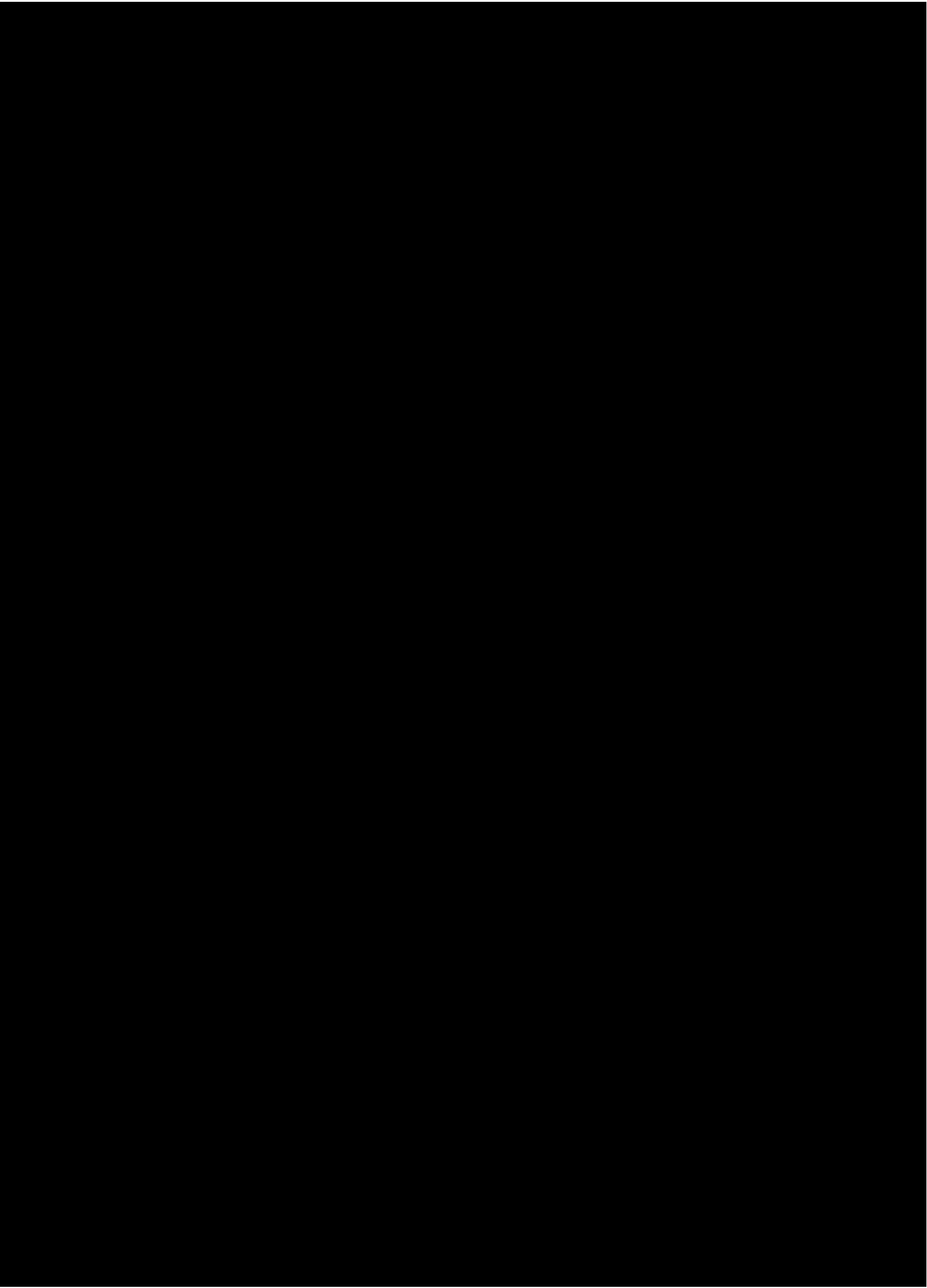
Email: eward@fmgl.com.au

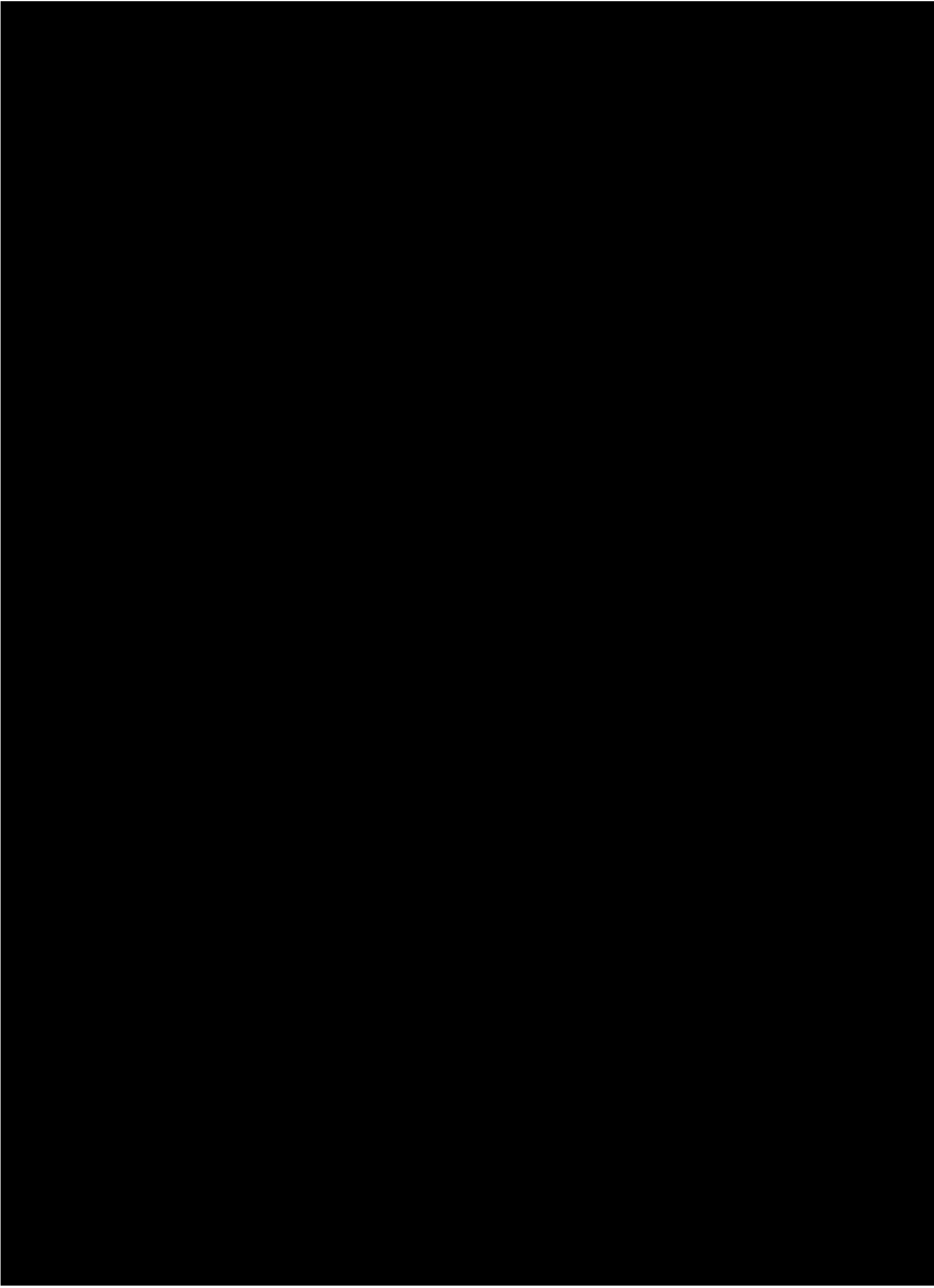


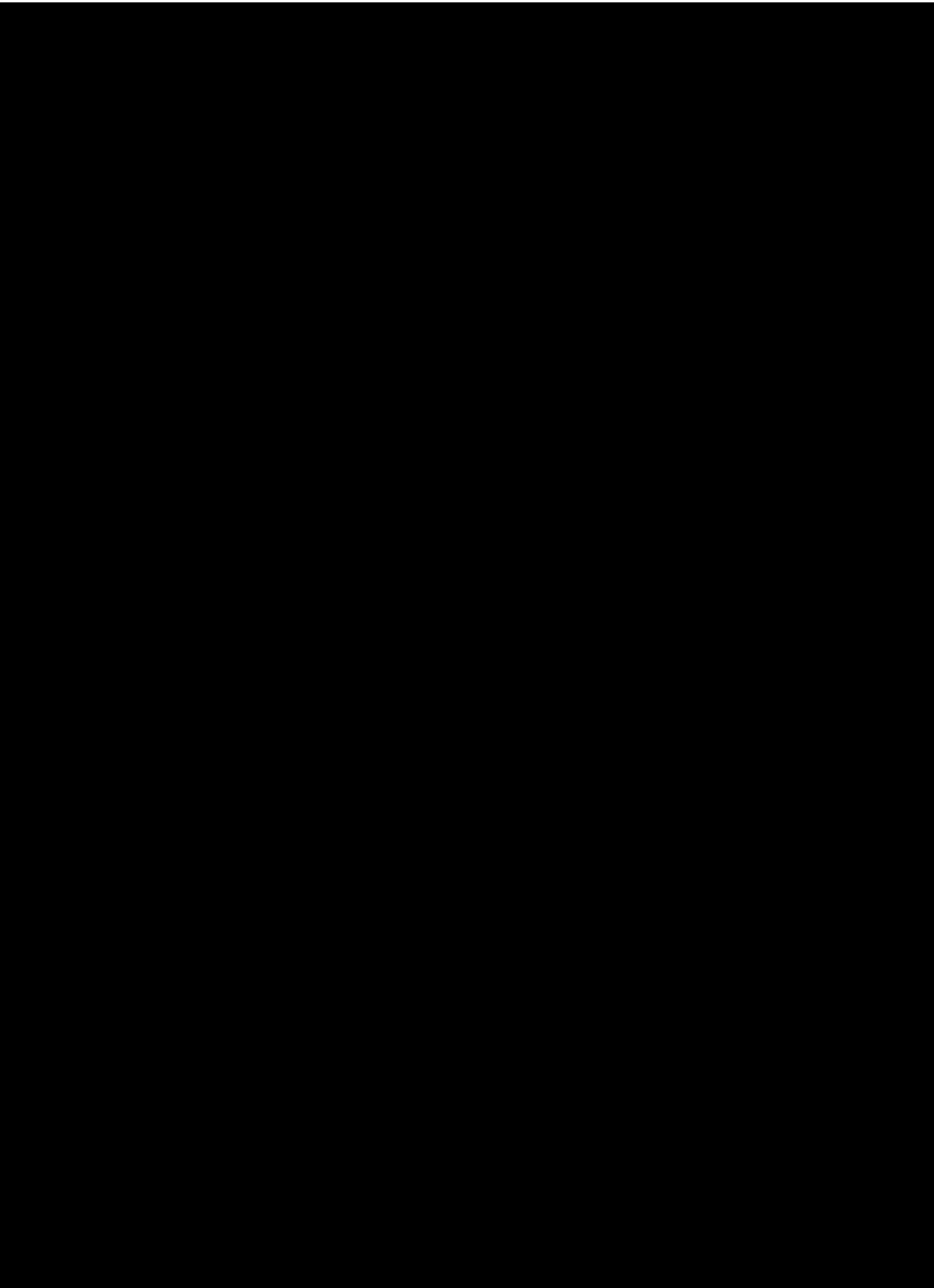
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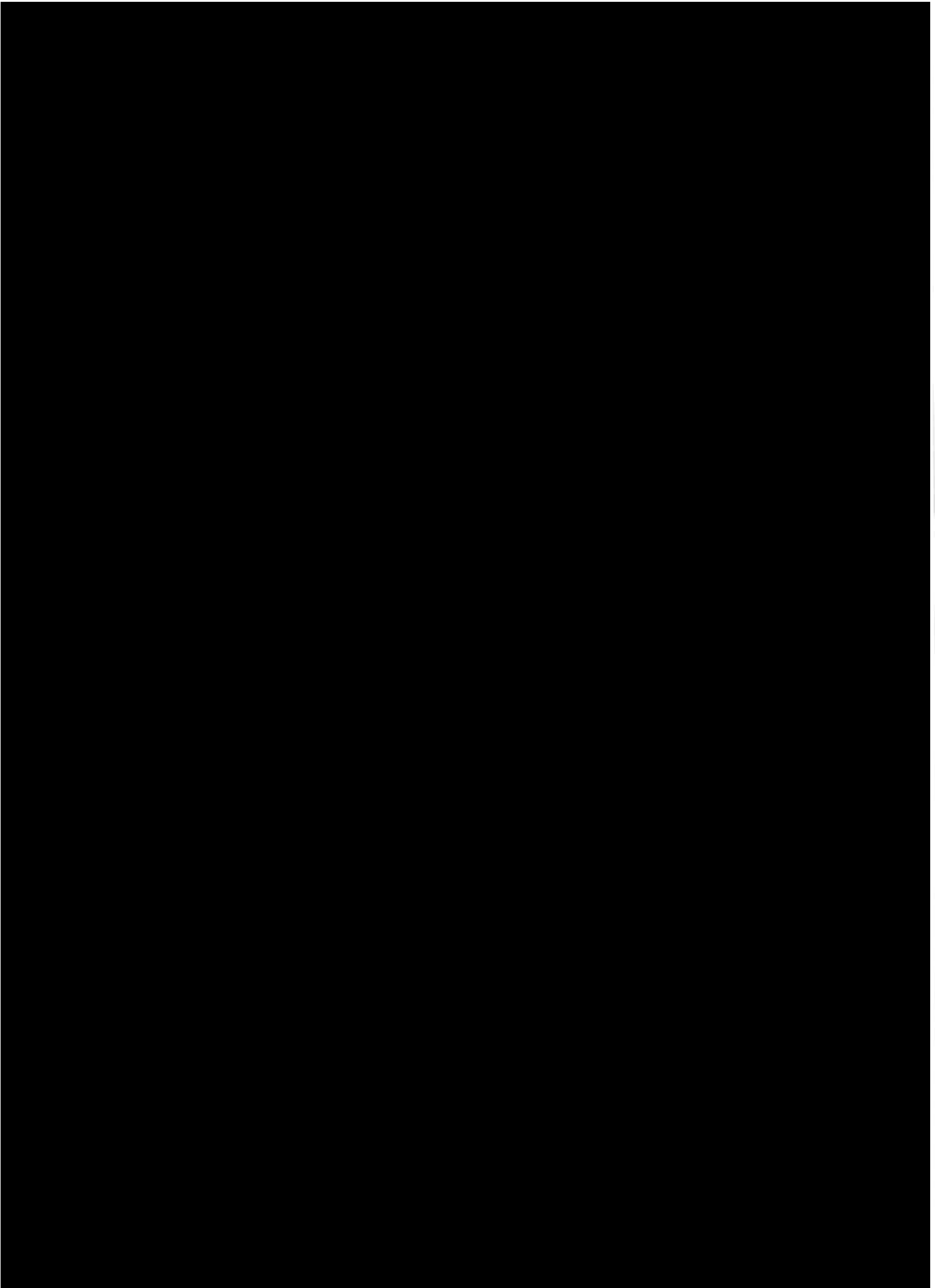


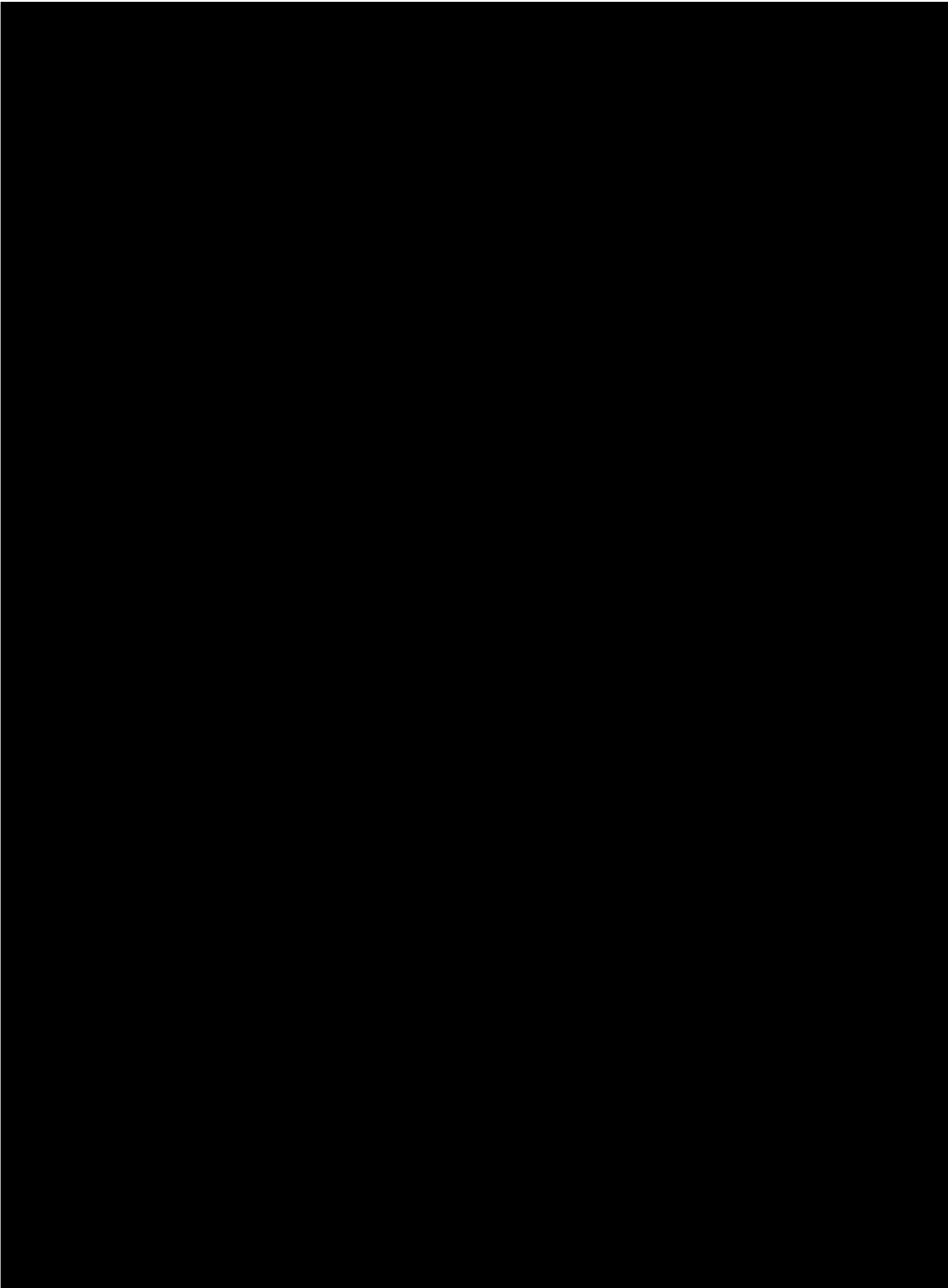


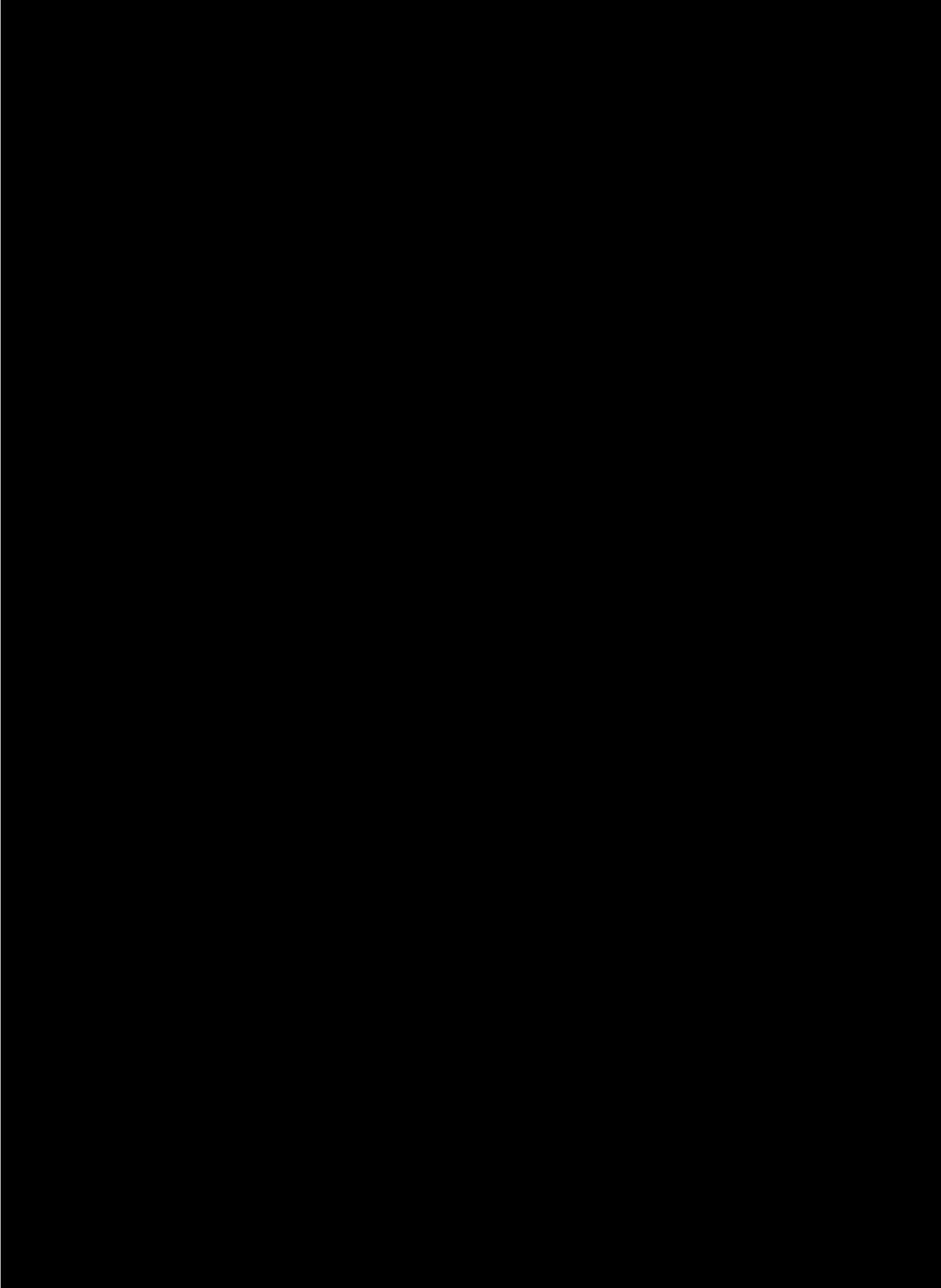


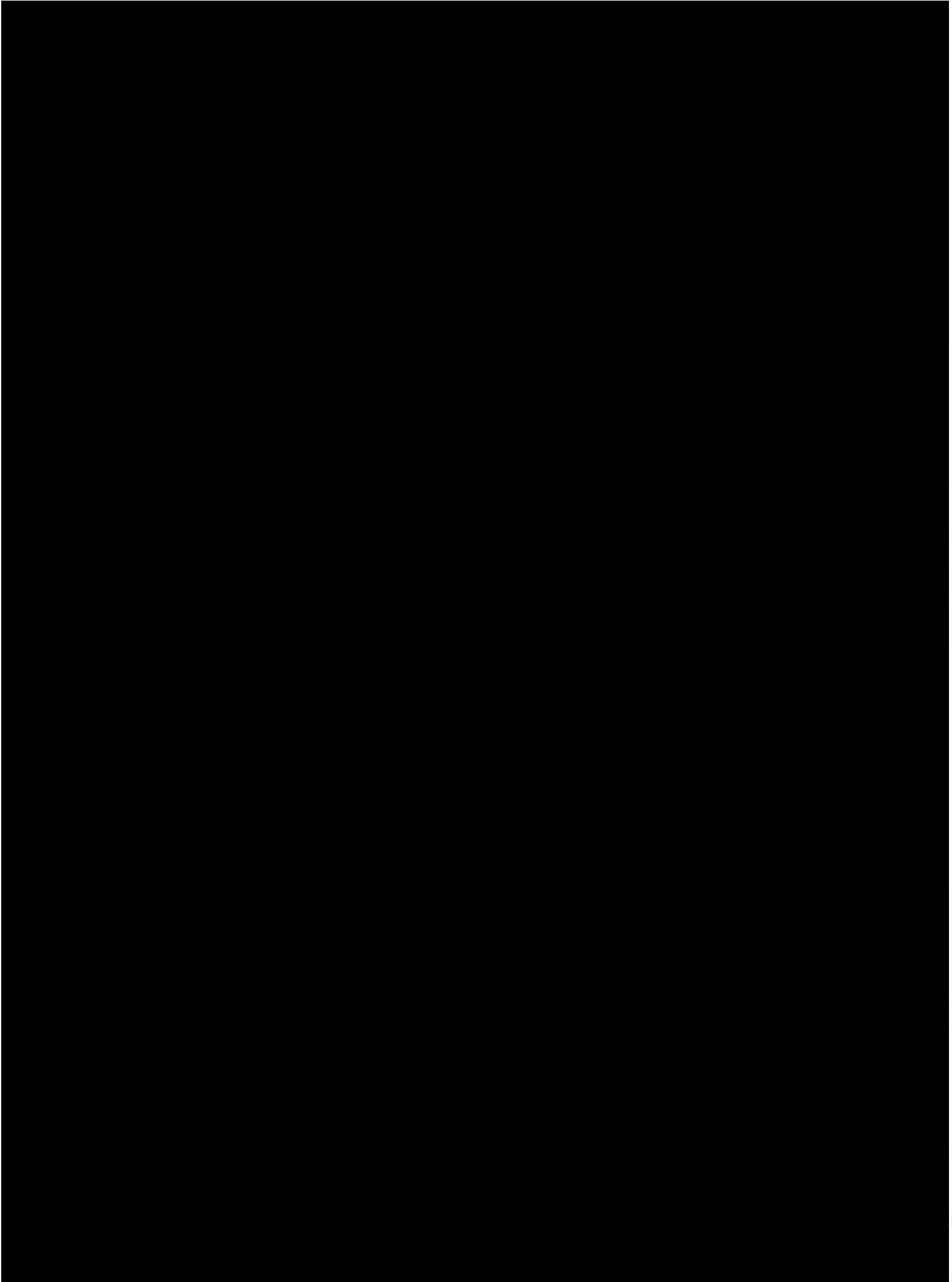












Susanne Hantos

From: Bart Kolodziejczyk
Sent: Wednesday, 21 October 2020 8:50 PM
To: [REDACTED]
Subject: [REDACTED]

Hi [REDACTED],

Apologies for my bad connection. Luckily, we have discussed everything regarding [REDACTED]
[REDACTED].

I will draft a quick overview of preliminary work that we have done in ionic liquids and low temperature iron ore reduction and share it with you shortly.

I am looking forward to receiving [REDACTED].

Thank you,
Bart

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Susanne Hantos

From: Bart Kolodziejczyk
 Sent: Thursday, 10 December 2020 6:13 AM
 To: Michael Masterman; Julie Shuttleworth; Michaela Johnstone
 Subject: Re: [REDACTED] - Call with CEOhop

B

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From: Michael Masterman <mmasterman@squadronenergy.com>
 Sent: Thursday, December 10, 2020 5:15:35 AM
 To: Bart Kolodziejczyk <bkolodziejcz@fmgl.com.au>; Julie Shuttleworth <jshuttleworth@fmgl.com.au>; Michaela Johnstone <mjohnstone@fmgl.com.au>
 Subject: RE: [REDACTED] - Call with CEOhop

Bart
 Got it – remember you explaining to me (the Bjorn had me thinking Sweden and Abba)
 Agree could be a great fit
 I will give him a call – what is his mobile

M

Michael Masterman



M +61 429 957 831

P +61 8 6460 4949

E mmasterman@squadronenergy.com

PO Box 3155, Broadway Nedlands

WA 6009 Australia

squadronenergy.com

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From: Bart Kolodziejczyk <bkolodziejcz@fmgl.com.au>
 Sent: Wednesday, 9 December 2020 10:23 PM
 To: Julie Shuttleworth <jshuttleworth@fmgl.com.au>; Michael Masterman <mmasterman@squadronenergy.com>; Michaela Johnstone <mjohnstone@fmgl.com.au>
 Subject: RE: [REDACTED] - Call with CEOhop

Hi Michael,

Bjorn is currently semi-retired and living in Thailand. Him and his wife had to take care of his wife's niece and adopt her. Until recently, he was working part-time as a professor at Waseda University in Tokyo and travelled back and forth every three months. After a couple of years of living in Thailand, they are ready to move back to Australia. He is an Australian citizen and can move back as quickly as 3+ months.

Bart

From: Julie Shuttleworth
 Sent: Wednesday, 9 December 2020 5:47 PM
 To: Michael Masterman <mmasterman@squadronenergy.com>; Bart Kolodziejczyk <bkolodziejcz@fmgl.com.au>;
 Michaela Johnstone <mjohnstone@fmgl.com.au>
 Subject: RE: [REDACTED] - Call with CEOhop

Bart
 Please answer MM's query. Is Bjorn in Singapore.?

From: Michael Masterman <mmasterman@squadronenergy.com>
 Sent: Wednesday, 9 December 2020 4:49 PM
 To: Julie Shuttleworth <jshuttleworth@fmgl.com.au>; Bart Kolodziejczyk <bkolodziejcz@fmgl.com.au>; Michaela
 Johnstone <mjohnstone@fmgl.com.au>
 Subject: RE: [REDACTED] - Call with CEOhop

Julie
 Ok we will action

Where is Bjorn based? We do need to bring the technical team together – initially in Perth

Happy to give him a call

Will bring Aaron on a contract basis.

Michael

Michael Masterman



M +61 429 957 831

P +61 8 6460 4949

E mmasterman@squadronenergy.com

PO Box 3155, Broadway Nedlands

WA 6009 Australia

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From: Julie Shuttleworth <jshuttleworth@fmgl.com.au>

Sent: Wednesday, 9 December 2020 6:47 PM

To: Bart Kolodziejczyk <bkolodziejcz@fmgl.com.au>; Michaela Johnstone <mjohnstone@fmgl.com.au>; Michael Masterman <mmasterman@squadronenergy.com>

Subject: FW: [REDACTED] - Call with CEOhop

Hi Bart and Michael

Just answering this email. Happy for you to proceed with Aaron, since you have already done the interview.

I am also happy for you to bring Bjorn on board, once Michael has had a quick interview with him to check FFI values. Michael, Paul Scott and Cameron have offered to join the call if you want either of them to do so. Otherwise, happy for you to have this chat by yourself MM.

We are recruiting for a Manufacturing Manager, however that may take 2 months until onboard. Therefore, I am happy for these two new positions to temporarily report to Michael. Bart and Michael we will involve you in the interviews for that position.

Does that work for everyone? Happy for any other ideas.

Will have a call on manufacturing next week when I am in quarantine, and make sure we really get this cranked up. Having a good discussion on the plane now with Rod, Paul S and Rod.

Cheers
Julie

Julie Shuttleworth

From: Bart Kolodziejczyk <bkolodziejcz@fmgl.com.au>

Sent: Monday, 7 December 2020 10:50 AM

To: Julie Shuttleworth <jshuttleworth@fmgl.com.au>

Cc: Michael Masterman <mmasterman@fmgl.com.au>; Michaela Johnstone <mjohnstone@fmgl.com.au>

Subject: RE: [REDACTED] - Call with CEOhop

Hi Julie,

We've already got your support. That's super helpful.

Please find attached CVs of Aaron and Bjorn.

Bjorn is my PhD supervisor, who is semi-retired and currently in Thailand. He is probably the best electrochemist I know. His involvement in this would be essential. He is also very hands-on, and I have already discussed it with him without revealing too many details. Before he got his PhD, Bjorn has developed several processes which are deployed commercially. Same time, Bjorn would probably have to report to Michael M, Paul Scott, or someone else.

Best regards,
Bart

From: Julie Shuttleworth

Sent: Monday, 7 December 2020 10:43 AM

To: Bart Kolodziejczyk <bkolodziejcz@fmgl.com.au>

Cc: Michael Masterman <mmasterman@fmgl.com.au>; Michaela Johnstone <mjohnstone@fmgl.com.au>

Subject: Re: [REDACTED] - Call with CEOhop

Hi team

Please proceed with high speed on this

Please get Michaela In the loop so we can get it organised.

Please send me his CV.

What else do you need from me?

Thanks
Julie

Julie Shuttleworth
Fortescue Metals Group
Fortescue Future Industries
+61 439918677

On 6 Dec 2020, at 19:43, Bart Kolodziejczyk <bkolodziejcz@fmgl.com.au> wrote:

Hi Julie,

I agree with Michael. We will need someone to drive this while we do 100s other things and having a quick chat with Aaron. He seems like a great candidate.

Aaron is currently in the process of getting our NDA signed. We will have a more detailed follow-up call with him, but getting him on board asap would definitely help and take some of the work burden from us.

Bart

From: Michael Masterman
Sent: Monday, 7 December 2020 9:35 AM
To: Bart Kolodziejczyk <bkolodziejcz@fmgl.com.au>; Julie Shuttleworth <jshuttleworth@fmgl.com.au>
Subject: RE: [REDACTED] - Call with CEOhop

Julie

We need someone practical who has a can do attitude and is great at setting up mechanical and material operations.

Bart and I have spoken to Aaron Szumilak (Polish background born in Canada) who worked on the Iron Bridge project and was pivotal in making the HPGR work and overall project innovation. Paul Scott has had a look at the resume. He knows the FMG/FFI values.

He is also very practical and frugal and can work with speed. (not recommending it but he could probably weld up the [REDACTED] pod we saw [REDACTED] and get the kiln brick installation going before [REDACTED] close their term sheet)

Andrew is agitating on all this work. If we bring Aaron on with a contract we can get the arms and legs to start the process.

Michael

From: Bart Kolodziejczyk <bkolodziejcz@fmgl.com.au>
Sent: Sunday, 6 December 2020 7:22 PM
To: Andrew Forrest - [REDACTED]; Michael Masterman <mmasterman@fmgl.com.au>; John Paul Olivier <jolivier@fmgl.com.au>
Cc: John Hartman <jhartman@tattarang.com>; Julie Shuttleworth <jshuttleworth@fmgl.com.au>; Alan Krause <akrause@fmgl.com.au>
Subject: RE: [REDACTED] - Call with CEOhop

Hi Andrew,

I am in Malaysia and this is exactly what I am doing this week while in quarantine.

We will do it better. It will be low-temperature processing from ionic liquids.

Bart

From: Andrew Forrest - [REDACTED]
Sent: Saturday, 5 December 2020 11:44 PM
To: Bart Kolodziejczyk <bkolodziejcz@fmgl.com.au>; Michael Masterman <mmasterman@fmgl.com.au>; John Paul Olivier <jolivier@fmgl.com.au>
Cc: John Hartman <jhartman@tattarang.com>; Julie Shuttleworth <jshuttleworth@fmgl.com.au>; Alan Krause <akrause@fmgl.com.au>
Subject: Re: [REDACTED] - Call with CEOhop

Bart

So set up a decent testing facility in Perth and properly prove or disprove the concept so I can set up a steel manufacturing facility.

A

Sent via [BlackBerry Hub+ Inbox for Android](#)

Andrew Forrest

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From: bkolodziejcz@fmgl.com.au
Sent: 4 December 2020 15:01
To: mmasterman@fmgl.com.au; jolivier@fmgl.com.au; [REDACTED]
Cc: jhartman@tattarang.com; jshuttleworth@fmgl.com.au; akrause@fmgl.com.au
Subject: RE: [REDACTED] - Call with CEO

Hi Michael,

The idea makes sense. Having one step-process which can be easily controlled by tuning applied voltage is definitely preferred over solid-state reduction using green hydrogen or ammonia. It merely makes it easier and potentially cheaper.

In terms of energy intensity, the process uses roughly 4 MWh/tonne of steel. Hence, with 500 MW of hydropower and uninterrupted operation, we would get nearly 1.1 million tonnes of steel per year. While it seems not much, we need to remember that there is a reason why steelmaking is one of the major contributors to global carbon emissions, contributing roughly 7% of global CO₂ emissions. The steelmaking process is very energy-intensive. The energy contained in coal used to process iron ore via traditional pathways contains around 5.3 MWh/tonne of steel. On average 0.8 tonnes of coal is used to produce 1 tonne of steel.

Bart





Susanne Hantos

From: Bart Kolodziejczyk
 Sent: Tuesday, 15 December 2020 10:58 AM
 To: Andrew Forrest - [REDACTED]; Michael Masterman; John Hartman
 Cc: John Paul Olivier
 Subject: [REDACTED]

Andrew, this is exactly what will keep us busy in 2021. We are getting our manufacturing and R&D facilities set up and this work will proceed shortly.

Same time I agree with Michael. We need to look at both hydrogen and ammonia. To convert existing blast furnaces. Green ammonia can be used a carbon-free reductant and it is easier to ship than hydrogen.

Bart

From: Andrew Forrest - [REDACTED]
 Sent: Tuesday, 15 December 2020 10:55 AM
 To: Michael Masterman <mmasterman@squadronenergy.com>; Bart Kolodziejczyk <bkolodziejcz@fmgl.com.au>; John Hartman <jhartman@tattarang.com>
 Cc: John Paul Olivier <jolivier@fmgl.com.au>
 Subject: [REDACTED]

Or build our own mini plant in Freo and shortly after a commercial scale pilot plant in Port Hedland.

Sent from my BlackBerry — the most secure mobile device

Andrew Forrest

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From: mmasterman@squadronenergy.com
 Sent: 15 December 2020 11:53
 To: bkolodziejcz@fmgl.com.au; jhartman@tattarang.com; [REDACTED]
 Cc: jolivier@fmgl.com.au
 Subject: [REDACTED]

We probably also need to understand how a steel mill like Posco would practically use H₂ as a reductant to replace coking coal in a sinter furnace or blast furnace

Might be smoking drugs but is there anything we could do at the Bluescope steel works at Port Kembla

M

Michael Masterman



M +61 429 957 831

P +61 8 6460 4949

E mmasterman@squadronenergy.com

PO Box 3155, Broadway Nedlands

WA 6009 Australia

squadronenergy.com

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From: Bart Kolodziejczyk <bkolodziejcz@fmgl.com.au>

Sent: Tuesday, 15 December 2020 1:46 PM

To: Michael Masterman <mmasterman@squadronenergy.com>; John Hartman <jhartman@tattarang.com>;

Andrew Forrest - [REDACTED]

Cc: John Paul Olivier <jolivier@fmgl.com.au>

Subject: [REDACTED]

Hi Michael,

Sounds good. We'll do it at low temperature using ionic liquids as iron ore solvents. Low temperature electrochemical reduction will allow us to switch on and off our "iron ore electrolyser" within seconds or minutes and as such we will be able to operate with highly intermittent power supply like wind and solar.

[REDACTED]

[REDACTED]

I am available any time this week.

Bart

From: Michael Masterman <mmasterman@squadronenergy.com>

Sent: Tuesday, 15 December 2020 10:40 AM

To: John Hartman <jhartman@tattarang.com>; Andrew Forrest - [REDACTED]; [REDACTED]; Bart Kolodziejczyk <bkolodziejcz@fmgl.com.au>

Cc: John Paul Olivier <jolivier@fmgl.com.au>

Subject: [REDACTED]

Will keep to ourselves

JP, Bart

Lets have a call on expediting Green Steel (as you can imagine its on the top of Andrews priority list)

M

Michael Masterman**M** +61 429 957 831**P** +61 8 6460 4949**E** mmasterman@squadronenergy.com

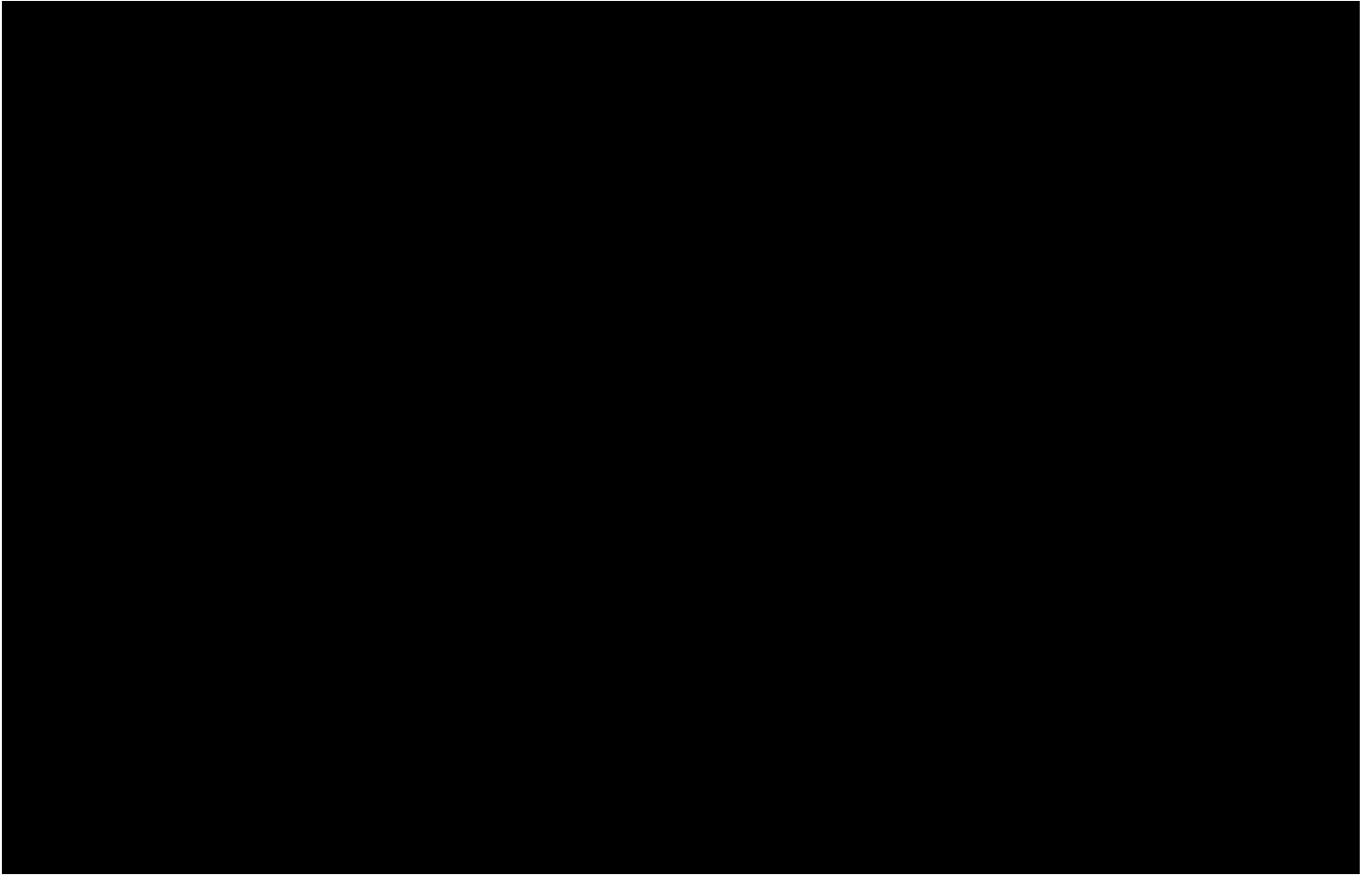
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Susanne Hantos

From: Bart Kolodziejczyk
Sent: Tuesday, 22 December 2020 10:06 AM
To: 'Andrew Forrest'; Michael Masterman
Subject: RE: The batteries that could make fossil fuels obsolete - BBC Future

I will do my best, Andrew.

By May, we will definitely have a good idea and a working prototype in our Perth facility. Having a large(er) commercial-scale plant in Pilbara by June 30 might be very challenging. Anyway, challenge accepted.

On the same note, I am currently working on a patent application for our low-temperature electrochemical ores reduction in ionic liquid electrolytes.

This patent application is based on my initial work done a couple of years ago, where I have managed to produce iron from iron oxides, copper from copper complexes, and nickel from nickel oxides. I would like Michael and you to be listed as co-inventors. We wouldn't be doing this work if not for your push. Are you ok with being on that patent?

Bart

From: Andrew Forrest
Sent: Tuesday, 22 December 2020 9:55 AM
To: Bart Kolodziejczyk <bkolodziejcz@fmgl.com.au>; Michael Masterman <mmasterman@squadronenergy.com>
Subject: Re: The batteries that could make fossil fuels obsolete - BBC Future

Well done and thank you.

I need you testing in the Pilbara before June 30 Bart.

A

Sent from my BlackBerry — the most secure mobile device

From: bkolodziejcz@fmgl.com.au
Sent: 22 December 2020 9:06 am
To: [REDACTED] mmasterman@squadronenergy.com
Subject: RE: The batteries that could make fossil fuels obsolete - BBC Future

Hi Andrew,

I think batteries have a role to play.

Michael M and I looked at battery ships to send electricity from Pilbara to Japan (and elsewhere) directly in the form of electricity contained in batteries on a vessel. Batteries are so heavy and bulky that using the best batteries today, we would be able to ship only 9% of the energy per shipment compared to energy contained in today's LNG shipping vessels.

Highest performing batteries today are lithium-sulfur batteries. Their energy densities reach 0.55 kWh/L, and specific energy is in the range of 0.5 kWh/kg. For comparison, liquid hydrogen is 2.7 kWh/L and 39.4 kWh/kg. Ammonia gives 3.2 kWh/L and 5.1 kWh/kg.

Batteries will be used for stationary energy storage. Hydrogen and ammonia will be used to ship energy globally.

We are very happy to be out with families.

Very busy 2021 ahead we will be doing work over Christmas to establish our Perth manufacturing in early 2021. We need to have working electrolyzers and low-temperature electrochemical iron ore processing plants. Testing in Pilbara to commence in late 2021.

Bart

From: Andrew Forrest
Sent: Monday, 21 December 2020 8:04 PM
To: Bart Kolodziejczyk <bkolodziejcz@fmgl.com.au>; Michael Masterman <mmasterman@squadronenergy.com>
Subject: The batteries that could make fossil fuels obsolete - BBC Future

"The batteries that could make fossil fuels obsolete - BBC Future"
<https://www.bbc.com/future/article/20201217-renewable-power-the-worlds-largest-battery>

Trust you guys are enjoying some super well deserved freedom. Love to both of you and your families.

A

Sent via [BlackBerry Hub+ Inbox for Android](#)

Susanne Hantos

From: Bart Kolodziejczyk
Sent: Tuesday, 22 December 2020 4:08 PM
To: Robert Grant
Subject: Low-temperature electrochemical ores reduction in ionic liquids
Attachments: 22122020 Patent Assessment Form (Electrochemical ore reduction).pdf

Hi Rob,

I hope you're doing well. I have attached a patent assessment form for the intended patent application covering low-temperature electrochemical ores reduction in ionic liquids. Applying Fortescue stretch targets, we are aiming to test it in Pilbara by June 30, 2021.

The technology is proven. I have developed this method and tested it in a small scale laboratory setting before. Now we need to scale it up and couple it with a green power source.

If you don't have any comments, can you please approve the form? I will be working over Christmas to finalise a draft for this application.

Bart

Bart Kolodziejczyk
Fortescue Metals Group Ltd
Level 2, 87 Adelaide Terrace East Perth WA 6004

Mobile: +61 437 947 164 **Web:** www.fmgl.com.au
Twitter: @FortescueNews | www.fmgl.com.au





PATENT ASSESSMENT FORM

PURPOSE

The purpose of this form is to assist Fortescue's personnel to determine whether or not an invention or innovation should be patented.

The information in this document is strictly private and confidential and must not be publicly disclosed until a patent application has been filed or a decision has been made not to seek patent protection.

The Guidance Notes at the back of this form provides additional information in relation to some of the items.

INVENTION DETAILS

Inventor's Name (Guidance Note 1)	Bartlomiej Piotr KOLODZIEJCZYK
Inventor's Manager's Name	Robert GRANT
Department	Fortescue Future Industries
Title of Invention	Low-temperature Electrochemical Ore Reduction
Summary of Invention	The invention revolves around the use of ionic solvents and electrochemical devices for the low-temperature reduction of ores and oxides, including but not limited to iron ores and nickel ores. Careful selection of ionic liquid or mixture of ionic liquids allows to dissolve ores at low-temperatures. The electrochemical window of ionic liquid or ionic mixtures is selected so that the applied electrochemical potential required to reduce ores does not damage the ionic electrolyte.
Benefit of Invention (Guidance Note 2)	Today's steelmaking accounts for roughly 6 - 7% of global carbon dioxide emissions. Steelmaking processes require the use of coal as an iron ore reductant. Decarbonisation of this process would significantly reduce global carbon dioxide emissions while creating a new commodity – green steel. Proposed carbon-free alternatives are complex and require a multi-step approach, where green hydrogen or green ammonia are used as reductants. In addition, thermochemical processes tend to operate at high temperatures and are challenging to sustain using an intermittent power supply, like wind or solar energy. The low-temperature one-step electrochemical process would overcome those limitations by providing modular and scalable approaches that could operate with a higher degree of flexibility than intermittent renewable energy sources.
Specific Inventive Element (Guidance Note 3)	There are a couple of inventive steps to this process. Firstly, ionic liquids, their mixtures, and composition ratio are innovative. The application of ionic liquids in metal oxide reduction is innovative by itself. In addition, the selection of electrode materials and cell design are novel and unique.
What is the Status of the Invention? Has it been Designed? Constructed? Tested? Used?	The concept has been tested in a laboratory setting and is intended to be scaled up to a commercial system in 2021.
Any Other Comments	NA

Rev 1	PREPARED BY	CHECKED BY	APPROVED BY
	Simon Yamchikov	Rebecca Hayward	Rebecca Hayward
14 July 2017			



PATENT ASSESSMENT FORM

Inventor's Email Address	bkolodziejcz@fmgl.com.au , kolodziejczyk.bartlomiej@gmail.com
Inventor's Mobile Phone Number	+61 416 833 585, +61 437 947 164
Date	22/12/2020

PATENT ASSESSMENT

Patents

A patent is a legally enforceable right for a device, substance, method or process. A patent gives Fortescue the right to stop others from using the invention without Fortescue's permission.

When granted, a patent will give Fortescue exclusive commercial rights to the invention for 20 years for a standard patent, or 8 years for an innovation patent.

To be patentable, an invention must be new, useful and inventive or innovative.

Prior to filing the patent application, the invention must be kept confidential. If the invention is disclosed to the public or commercially used before a patent application is filed, there is a risk that the patent will not be granted. If disclosure is required to a third party, the IP Team can assist you to put in place a confidentiality agreement to ensure that information about the invention is kept confidential.

Fortescue has access to an international patent search database and is able to carry out searches to ensure that the invention is not already covered by another patent. Please request the IP Team to carry out searches if you are unsure if the invention is new.

As a general estimate, the initial cost of applying for a patent are in the range of \$6,000 to \$9,000 with maintenance and ancillary costs bringing the total cost over a five year period up to \$30,000 depending on the particular circumstances.

Key Considerations

If in your view the invention or innovation is patentable, the following must be considered:

- what is the objective of protecting the invention? For example:
 - to obtain a commercial advantage over Fortescue's competitors because:
 - the invention improves Fortescue's efficiency/productivity;
 - the invention reduces Fortescue's costs; or
 - the invention may be used in negotiations with a third party to gain another advantage;
 - to commercialise the invention and create a financial return for Fortescue (i.e., through licensing or sale of technology);
 - to ensure Fortescue has the freedom to use and operate that invention without restriction; or
 - to create marketing or business development benefits for Fortescue.
- do the benefits of patent protection outweigh the time, effort and cost (including filing and maintenance costs of the patent) required to file and maintain the patent?

INVENTOR'S DECLARATION

- I have reviewed and considered the information provided in this Patent Assessment Form and in my view the invention should be considered for patent protection by Fortescue's IP Team.
- I acknowledge and agree that the invention and the patent are the sole and exclusive property of Fortescue Metals Group.

What is the objective of patenting the invention?

The objective is to protect the initial invention and enable further scale-up and commercial deployment in Pilbara and elsewhere.



PATENT ASSESSMENT FORM

Do the benefits of patenting the invention outweigh the time, effort and costs?	No, the production of green metals, including green iron, green steel, green nickel, and green copper, among other metal commodities, is at the core business of Fortescue Future Industries. Protecting this development will give FFI a competitive advantage in this growing industry space.
Are searches required of the patent database? If yes, please provide search terms and the countries which the searches should cover (i.e., "remote dozing" in Australia) (Guidance Note 4)	Patent searches have been performed, and search results will be presented in a longer write up. Technology that is similar to the current proposal is that of Boston Metal, a spin-off from MIT. The difference is that Boston Metal technology uses molten oxide electrolyte and operates at very high temperatures, up to 1,500 °C.
Has this invention been discussed with others? If yes, with whom? Was the invention developed in co-operation or collaboration with outside parties? If yes, please give details of any such parties.	No
Has the invention or information relating to the invention been made publically available or disclosed to third parties? If so, please provide details of the disclosure. (Guidance Note 5)	No, invention has not been publicly disclosed. All information related to this invention is kept internally within Fortescue Future Industries.
Inventor's Name	Bartłomiej Piotr KOŁODZIEJCZYK
Inventor's Signature	
Date	22/12/2020
Inventor's Manager's Name	Robert GRANT
Inventor's Manager's Signature	
Date	

NEXT STEPS

If you consider that the invention or innovation should be patented, please complete this Patent Assessment Form and submit it to Fortescue's IP Team at the following email address: ip@fmgl.com.au

If you have any queries, please do not hesitate to contact Simon Yamchikov on 0428 164 830 or ip@fmgl.com.au

GUIDANCE NOTES

- Inventor's Name:** There can be more than one inventor. If contractors or consultants have been involved with the invention, please make a note of this as well the role which they have played. If the consultant or contractor was engaged under an agreement, please provide details of that agreement.



PATENT ASSESSMENT FORM

2. **Benefit of Invention:** The benefits of the invention are not limited to being financial benefits or cost savings. The benefits of the invention can include safety improvements, the potential to use the intellectual property as bargaining power with another supplier or to gain an advantage over a competitor.
3. **Specific Inventive Element:** What inventive or innovative feature of the device, substance, method or process distinguishes the invention from existing devices, substances, methods or processes? The inventive element might be a structural feature or a function of the invention or it may be a number of different features, improvements or modifications.
4. **Searches:** In order to be patentable, the invention must be new. The IP Team can carry out patent searches to ensure that the invention is new when compared with the prior art base and has not been previously patented.
5. **Public Disclosure:** Disclosure includes contractors inspecting the invention, Fortescue discussing the invention at a presentation or providing information in a publically available document. All communication should be carefully managed and confidentiality agreement should be used wherever possible to ensure that the invention is not disclosed to the public prior to the filing of the patent.

Susanne Hantos

From: Bart Kolodziejczyk
Sent: Wednesday, 23 December 2020 8:20 AM
To: Julie Shuttleworth
Subject: RE: green steel plant Pilbara

Hi Julie,

Sure. It would be great to have a presentation or a pitch deck.

I will ask Chloe to work on this. Her economics background, together with what she has learned during our trips, should be good enough to do this task. I will work with Chloe to make sure that everything is aligned with Fortescue's vision.

We are proposing the development of two green steel technologies. One will be low-temperature electrochemical ore reduction in ionic liquids. The second one will be the electrolysis of iron ore in molten carbides. I am drafting R&D roadmaps for both of those technologies. Those roadmaps and write-ups will subsequently be used for patent applications.

I will give you a call later today to quickly discuss how we can try something up to scale in Pilbara by June 30, 2021. We need to get equipment for our manufacturing and R&D facility, and we don't have time to wait. My idea is to start getting chemicals, flasks, and other R&D equipment even before our facility is established. I will work with procurement on this. So that by the end of January, we can start hands-on work.

Bart

From: Julie Shuttleworth
Sent: Tuesday, 22 December 2020 8:48 PM
To: Bart Kolodziejczyk <bkolodziejcz@fmgl.com.au>
Subject: RE: green steel plant Pilbara

Hi Bart

Thanks for the info.

Only a few days ago Andrew again mentioned doing green steel in the Pilbara. He is asking [REDACTED] and others if they want to partner with us to do green steel in the Pilbara.

I still think we need to follow up and get some slides together with numbers etc.

I can ask Rob Grant to find someone to get onto this if you don't have time, I know you have a lot of things on

Let me know, and feel free to call if you wish

Regards
Julie

From: Bart Kolodziejczyk <bkolodziejcz@fmgl.com.au>
Sent: Monday, 21 December 2020 10:09 AM
To: Julie Shuttleworth <jshuttleworth@fmgl.com.au>
Subject: RE: green steel plant Pilbara

Hi Julie,

Michael and I have had a number of calls with Andrew on this. Hence, I have assumed that this was closed.

[REDACTED]
[REDACTED]
[REDACTED]
[REDACTED]

We are getting NDAs signed with [REDACTED] and [REDACTED] to understand CAPEX and OPEX of hydrogen-powered DRI plants. Also, something to have in mind is that our ores probably have too high silica content to work with DRI. Once, NDAs are signed we will ship our ores to [REDACTED] and [REDACTED] for trials.

Bart

From: Julie Shuttleworth
Sent: Saturday, 19 December 2020 2:43 PM
To: Bart Kolodziejczyk <bkolodziejcz@fmgl.com.au>
Subject: green steel plant Pilbara

Bart
Just going through some older emails

The below in yellow. What help do you need with this?
Don't want you to think you have to do this one all by yourself.

Cheers
Julie

From: Andrew Forrest (Munderoo) <[REDACTED]>
Sent: Sunday, 15 November 2020 3:59 AM
To: Bart Kolodziejczyk <bkolodziejcz@fmgl.com.au>; Julie Shuttleworth <jshuttleworth@fmgl.com.au>
Subject: Fw: Shared from BBC:The new fuel to come from Saudi Arabia

Bart your views please.

This is similar to what we are going to do in the Pilbara right?

Bart

IF you can find the time...

I need you to do a quick scoping study on making our own steel in Port Headland please.

I want a rough idea on capex and open per million tonnes produced.

Aiming for a [REDACTED] plant.

Are you up for it?

A

Sent from my BlackBerry — the most secure mobile device

From: chasbrooke@runbox.com

Sent: 14 November 2020 14:38

To: [REDACTED]

Subject: Shared from BBC: The new fuel to come from Saudi Arabia

<https://www.bbc.com/future/article/20201112-the-green-hydrogen-revolution-in-renewable-energy?ocid=ww.social.link.email>

A

I am sure you have probably read this !

all the best and safe travels

Charlie

Kind regards

Charlie

Sent from my iPhone

Susanne Hantos

From: Bart Kolodziejczyk
Sent: Wednesday, 6 January 2021 2:15 PM
To: Chris McMahan;John Paul Olivier;Michael Masterman
Cc: Danny Goeman
Subject: RE: Report from [REDACTED]

Hi Chris,

Thank you for sharing this draft. It provides some valuable insights into the MOE process.

We are currently developing an R&D roadmap where a number of challenges outlined in this report will be addressed. The major challenge is MOE's high operating temperature, which requires specialised materials, often based on noble and expensive metals. The system's high thermal inertia is also a challenge when running the MOE process with highly intermittent wind and solar power supply.

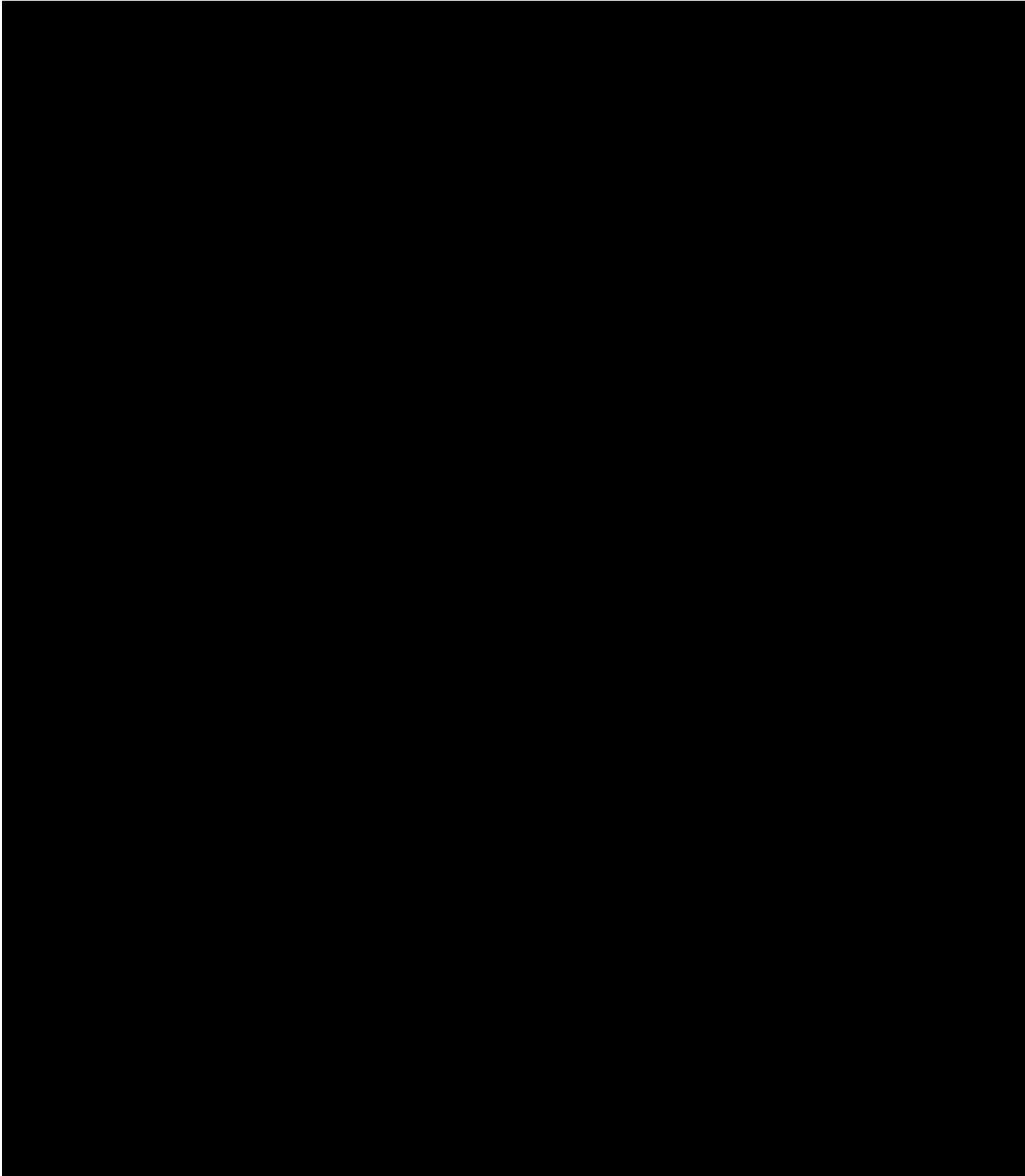
[REDACTED]

In our development, we are looking at using solvents capable of dissolving iron ore at low temperatures < 300 deg C and/or using molten carbonate electrolyte, which would allow the dissolution of iron ore at temperatures ranging between 700 and 800 deg C. Same time allowing to use less exotic and less expensive materials and making the entire process more compatible with intermittent power supply. Same time we are open to testing MOE too.

Based on your description, Joe seems like a valuable potential employee. However, I know too little about your previous engagement to be able to comment on any future engagement with Joe.

[REDACTED]

Best regards,
Bart



Susanne Hantos

From: Bart Kolodziejczyk
Sent: Wednesday, 6 January 2021 2:39 PM
To: Shanta Barley
Subject: RE: [REDACTED]

Hi Shanta,

We are working internally at Fortescue on alternative processes that would utilise lower temperatures and direct electrochemical reduction of iron ore into iron and further steel.

The electrochemical reduction is done in a liquid phase. Hence iron ore has to be dissolved in the electrolyte prior to being electrolysed. High temperature helps iron ore dissolution but poses certain technical challenges, especially when running the intermittent power supply process. With the intermittency of wind and solar energy supply, it becomes challenging to maintain the high temperature of the process.

We are working to overcome this issue.

Other than the above, I am not aware of alternatives.

As we have discussed before, we could use green hydrogen as an iron ore reductant instead of using coal as a reductant (traditional steel making process uses coal). But this is different from using direct current.

Bart

From: Shanta Barley <sbarley@minderoo.org>
Sent: Wednesday, 6 January 2021 2:17 PM
To: Bart Kolodziejczyk <bkolodziejcz@fmgl.com.au>
Subject: [REDACTED]

Dear Bart,

I was wondering if you know of a good alternative to [REDACTED] for the sentence below:

[REDACTED] to turn iron oxide into steel. This is a radical step change that does away, not only with coal, but with blast furnaces.

Thanks!
Shanta

Shanta Barley
Minderoo Foundation • Research



M +61 439 485 [REDACTED]
P +61 8 6460 4949
E sbarley@minderoo.org
L Perth (GMT+8)

PO Box 3155, Broadway Nedlands
WA 6009 Australia
minderoo.org/research

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Susanne Hantos

From: Bart Kolodziejczyk
Sent: Friday, 22 January 2021 11:41 AM
To: Ashlee Crabbe;Chris McMahan;Geoff Beros
Cc: Danny Goeman;Alison Terry;Stephanie Vanicek;Julie Shuttleworth
Subject: RE: For review: Media enquiry AFR green steel pilot

Hi Ashlee,

The way I interpret Chairman's Boyer Lecture is that Fortescue is interested in exploring green steel opportunities. Production of green steel would be a natural extension to our vertically integrated value chain and fits well with Fortescue's decarbonisation strategy.

In terms of a pilot plant in Pilbara, the lecture does not talk about that plant's size. It could be 10 tonnes/day, but it could be 100 kg/day. We are exploring various existing technologies, but we are also developing internally enabling technologies for iron ore processing to produce green commodities.

It is going to be a small scale pilot plant.

As discussed over the phone, please find links to four existing technologies that use hydrogen as a green reductant for iron ore processing.

<https://www.thyssenkrupp-steel.com/en/company/sustainability/climate-strategy/>

<https://www.hybritdevelopment.com/>

<https://www.midrex.com/technology/midrex-process/midrex-h2/>

<https://www.energiron.com/hydrogen/>

Internally, we are developing a process that will allow us to take green electricity produced from wind, solar, hydropower, etc., and apply this green electricity to electrochemically reduce Fortescue's iron ore dissolved in a unique electrolyte. In other words, green electricity will be used to separate oxygen from iron. The selection of electrolyte, electrode material, and other materials used in the process is proprietary, and at this point, Fortescue's trade secret. In the future, we are aiming to file a series of patents covering this development.

[REDACTED]

Please let me know if this explanation is suitable? I am happy to provide feedback on your reply draft.

Bart

From: Ashlee Crabbe
Sent: Friday, 22 January 2021 10:28 AM
To: Chris McMahan <cmcmahen@fmgl.com.au>; Geoff Beros <gberos@fmgl.com.au>; Bart Kolodziejczyk <bkolodziejcz@fmgl.com.au>
Cc: Danny Goeman <dgoeman@fmgl.com.au>; Alison Terry <aterry@fmgl.com.au>; Stephanie Vanicek <svanicek@fmgl.com.au>
Subject: RE: For review: Media enquiry AFR green steel pilot

Hi all,

Are you please able to give an estimate of when I can get any info on this, or if it is available?

We have had a follow up from the journalist and I need to run any information past Elizabeth for approval asap.

Kind regards
Ashlee

From: Ashlee Crabbe
Sent: Friday, 22 January 2021 8:58 AM
To: Chris McMahan <cmcmahen@fmgl.com.au>; Geoff Beros <gberos@fmgl.com.au>; Bart Kolodziejczyk <bkolodziejcz@fmgl.com.au>
Cc: Danny Goeman <dgoeman@fmgl.com.au>
Subject: RE: For review: Media enquiry AFR green steel pilot

Thank you all

From: Danny Goeman <dgoeman@fmgl.com.au>
Sent: Friday, 22 January 2021 8:57 AM
To: Ashlee Crabbe <acrabbe@fmgl.com.au>
Cc: Geoff Beros <gberos@fmgl.com.au>
Subject: RE: For review: Media enquiry AFR green steel pilot

Hi Ashlee

Yes, this information is even available on the internet. Perhaps best to coordinate with Geoff/Chris/Bart - they are the technical experts.

Danny

From: Ashlee Crabbe <acrabbe@fmgl.com.au>
Sent: Friday, 22 January 2021 8:53 AM
To: Danny Goeman <dgoeman@fmgl.com.au>
Cc: Chris McMahan <cmcmahen@fmgl.com.au>; John Paul Olivier <jolivier@fmgl.com.au>; Bart Kolodziejczyk <bkolodziejcz@fmgl.com.au>; John Paul Olivier <jolivier@fmgl.com.au>; Alison Terry <aterry@fmgl.com.au>; Stephanie Vanicek <svanicek@fmgl.com.au>; Ben Kuchel <bkuchel@fmgl.com.au>
Subject: RE: For review: Media enquiry AFR green steel pilot

Thanks Danny,

I think what Brad is hoping to receive, is some basic information about how the processes work for people (like me) who aren't across the technical process.

Are there any summaries available on these two processes?

Ash

From: Danny Goeman <dgoeman@fmgl.com.au>

Sent: Friday, 22 January 2021 8:52 AM

To: Ashlee Crabbe <acrabbe@fmgl.com.au>

Cc: Chris McMahan <cmcmahan@fmgl.com.au>; John Paul Olivier <jolivier@fmgl.com.au>; Bart Kolodziejczyk <bkolodziejcz@fmgl.com.au>; John Paul Olivier <jolivier@fmgl.com.au>; Alison Terry <aterry@fmgl.com.au>; Stephanie Vanicek <svanicek@fmgl.com.au>; Ben Kuchel <bkuchel@fmgl.com.au>

Subject: RE: For review: Media enquiry AFR green steel pilot

Hi Ashlee,

What Andrew is referring to here is (i) reducing/removing coal in the steel making process in the BF and replacing it with hydrogen, and (ii) direct reduction of iron ore by using electricity to create steel. We don't have an agreed commercial design/solution on how to achieve either at this stage. That said, we are engaging/collaborating with a number of parties in the steel making industry and elsewhere to pursue solutions.

Chris/Geoff/Bart (copied) are across the details of discussions/progress to date, but I am not sure we necessarily want to reveal who we are engaging - for obvious reasons. Between Bart/Chris/Geoff we can dig up some high-level generic information to explain the concepts.

Regards,

Danny

From: Ashlee Crabbe <acrabbe@fmgl.com.au>

Sent: Friday, 22 January 2021 8:42 AM

To: Geoff Beros <gberos@fmgl.com.au>; Danny Goeman <dgoeman@fmgl.com.au>

Cc: Alison Terry <aterry@fmgl.com.au>; Stephanie Vanicek <svanicek@fmgl.com.au>

Subject: For review: Media enquiry AFR green steel pilot

Hi Geoff and Danny,

Following our Chairman's Boyer Lecture last night, Brad Thompson from the Australian Financial Review has asked us for background information on the two green steel processes Andrew referenced in the speech.

Do we have any background information to hand, which I could edit and provide to the AFR?

From the Chairman's speech, there are two ways:

- In one, you replace coal in the furnace with green hydrogen. You get steel – but instead of emitting vast clouds of CO₂, you produce nothing more than water vapour.
To strengthen the steel, you simply add the carbon separately. It bonds into the metal rather than dispersing into the atmosphere.
- The other way to make green steel is to scrap the blast furnace altogether and just zap the ore with renewable electricity.

Brad is working to an East Coast deadline for the AFR, so would be great to get this as soon as possible. Please feel free to call me for further clarification 0439 941 [REDACTED].

Thank you
Ashlee

Ashlee Crabbe

Senior Media and Corporate Affairs Specialist

Fortescue Metals Group Ltd

Level 2, 87 Adelaide Terrace East Perth WA 6004

Phone: +61 8 2930 1855 | **M:** 0439 941 [REDACTED]

E: acrabbe@fmgl.com.au

Twitter: @FortescueNews | www.fmgl.com.au



Susanne Hantos

From: Bart Kolodziejczyk
 Sent: Friday, 22 January 2021 4:13 PM
 To: Michael Masterman;Julie Shuttleworth;Rod Aguilar
 Subject: RE: For review: Media enquiry AFR green steel pilot
 Attachments: 7.3 Green Steel_v1 (BK).docx

Hi Michael and Rod,

Can you have a look at this first draft before sending to Julie for further feedback?

Michael and Rod, can you help me with financial section as per my comment in the Word doc?

Rod, given Chairman's clear direction, do we need any further elaboration on HyET in the main FFI board paper.

Have a good weekend,
 Bart

From: Michael Masterman <mmasterman@squadronenergy.com>
 Sent: Friday, 22 January 2021 12:22 PM
 To: Julie Shuttleworth <jshuttleworth@fmgl.com.au>; Bart Kolodziejczyk <bkolodziejcz@fmgl.com.au>; Rod Aguilar <roaguilar@fmgl.com.au>
 Subject: RE: For review: Media enquiry AFR green steel pilot

Will look at Barts draft over the weekend

(assume we are talking green steel)

M

Michael Masterman



M +61 429 957 831

P +61 8 6460 4949

E mmasterman@squadronenergy.com

PO Box 3155, Broadway Nedlands

WA 6009 Australia

squadronenergy.com

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From: Julie Shuttleworth <jshuttleworth@fmgl.com.au>
 Sent: Friday, 22 January 2021 11:56 AM

To: Bart Kolodziejczyk <bkolodziejcz@fmgl.com.au>; Rod Aguilar <roaguilar@fmgl.com.au>; Michael Masterman <mmasterman@squadronenergy.com>

Subject: RE: For review: Media enquiry AFR green steel pilot

Hi Bart & MM

Just speaking with the CLT, and lots of questions now coming in on this topic.

I am speaking with Greg Lilleyman about a plan with operational/technical/construction resources to help with this pilot plant, as approvals etc will be needed and we have some ideas to speed those up.

The Board paper is now critical as the CLT have the quarterly presentations next week and need to prepare their commentary.

Please can you let me know when I will get the first draft Board paper.

Regards & thanks

Julie

Julie Shuttleworth
Deputy Chief Executive Officer

Fortescue Metals Group Ltd
Level 2, 87 Adelaide Terrace East Perth WA 6004

P: +61 8 6218 8868 | **M:** +61 439 918 677

Twitter: @FortescueNews | www.fmgl.com.au

From: Ashlee Crabbe <acrabbe@fmgl.com.au>

Sent: Friday, 22 January 2021 8:18 AM

To: Bart Kolodziejczyk <bkolodziejcz@fmgl.com.au>; Rod Aguilar <roaguilar@fmgl.com.au>; Catherine Bozanich <bbozanich@fmgl.com.au>

Cc: Alison Terry <aterry@fmgl.com.au>; Stephanie Vanicek <svanicek@fmgl.com.au>; Julie Shuttleworth <jshuttleworth@fmgl.com.au>

Subject: For review: Media enquiry AFR green steel pilot

Good morning Bart and Rod,

Brad Thompson from the Australian Financial Review has asked Elizabeth for comment following the Boyer Lecture. Specifically, he has asked the question around current capital/budgets, however he has also asked for background information on the two green steel processes Andrew referenced in the speech.

Do we have any background information to hand, which I could edit and provide to the AFR?

From the Chairman's speech, there are two ways:

- In one, you replace coal in the furnace with green hydrogen. You get steel – but instead of emitting vast clouds of CO₂, you produce nothing more than water vapour.
To strengthen the steel, you simply add the carbon separately. It bonds into the metal rather than dispersing into the atmosphere.
- The other way to make green steel is to scrap the blast furnace altogether and just zap the ore with renewable electricity.

Brad is working to an East Coast deadline for the AFR, so would be great to get this as soon as possible. Please feel free to call me for further clarification 0439 941 [REDACTED].

Thank you
Ashlee

Ashlee Crabbe

Senior Media and Corporate Affairs Specialist

Fortescue Metals Group Ltd

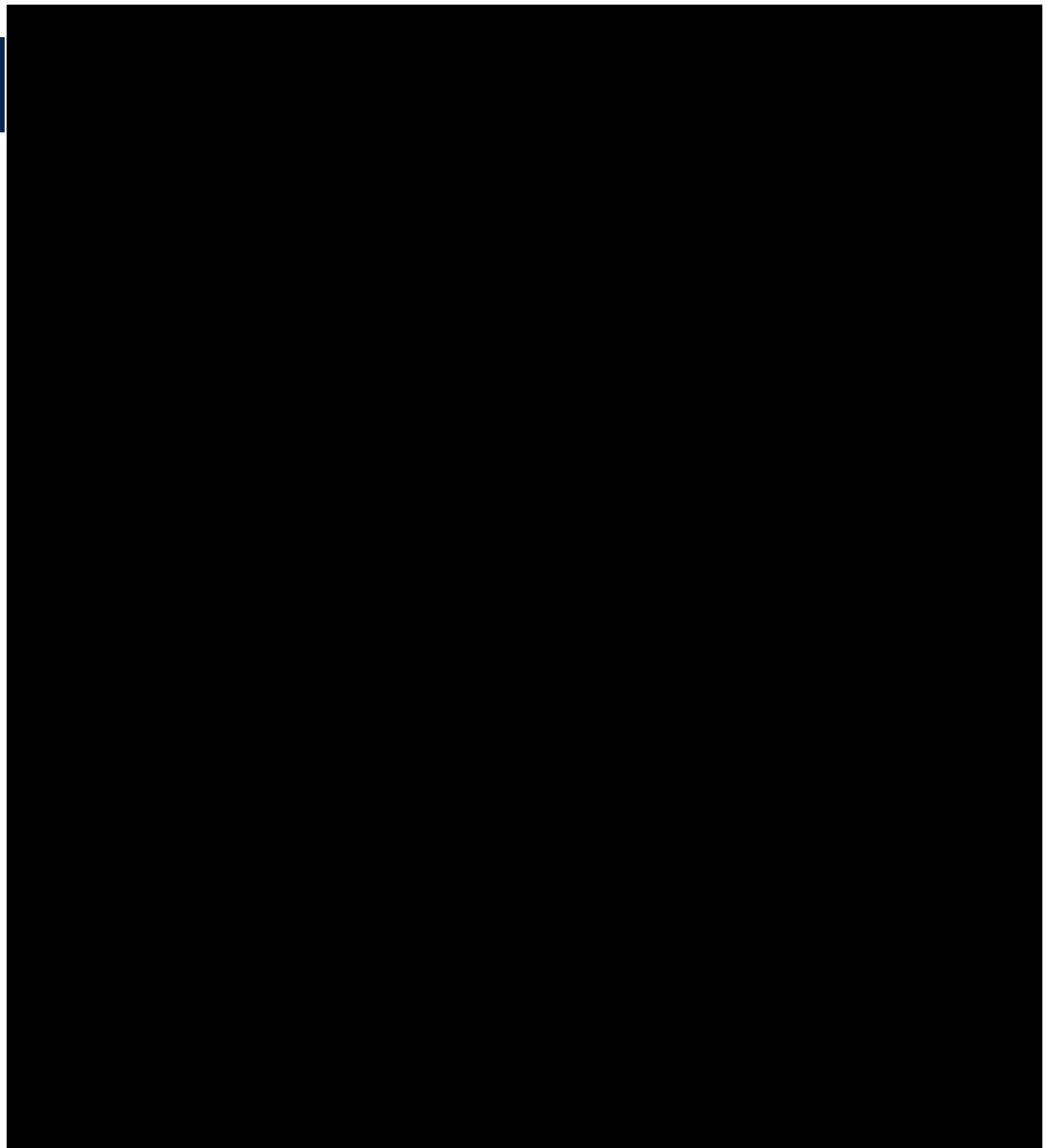
Level 2, 87 Adelaide Terrace East Perth WA 6004

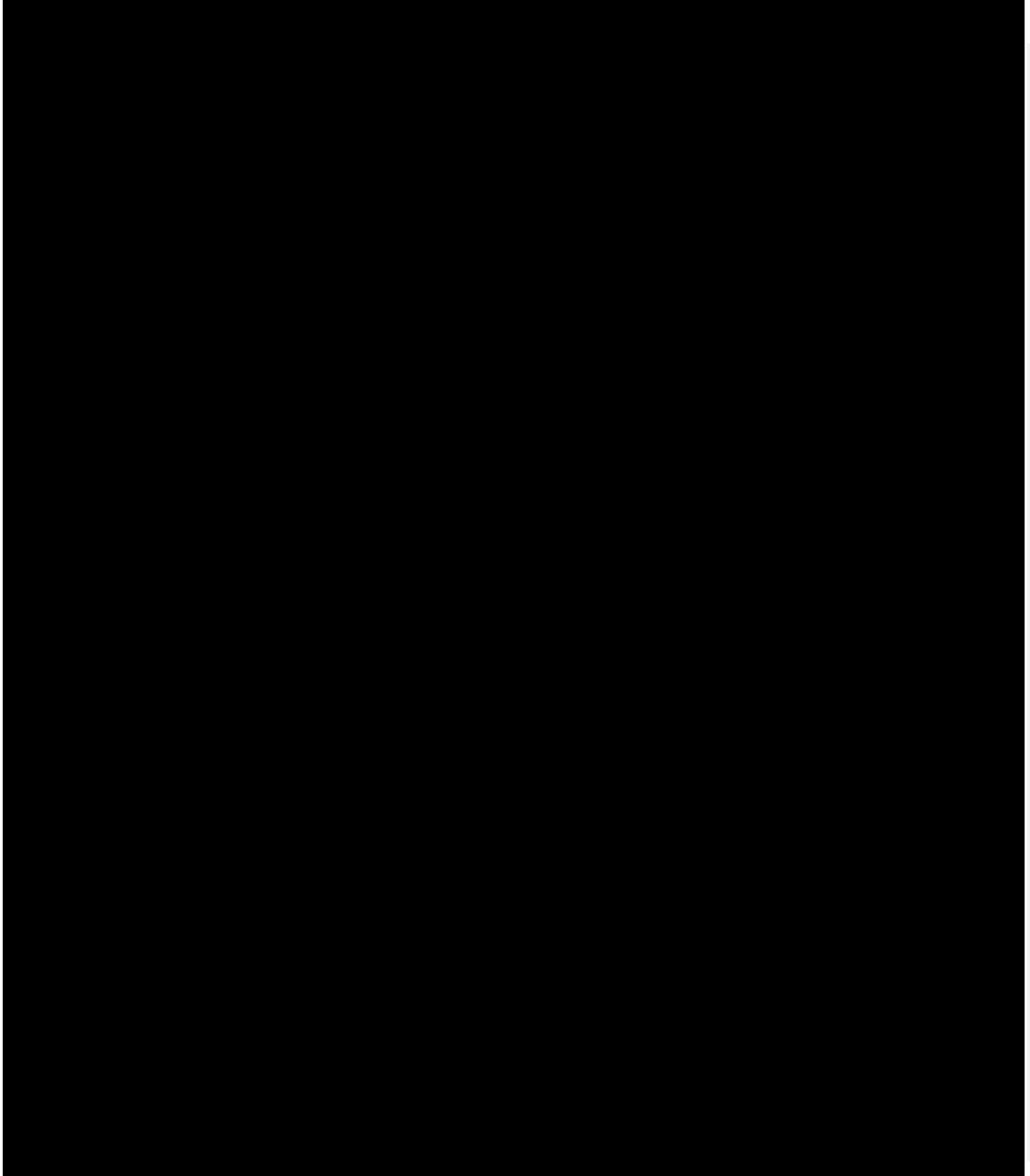
Phone: +61 8 2930 1855 | **M:** 0439 941 [REDACTED]

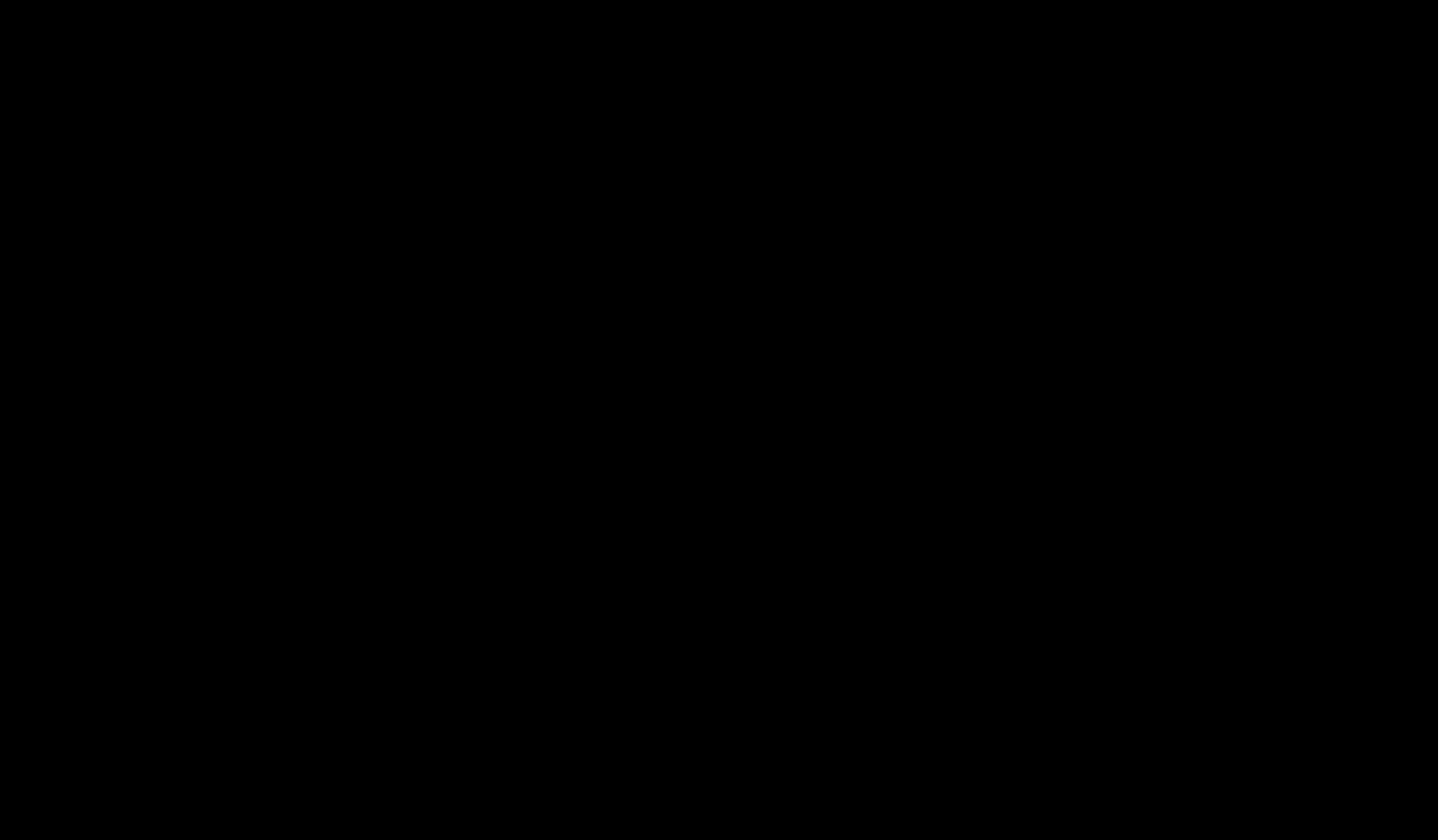
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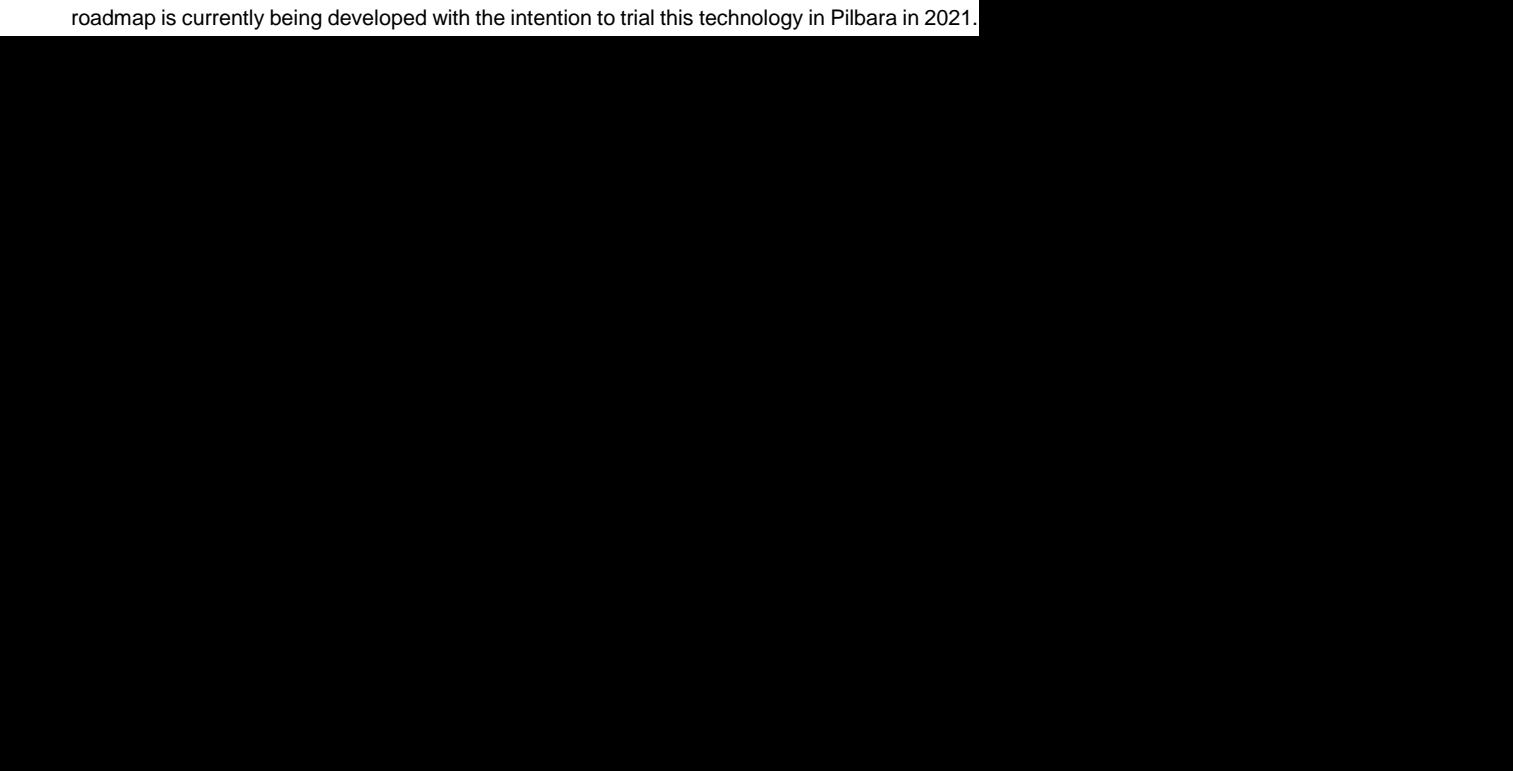


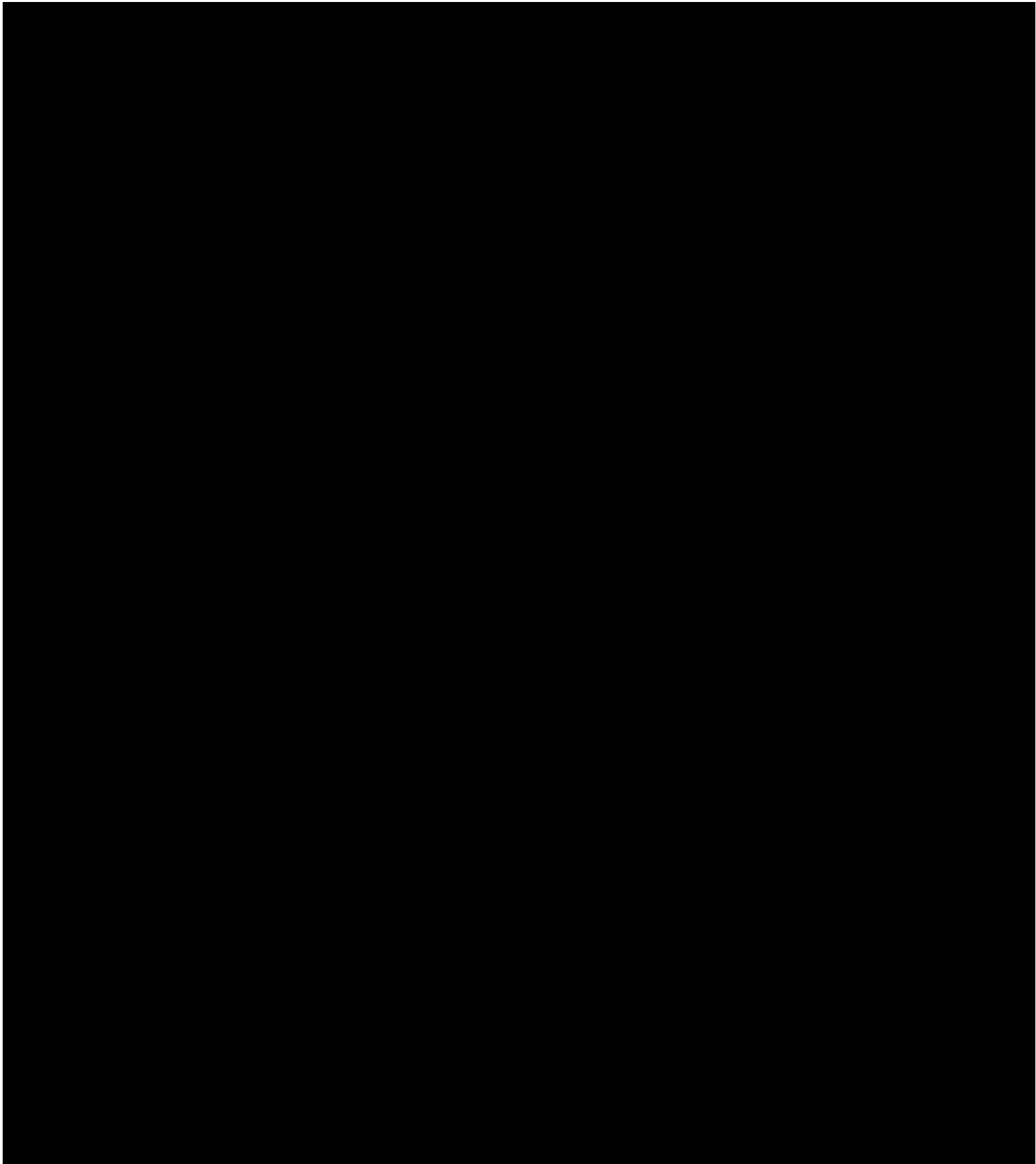


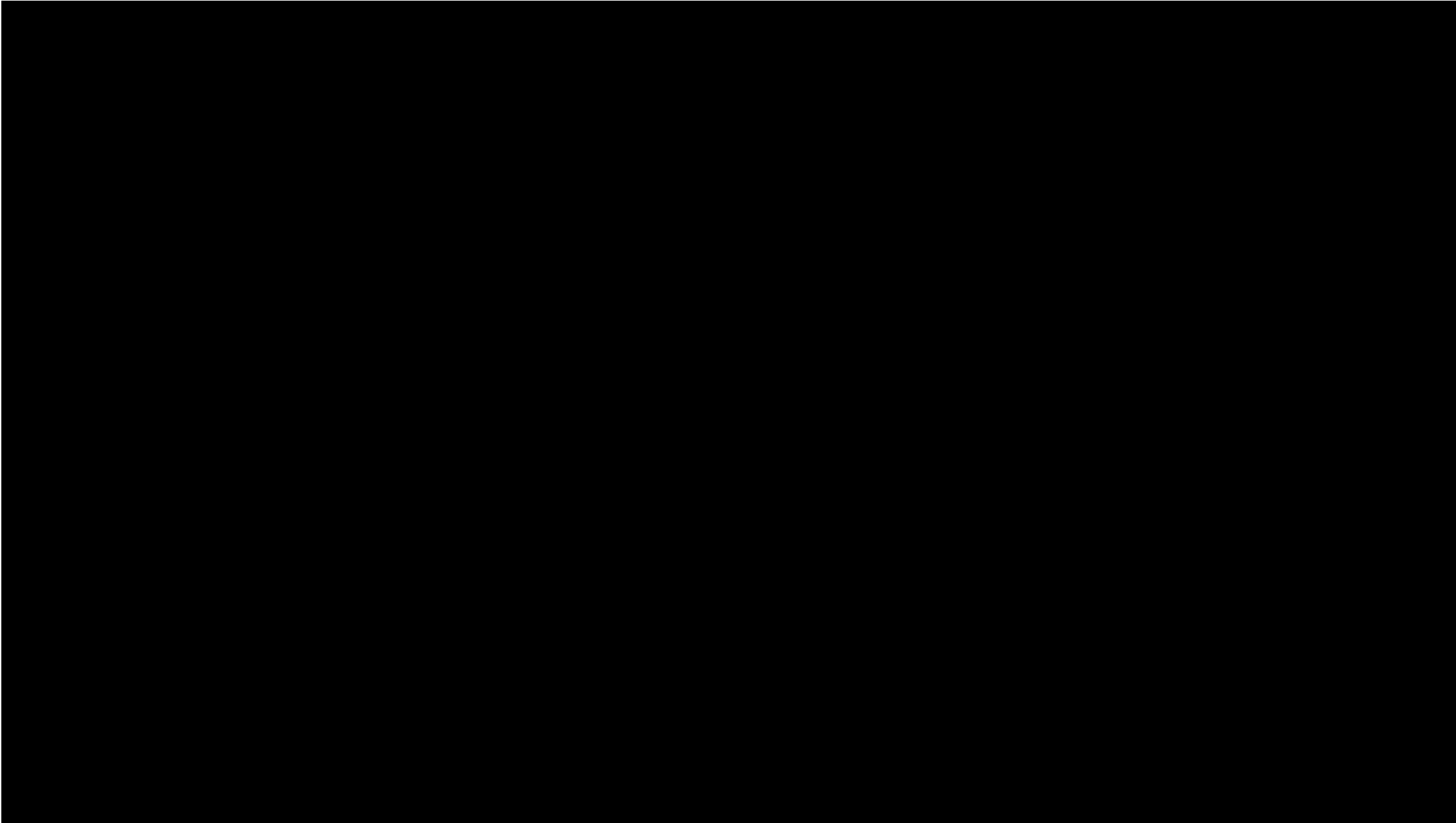


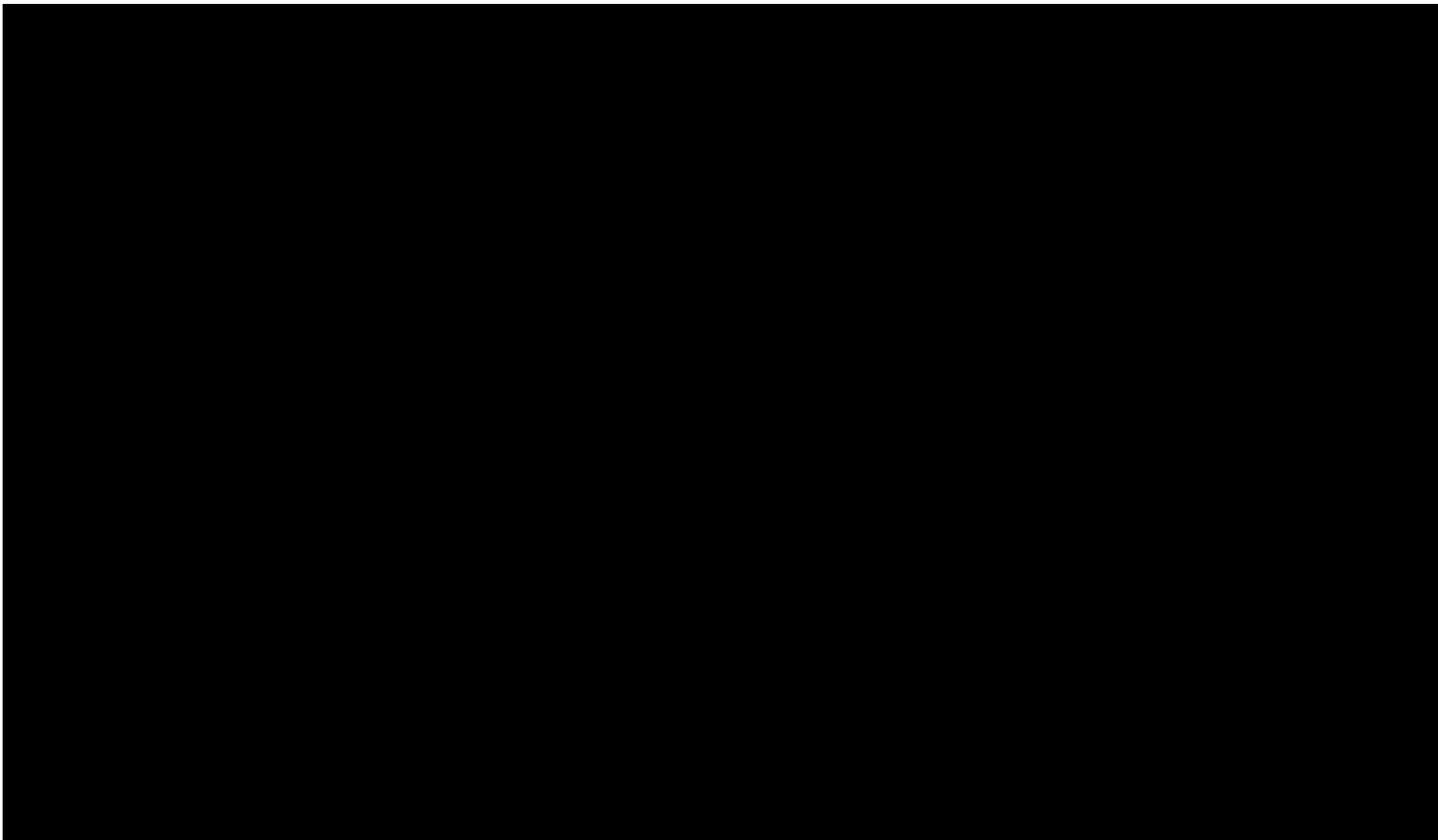


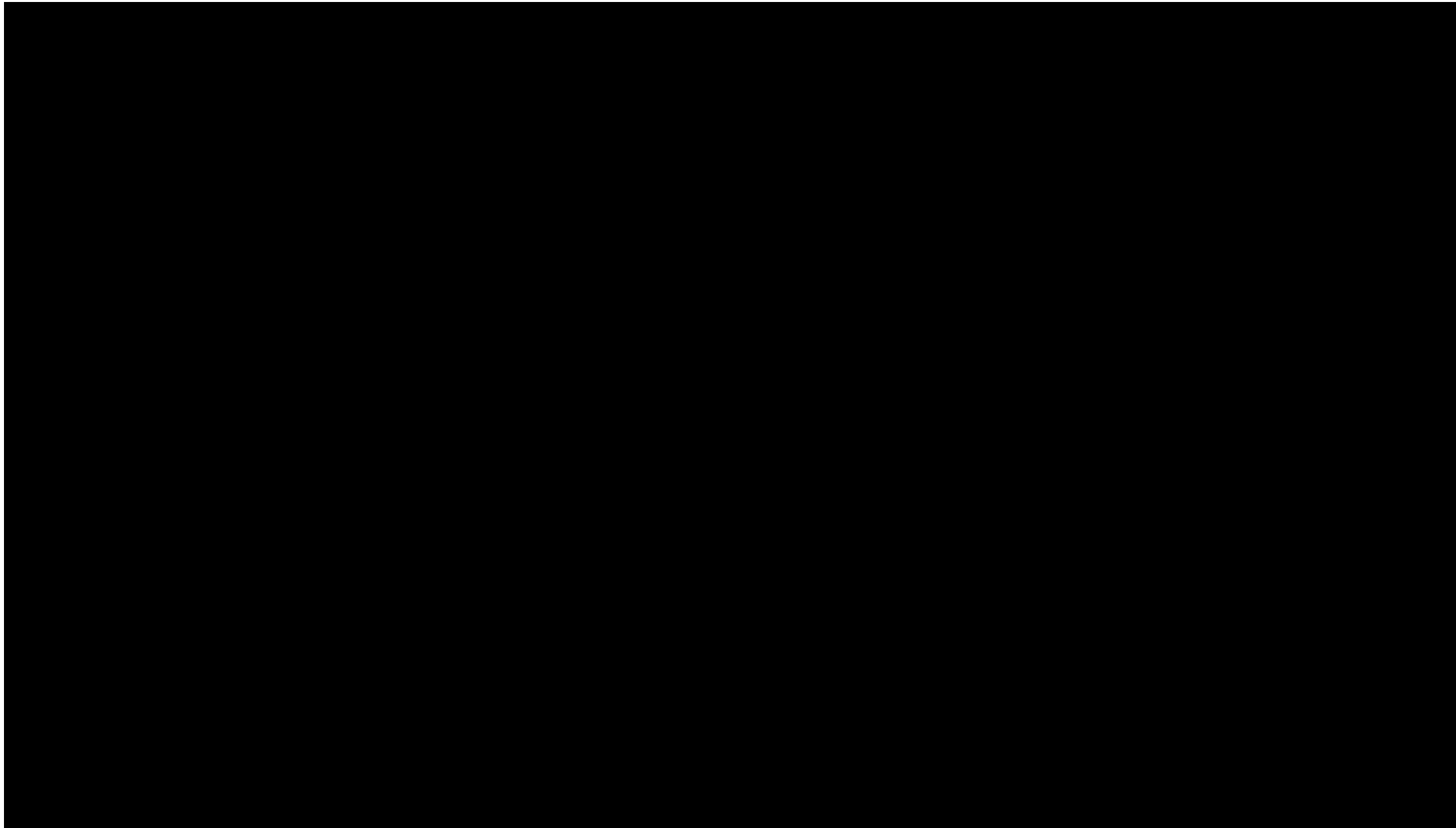
The Fortescue team has done an initial evaluation of various suitable electrolytes. Further laboratory desktop studies will be undertaken at FFI's manufacturing precinct in February/March 2021. The R&D roadmap is currently being developed with the intention to trial this technology in Pilbara in 2021.











Susanne Hantos

From: Bart Kolodziejczyk
Sent: Wednesday, 27 January 2021 5:29 PM
To: bjorn winther-jensen
Subject: RE: Out of quarantine yet ?

Hi Bjorn,

Yes, we've got money for R&D. Additional, [REDACTED] will go towards scale up and pilot plant.

Yes, I have read many of those NaOH papers. Another option, potentially in the future would be using molten carbonate or ionic liquids.

Do you want to have a call to discuss this, this or next week? It is much easier than emails.

Also apologies for late reply, I am swamped with "urgent" emails.

Talk soon,

Bart Kolodziejczyk
Fortescue Metals Group Ltd
Level 2, 87 Adelaide Terrace East Perth WA 6004

Mobile: +61 437 947 164 **Web:** www.fmgl.com.au
Twitter: @FortescueNews | www.fmgl.com.au



From: bjorn winther-jensen <bjornwj@gmail.com>
Sent: Sunday, 24 January 2021 5:33 PM
To: Bart Kolodziejczyk <bkolodziejcz@fmgl.com.au>
Subject: Out of quarantine yet ?

Hi Bartek,

Are you guys out of the quarantine ?
(Maybe the real question is if you are back to "normal" work tomorrow ?)

You wrote: "the idea is to ask for [REDACTED] for green steel R&D and a pilot project in Pilbara". Are there any decisions made for a plan regarding this ?

I understand the need for doing/achieving something fast (pilot project) and on the other hand I see the need for "buying" a fair bit of time for R&D.

So, here is a suggestion (although that I should not involve myself in politics...):

The most obvious possibility, I think, to do something (meaningful) fast is to suggest that the pilot project should be on solid state electrochemical reduction of magnetite from the Iron Bridge site. The product coming out of Iron Bridge is expected to be (in press releases etc.) 67% Fe. When water/moisture is subtracted that means almost pure Fe₃O₄. In other words, the electrochemical process does not need to include removal of other oxides - and can

therefore be a solid state process. The conductivity of magnetite is relatively high (compared to other iron oxides), which will also be an advantage to a solid state process.

There are numerous reports on performing such solid state electrochemical reduction in concentrated NaOH (which suppress the hydrogen evolution and also means that the same anode material intended for electrolysis can be used here). Potentials below 2V at reasonably high current densities have been achieved at around 100 degC (which suppress/eliminate the crossover reaction from dissolved oxygen).

Getting that going could (maybe) allow some time to find some smarter approaches to tackle hematite - which understandably is the higher aim.

This suggestion clearly needs decisions on the highest level - where understandably, there are other issues to take into account (e.g. that Iron Bridge has minority owners...).

Think about it and maybe we should arrange a call soonish.

Cheers

Bjorn

Susanne Hantos

From: Bart Kolodziejczyk
 Sent: Wednesday, 27 January 2021 5:42 PM
 To: bjorn winther-jensen
 Subject: RE: contract signed...

Hi Bjorn,

We have visited [REDACTED] roughly two months ago.

[REDACTED]

I have looked at water, ionic liquids, and molten carbonate.

[REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

Suggest any supplier globally, I am having a meeting with our procurement team to prepare them from what is coming and make it clear to them that their traditional procurement approaches won't work.

Bart

From: bjorn winther-jensen <bjornwj@gmail.com>
 Sent: Wednesday, 20 January 2021 5:47 PM
 To: Bart Kolodziejczyk <bkolodziejcz@fmgl.com.au>
 Subject: Re: contract signed...

Hi Bartek

Thanks for the info and the report.

I can see the industrial appeal in the MOE process, but man, it is not at all "elegant" or even efficient (I even think that the energy efficiency calculation in the report is overestimating the efficiency...).

Unfortunately it looks like they are ahead of any other technology for CO2 free steel.

Is it correctly understood that the molten iron (or other metal) is separated from the electrolyte by "simple" phase separation (helped by gravity) ?

At the current state, do they do batch processing or can they do continuous operation ?

I have been looking at many (MANY) papers and technical reports on dissolving iron ore. (Notably, magnetite seems to be quite easy to dissolve - especially compared to Hematite). All these reports have one thing in common: They intend to dissolve the ore in water.

Have you seen any reports on attempting dissolution in (polar) organic solvents ?

The point is that many iron(II) and iron(III) salts have higher solubility in e.g. alcohols than in water. So it is quite curious that there seems to be no attempts in that direction... (ILs not counting !)

On the lab equipment and chemicals shopping: Does Fortescue have "preferred suppliers" ? Or can I suggest products from any supplier in Australia/Perth ?

Cheers
Bjorn

On Mon, Jan 18, 2021 at 3:17 PM Bart Kolodziejczyk <bkolodziejcz@fmgl.com.au> wrote:

Wow, sounds good. Yes, we will start ordering chemicals as soon as we have the facility.

It is also great that you're making a list of things that we will need. I am working with Emily and our procurement team to simplify and expedite procurement processes to get the necessary equipment asap.

I have attached a report draft from tests on Fortescue ores using Molten Oxide Electrolysis.

[REDACTED]

We are having a board meeting in February, the idea is to ask for [REDACTED]
[REDACTED]. With further funds in "the next grant round" for scale up.

Bart Kolodziejczyk

Fortescue Metals Group Ltd

Level 2, 87 Adelaide Terrace East Perth WA 6004

Mobile: +61 437 947 164 **Web:** www.fmgl.com.au

Twitter: @FortescueNews | www.fmgl.com.au



From: bjorn winther-jensen <bjornwj@gmail.com>
Sent: Monday, 18 January 2021 3:47 PM
To: Bart Kolodziejczyk <bkolodziejcz@fmgl.com.au>
Subject: Re: contract signed...

I also got the signed NDA back, today.

I have been trying to make "shopping lists" for both lab-equipment and chemicals. So if you need input, please let me know (also before 15th of Feb..).

Also been looking for possible passes for the ore to iron process. Have got some possible good ideas that will be easy to try out. Am considering doing initial trials while here in Thailand to test viability. I should be able to do it with the gear we have here...

Cheers

Bjorn

On Mon, Jan 18, 2021 at 2:34 PM Bart Kolodziejczyk <bkolodziejcz@fmgl.com.au> wrote:

That's great! I am happy that you didn't have to start as contractor. Enjoy your "holidays" 😊

From: bjorn winther-jensen <bjornwj@gmail.com>
Sent: Monday, 18 January 2021 3:12 PM
To: Bart Kolodziejczyk <bkolodziejcz@fmgl.com.au>
Subject: Re: contract signed...

Starting date is 15th of Feb. - there are "things" here that need time to be resolved before I can focus 38 hours a week on FFI work... 🙄

I will be employed directly by Fortescue from the 15th of Feb. Having an Australian taxfile number and an Australian bank account apparently solves the issue.

We hope to be able to make the move to Perth in mid-April. Fingers crossed.

Cheers

Bjorn

On Mon, Jan 18, 2021 at 1:58 PM Bart Kolodziejczyk <bkolodziejcz@fmgl.com.au> wrote:

No worries. Congrats!

When is your start day? Are you going to be initially engaged as a contractor working form Thailand?

From: bjorn winther-jensen <bjornwj@gmail.com>
Sent: Monday, 18 January 2021 2:55 PM
To: Bart Kolodziejczyk <bkolodziejcz@fmgl.com.au>
Subject: contract signed...

Hi Bartek,

I got, signed and returned the contract today ! 😎

Thanks for initiating this whole process.

Cheers

Bjorn

Susanne Hantos

From: Bjorn Winther-jensen
Sent: Tuesday, 23 February 2021 10:51 AM
To: Bart Kolodziejczyk
Subject: Research plan for Green Steel
Attachments: Electrochemical Green Steel.docx

Hi Bartek,

Before I go much further with the time-line for the research activities, personnel etc. , I would kindly ask you to have a look at the attached *draft* research plan (sorry for the repetitive structure of the document...) to see if there are any significant areas that I have overlooked or over/under prioritized.

Also where possible, provide input to perspective collaborative research groups you know of and/or have already been in contact with.

Cheers
Bjorn

Electrochemical Green Steel - Starting from iron ore

General background and considerations

Roadmap and research plan for Electrochemical Green Steel (EC Green Steel)

Generally, the process of converting iron ore to steel contains two tasks:

- To reduce iron oxides to steel
- To remove a sufficient level of impurities/oxides

In traditional industrial practice carbon is employed for the reduction, itself being oxidized to CO₂ in a high-temperature blast furnace process. The removal of impurities – in this case mainly excess carbon as well as silicon- and metal oxides from the ore are removed in a subsequent high-temperature process through the formation of slag.

The obvious drive for developing an alternative reduction process is to stop the CO₂ release. However, a new route must also be able to manage the removal of impurities to an appropriate level, such that the resulting Green Steel products are optimized to suit the subsequent steel-making process overseas.

As such three major theoretical routes can be outlined:

Molten Iron Route.

- From dissolved ore at high-temperature, purification through phase separation of molten iron from the electrolyte (██████ type)

Dissolved Iron Route.

- Dissolution of ore in chelating or coordinating electrolytes, purification through non-solution of impurities. Followed by electrochemical (EC) reduction

Solid-state Route.

- Through solid-state electrochemistry, purification of ore prior to or after electrochemical operation

For all scenarios, the counter electrode (anode) process is oxygen evolution

Main details, requirements and limitations for these possibilities are listed below.

Molten Iron Route.

From dissolved/melted ore at high temperature above the melting temperature of (carbon-free) iron, i.e. in the 1500°C range.

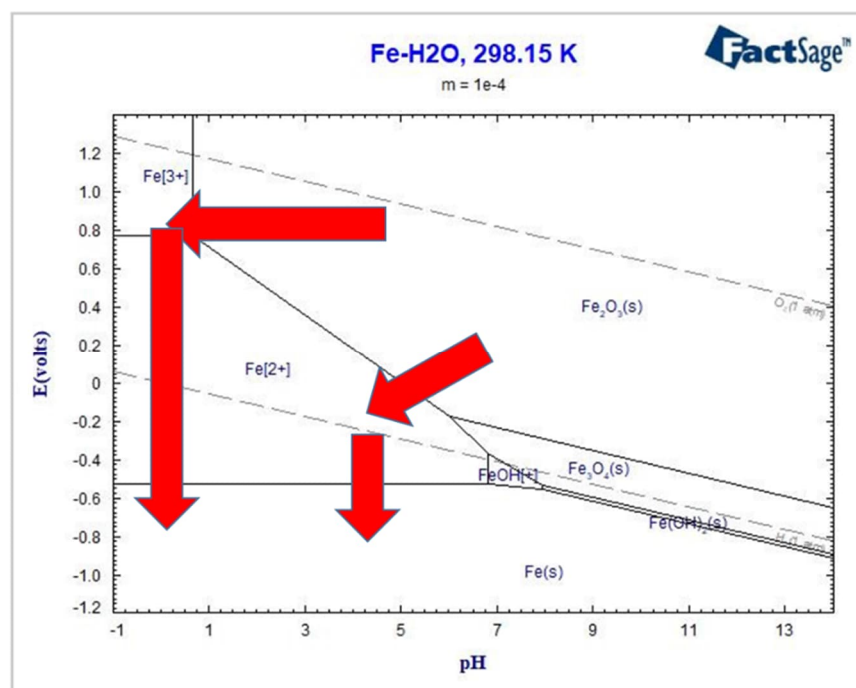
- Electrolyte. molten oxides (██████ model), other possibilities may include carbonates or molten salts
- Current ore qualities can be used directly. However, water and other volatiles have to be removed in a pre-melting step (presumably to avoid steam explosions in the electrolyte !)

- Not very compatible with intermittent power supply from solar and wind.
- Expected Power Efficiencies in the 20 – 30% range
- Apparent long development time-line
- The iron is separated from the electrolyte in the molten state by gravity assisted phase separation. Impurities (SiO_2 and metal oxides) thus remain in the electrolyte => electrolyte “cleaning” needed

Dissolved Iron Route(s)

Dissolution of ore in chelating or coordinating electrolytes, purification through non-solution of impurities

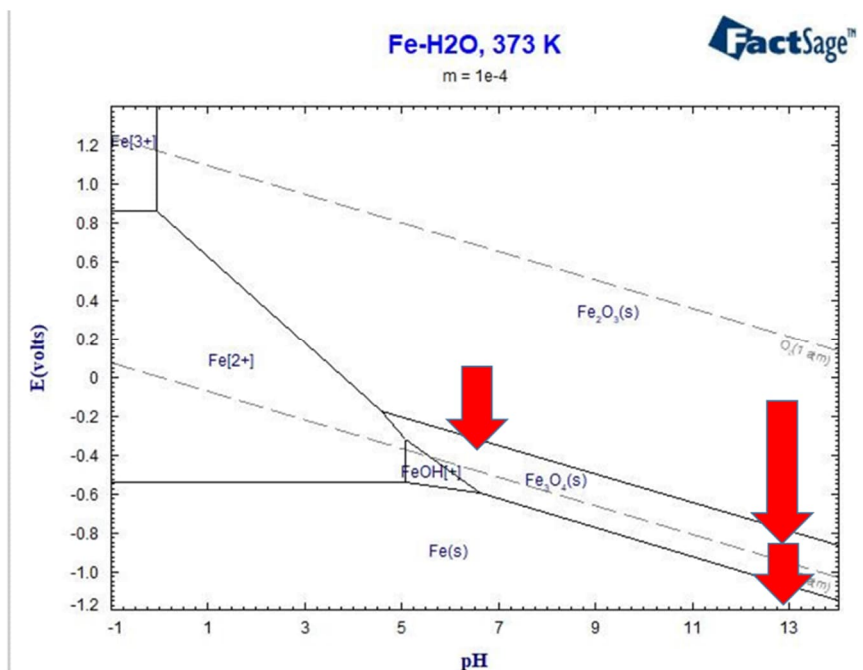
- Dissolution of hematite is generally very slow
- The chelating/coordination is increasing the potential required for iron deposition
- The chelating/coordination is allowing a wider range of pH and solvents.
- Expected Power Efficiencies in the 30 – 60 % range
- Deposition is limited by the concentration of iron in solution – which may be low in these systems
- Impurities remain in the electrolyte => electrolyte “cleaning” needed
- Significant research has been conducted but without any clear “winner” technology.
- New possibilities may emerge from “medium” temperature options using ionic liquids, molten salts or molten carbonates (300 – 800°C)
- Apparent long development time-line
- Dissolution of magnetite is significantly easier than hematite. However, it seems a detour when solid-state reduction of magnetite concentrate could give a Green Steel product directly



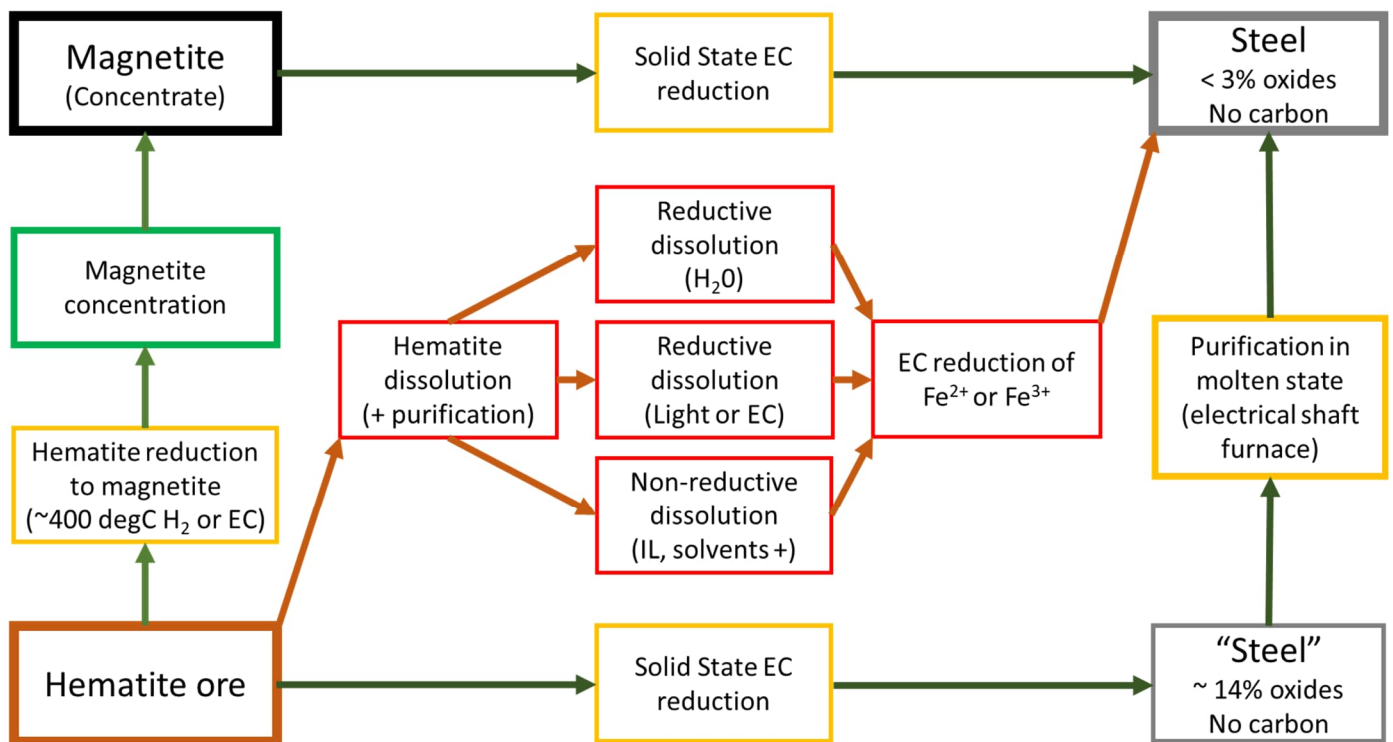
Solid-state Route(s)

The electrochemistry is resembling the “Edison cell” in charging mode where magnetite is reduced to metallic iron through a $\text{Fe}(\text{OH})_2$ intermediate. At temperature above $\sim 85^\circ\text{C}$, the $\text{Fe}(\text{OH})_2$ intermediate becomes thermodynamically unstable and the conversion from magnetite to iron can proceed directly and significantly faster.

- Impurities are not removed through the process => requires pure enough ore concentrates to produce a meaningful product or a post-reduction process e.g. in molten state for slag formation
- Cheap electrolyte (high pH NaOH or KOH solutions)
- Impurities are not deposited in the electrolyte => longer electrolyte lifetime
- Expected Power Efficiencies in the $> 60\%$ range
- High deposition rates at temperature above 85°C
- Apparent short development time-line
- Magnetite Concentrate could be a starting material, producing a pig iron quality product (without carbon)
- Large scale conversion of hematite to magnetite has been reported with hydrogen as reductant in fluidbed setups
- Direct solid-state reduction of hematite is possible. However, resulting in a “steel” product with $\sim 14\%$ oxides (based on existing ore qualities from FMG)



Flow diagram for dissolved iron (red) and solid-state (green) routes of iron ore reduction



Green frame indicates well-known, unscaled process. Yellow frame indicates well-documented research at (at least) pilot-scale level. Red frame indicates solely research level.

Alignment

In order to make a meaningful R&D planning, communication with other parts of FMG should be established to ensure that the products R&D are aiming for are aligned with "the market" and that there are agreements in place to "allow" the use of different ore types. i.e. can we suggest to firstly aim for magnetite concentrate conversion and later move to hematite ?

Below some of the questions regarding the requirements to Green Steel products out of Port Headland – to qualify to be a "product". => Anticipating the product is a type of "raw" or intermediate material in the steel production process

- Maximum level of impurities (oxides; SiO₂, Al₂O₃ etc.)
 - Is steel with 14% oxides a product ?
 - How will price be related to the level of impurities → what impurity level is it worth aiming for ?
- Porosity / Bulk density
- Preferred physical form (bars, "pigs", rolls, plates etc.)
- Estimate for max. production cost to be profitable

Preferred scenario from a R&D viewpoint

- *Priority*. Reduction of magnetite concentrate

To get prototype and pilot facility established based on solid-state reduction of magnetite concentrate to steel, where no further purification is needed to meet specs within “product range”.

- Justification.
 - The fundamentals of this process are known and tested
 - I see this as the most viable and economic (i.e. high volume) route to obtain a commercial Green Steel product on a short timescale.
 - Magnetite (concentrate) as starting material is preferred due to purity and electrical conductivity
 - It will give valuable knowhow also for possible solid-state reduction of hematite
 - It will broaden the possibilities for reduction of hematite. i.e. the hematite reduction may be carried out in two steps. Firstly, to magnetite, where concentration can proceed with known technology, secondly from magnetite to steel through the solid-state process.
- *Parallel research* with longer lead-time, maybe to be pursued in collaboration with universities and/or research institutions.
 1. Dissolution of hematite. The reaction rate is a main and general issue for both the dissolution and the deposition step.
 - a. Reductive dissolution (chelating with use of solvents)
 - b. Chelating (non-reductive) dissolution of hematite
 - c. Light induced/assisted dissolution of hematite
 - These three routes have all been reported previously without any serious scale-up. However, all with either low rates, low end-concentration and/or with unknown possibilities for recycling the media.
 - A method for electrodeposition of iron will depend on the “liquid” used for the dissolution. i.e. starting electrodeposition studies without having a dissolution route is therefore meaningless. The dissolution process must produce significant iron concentrations to allow appreciable deposition rates of metallic iron.
 - Shifting to “medium-high” temperatures (300-850°C) with molten salt or molten carbonate electrolytes could help the rate issues, but it is quite early days.
 2. Reduction of hematite to magnetite.
 - a. By hydrogen reduction of hematite (e.g. in a fluid bed setup at ~300 - 450 degC). This is well-documented and at least pilot-scale has been demonstrated

- b. Reduction of hematite, using metallic iron as reducing agent.
3. On-shore post-purification of "raw" Green Steel to export quality Green Steel.

Priority. Reduction of magnetite concentrate through a solid state process

A 67% Fe magnetite concentrate should produce a ~ 92.5% Fe Green Steel (without including the calculation of the removal of water/moisture, which would indeed be removed in the process – am awaiting a more detailed composition of the magnetite concentrate(s) existing and expected). This is approximately the iron content in pig iron.

The solid-state reduction of magnetite is less researched than that of hematite (except for the Edison cell !). The high(er) conductivity of magnetite should help limiting the ohmic loss in the process.

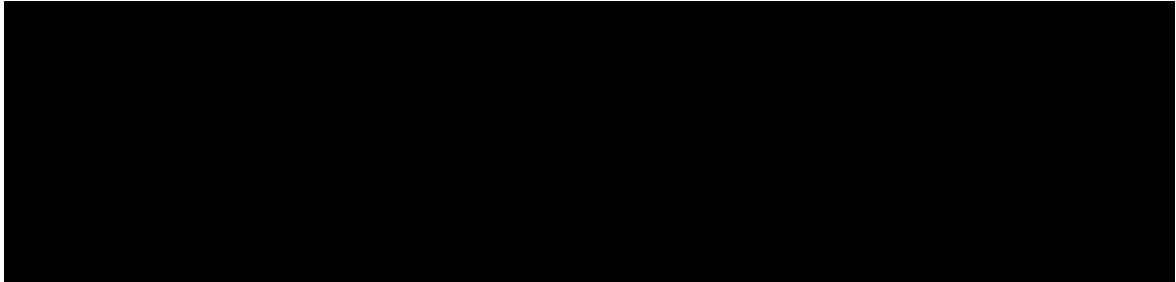
Research topics

- a) *Testing the reduction on relevant, available magnetite ore concentrates.* Most reports have been using synthetic magnetite (or synthetic hematite) so adjusting to large-scale reality is needed.
- b) *Optimization of electrolyte.* Traditional [REDACTED] NaOH electrolytes have been used with success. The NaOH electrolytes have high conductivity and low water activity, which is needed to suppress hydrogen evolution. However, there is merit in revisiting the electrolyte composition. During the reduction process, the released oxygen ions are reacting with water (not OH⁻) and thus a lower pH could be an advantage. The very high pH is in principal not helping the reaction to "escape" the hydrogen evolution potential (see Pourbaix diagram at 100°C above) and low water activity could alternatively be obtained by adding significant amounts of [REDACTED] (It is acknowledged that high pH is an advantage to the oxygen evolution reaction on the anode).
- c) *Securing 100% conversion of ore.* Particle size and distribution, reactor layout and dimensions, operational parameters (voltage and current density), The possibility of multiple reduction steps (by changing the operational parameters) as well as the dimensions of the magnetite layer, all have to be optimized.

- g) *Reactor design for upscaling, eventually continuous operation.*
 - Operating at 90°C or higher ([REDACTED]). Possible "co-heating" through pre-heating (drying of raw magnetite concentrate is needed to control the

electrolyte composition in a more continuous operation) of the magnetite concentrate by microwave or inductive heating.

- Efficient removal of produced oxygen from the anode and reactor closed to atmospheric oxygen to avoid oxygen reduction as cross reaction.

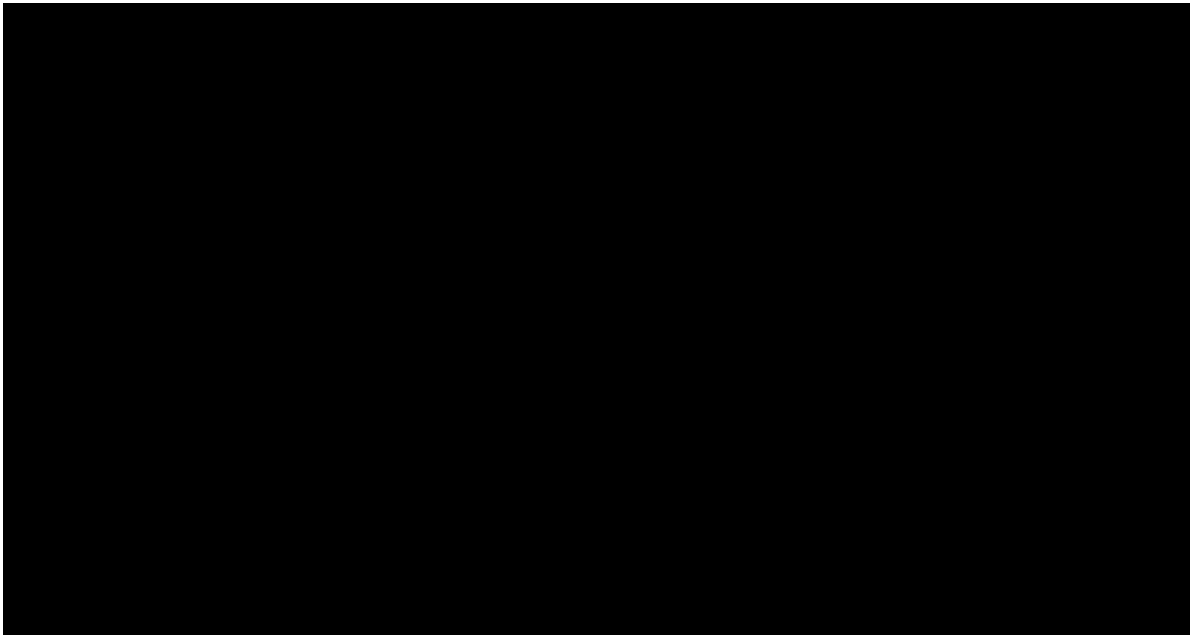


Parallel research with longer lead-time.

1. Dissolution of hematite.

We don't have a clear direction here. There is surely no apparent method that can provide appreciable dissolution rates. Pure aqueous systems are, in my opinion, not worth revisiting.

Research topics



- c) Molten salts, Molten carbonates. Iron dissolution and deposition has been reported from these medium-high temperature electrolytes. E.g. from $\text{CaCl}_2\text{-KF}$ @ 825°C . My suggestion would be to seek "proof of concept" projects (with clear scale-up passes) with relevant groups experienced in these systems, before setting up facilities in Perth. One such collaborator could be Professor Geir Martin Haarberg, Department of Materials Science and Engineering, Faculty of Natural Sciences, NTNU in Norway, geir.martin.haarberg@ntnu.no, +47 73594036. His group has been working on both molten salt and molten carbonate systems for various metals.
- d) Ionic Liquids. Here I suggest to search for systems/research groups that have shown reasonable dissolution rates of iron ore (hematite). I have not found any convincing reports

yet (!). If there is indeed merit for dissolution in the temperature range below 300°C, then we should pursue collaborative research projects until scaling has been verified.

2. Reduction of hematite to magnetite.

Research topics

- a) Reduction of hematite to magnetite is a well-documented field using either hydrogen, carbon (CO) or siderite (CO) as reducing agents. Pursuing one of these routes should not require further research on the R&D level but be on pilot plant level in collaboration with a fluid-bed-equipment manufacture.



3. On-shore post-purification of "raw" Green Steel to export quality Green Steel. Many in FMG and elsewhere will know much more about the possibilities and ultimately this topic may be well outside the R&D facility's business.

Research topics

- a) Using traditional high-temperature, molten iron processes for the removal of SiO₂ and metal oxides. E.g. Open-hearth process, Bessemer converter or Electric shaft furnace. Several patents have been filed in the area, e.g. US2693411A - Method of purifying molten pig iron, and EP2530171A1 - Method for removing impurities in molten cast iron.

Susanne Hantos

From: Bjorn Winther-jensen
Sent: Wednesday, 24 February 2021 3:02 PM
To: Bart Kolodziejczyk
Subject: Iron Ore samples

Hi Bartek,

The outcome of my last two hours considerations, given the current situation/state of facilities etc., etc.:
I cannot commit to produce any meaningful "something" (understood as solid iron samples made by electrochemical reduction of FMG iron ore) by the end of June 2021.
I don't mind challenges but this is out of proportion.

I guess the fastest way to "something" is by reduction of hematite with hydrogen at high temperature (700 – 900 degC) followed by removal of oxides in the molten state (1500 degC). These processes are well outside my expertise and a more appropriate person should be appointed for pursuing such path.

Cheers
Bjorn

From: Bjorn Winther-jensen
Sent: Wednesday, 24 February 2021 1:08 PM
To: Bart Kolodziejczyk <bkolodziejcz@fmgl.com.au>
Subject: RE: Iron Ore samples

Hi Bartek,

Better be today after 5pm (which is only 4pm here, I presume)

B

From: Bart Kolodziejczyk
Sent: Wednesday, 24 February 2021 1:03 PM
To: Bjorn Winther-jensen <bjorn.wintherjensen@fmgl.com.au>
Subject: RE: Iron Ore samples

Hi Bjorn, can do only after 5 pm, or tomorrow.

From: Bjorn Winther-jensen
Sent: Wednesday, 24 February 2021 1:57 PM
To: Bart Kolodziejczyk <bkolodziejcz@fmgl.com.au>
Subject: RE: Iron Ore samples

Hi Bartek,

When would you have time to talk ?

Cheers
Bjorn

From: Bart Kolodziejczyk
Sent: Wednesday, 24 February 2021 12:41 PM
To: Bjorn Winther-jensen <bjorn.wintherjensen@fmgl.com.au>
Subject: RE: Iron Ore samples

Hi Bjorn,

Yes, I talked to Deputy Vice-Chancellor of UWA. We'll get overarching R&D agreement this or early next week. You will be able to use any equipment at UWA.

Bart

From: Bjorn Winther-jensen
Sent: Wednesday, 24 February 2021 11:25 AM
To: Bart Kolodziejczyk <bkolodziejcz@fmgl.com.au>
Subject: RE: Iron Ore samples

Hi Bartek,

I see...

In that case I guess that we cannot wait for our own lab to be up running. Somehow we have to get started in somebody's else lab. Hmmm

Bjorn

From: Bart Kolodziejczyk
Sent: Wednesday, 24 February 2021 10:07 AM
To: Bjorn Winther-jensen <bjorn.wintherjensen@fmgl.com.au>
Subject: RE: Iron Ore samples

Sounds good. We had this Think Tank last two days, I was just told that we need to have something to show by June 30, 2021. The pressure is not only on us, but also others to decarbonise FMG operations.

On a positive note, Malcolm Turnbull was appointed FFI Australia Chairman.

From: Bjorn Winther-jensen
Sent: Wednesday, 24 February 2021 11:02 AM
To: Bart Kolodziejczyk <bkolodziejcz@fmgl.com.au>
Subject: RE: Iron Ore samples

Hi Bartek,

Am aware of the issues at Iron Bridge and that material may not be available on the short term. However, there must be data available e.g. from the pilot project at iron bridge and I would like to be able to at least consider the possibilities of using magnetite.

Cheers
Bjorn

From: Bart Kolodziejczyk
Sent: Wednesday, 24 February 2021 9:54 AM
To: Bjorn Winther-jensen <bjorn.wintherjensen@fmgl.com.au>
Subject: RE: Iron Ore samples

Hi Bjorn,

I am not sure if you get any magnetite at this point.

Iron Bridge has been suspended last week due to cost blow out. Magnetite projects have been highly unsuccessful globally.

[REDACTED]

[REDACTED]

Bart

From: Bjorn Winther-jensen
Sent: Wednesday, 24 February 2021 10:51 AM
To: Bart Kolodziejczyk <bkolodziejcz@fmgl.com.au>; Uu Vuu <tvuu@fmgl.com.au>; Simon Campbell-Hardwick <scampbellhardwick@fmgl.com.au>; Christopher Counsell <ccounsell@fmgl.com.au>
Cc: Aaron Szumilak <aszumilak@fmgl.com.au>; Benjamin Brun <bbrun@fmgl.com.au>; IRS-QA <RS-QA@fmgl.com.au>
Subject: RE: Iron Ore samples

Dear all,

- Thanks Bart for getting me in the loop.

I am currently investigating the overall possibilities for Green Steel processes. As help to evaluate these possibilities I need input regarding the composition and particle size of the available and "possible" ore qualities. For the hematite ores, I already have sufficient data. For the magnetite concentrate(s), data for "typical" composition and particle size distribution would be very helpful. I presume that these data already exist and can be made available to me.

Kind regards
Bjorn WJ

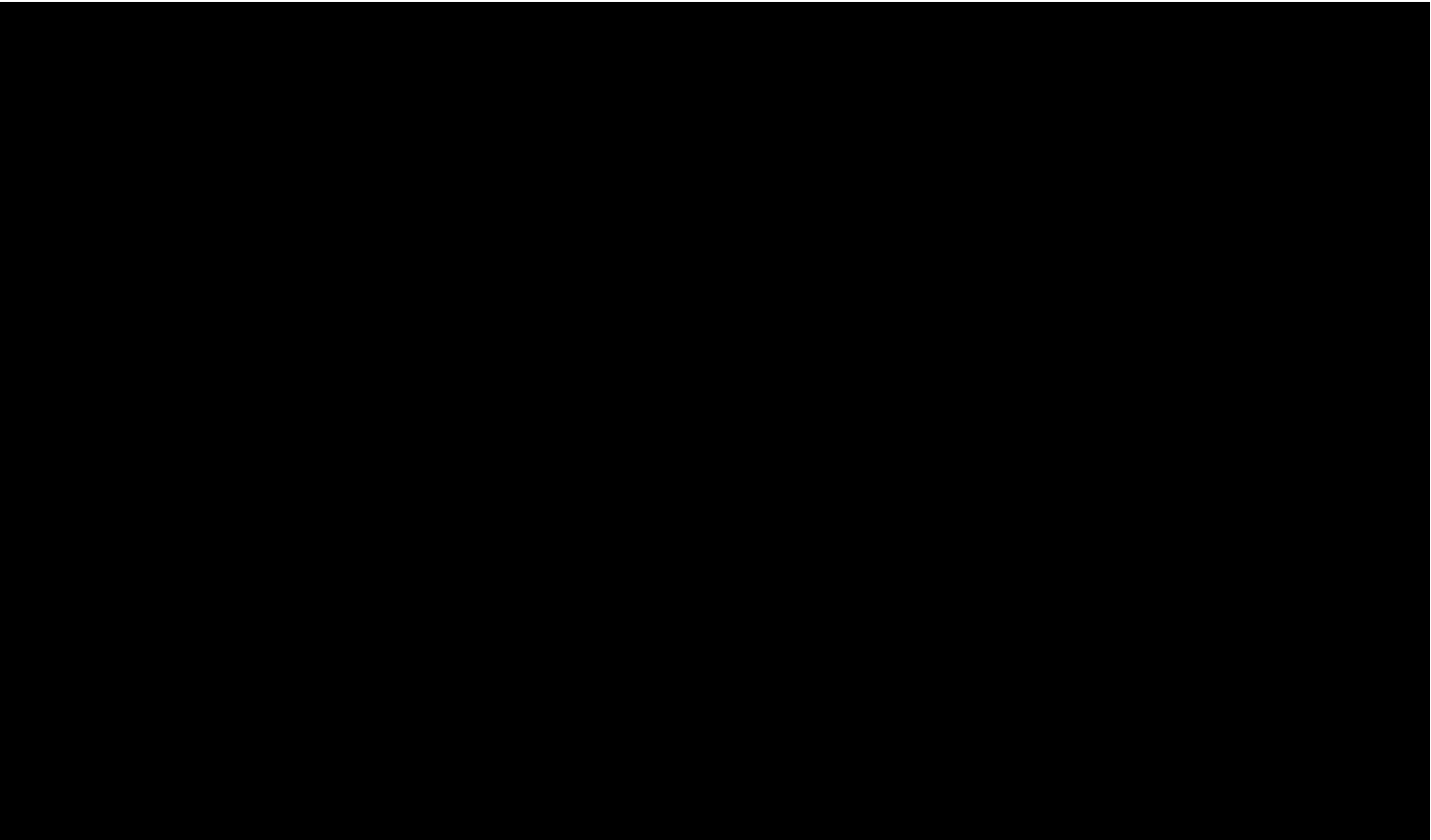
From: Bart Kolodziejczyk
Sent: Wednesday, 24 February 2021 8:42 AM
To: Uu Vuu <tvuu@fmgl.com.au>; Simon Campbell-Hardwick <scampbellhardwick@fmgl.com.au>; Christopher Counsell <ccounsell@fmgl.com.au>
Cc: Aaron Szumilak <aszumilak@fmgl.com.au>; Benjamin Brun <bbrun@fmgl.com.au>; IRS-QA <RS-QA@fmgl.com.au>; Bjorn Winther-jensen <bjorn.wintherjensen@fmgl.com.au>
Subject: RE: Iron Ore samples

Thank you, Tuu.

I have CC'ed Bjorn who also had questions regarding particle size and distribution would be helpful.

Bjorn is leading R&D on our green steel effort.

Thank you,
Bart



From: Bart Kolodziejczyk <bkolodziejcz@fmgl.com.au>
Sent: Friday, 19 February 2021 11:33 AM
To: Simon Campbell-Hardwick <scampbellhardwick@fmgl.com.au>; Christopher Counsell <ccounsell@fmgl.com.au>
Cc: Aaron Szumilak <aszumilak@fmgl.com.au>; Benjamin Brun <bbrun@fmgl.com.au>; IRS-QA <RS-QA@fmgl.com.au>
Subject: RE: Iron Ore samples

Hi Simon and Ben,

Thank you for your package. We have received it just now.

Can you please tell us more about the composition of this sample, if that information is available?

Thank you and have a great weekend,
Bart

From: Simon Campbell-Hardwick
Sent: Tuesday, 16 February 2021 4:56 PM
To: Bart Kolodziejczyk <bkolodziejcz@fmgl.com.au>; Christopher Counsell <ccounsell@fmgl.com.au>
Cc: Aaron Szumilak <aszumilak@fmgl.com.au>; Benjamin Brun <bbrun@fmgl.com.au>; IRS-QA <RS-QA@fmgl.com.au>
Subject: RE: Iron Ore samples

Hi Bart,

Nice to e-meet you too. Ben will be sending it to you via Express Post. It should arrive by the end of this week.

Cheers,
Simon

From: Bart Kolodziejczyk <bkolodziejcz@fmgl.com.au>
Sent: Tuesday, 16 February 2021 3:11 PM
To: Simon Campbell-Hardwick <scampbellhardwick@fmgl.com.au>; Christopher Counsell <ccounsell@fmgl.com.au>
Cc: Aaron Szumilak <aszumilak@fmgl.com.au>; Benjamin Brun <bbrun@fmgl.com.au>; IRS-QA <RS-QA@fmgl.com.au>
Subject: RE: Iron Ore samples

Hi Simon,

Nice e-meeting you.

That's a great news. Can we get it all sent to Level 2, 6-8 Bennett Street, East Perth?

Thank you,
Bart

From: Simon Campbell-Hardwick
Sent: Tuesday, 16 February 2021 1:56 PM
To: Christopher Counsell <ccounsell@fmgl.com.au>; Bart Kolodziejczyk <bkolodziejcz@fmgl.com.au>
Cc: Aaron Szumilak <aszumilak@fmgl.com.au>; Benjamin Brun <bbrun@fmgl.com.au>; IRS-QA <RS-QA@fmgl.com.au>
Subject: RE: Iron Ore samples

G'day Chris,

It looks like there is a 5kg duplicate of the WP (NJ1677).

Where would you like it sent?

Cheers,
Simmo

From: Christopher Counsell <ccounsell@fmgl.com.au>
Sent: Tuesday, 16 February 2021 12:40 PM
To: Simon Campbell-Hardwick <scampbellhardwick@fmgl.com.au>; Bart Kolodziejczyk <bkolodziejcz@fmgl.com.au>
Cc: Aaron Szumilak <aszumilak@fmgl.com.au>
Subject: Iron Ore samples

Gday Simmo

Bart is after 1kg sample of Iron ore for Electrolysis test work. Have we still got splits from the [REDACTED] test work? If so can we get a 1kg split of the WPF sample please?

Cheer

Chris