

# Cooperative Research Centres Projects (CRC-P) Quarterly Report

<u>CRC-P &amp; Selection Round Number:</u>	CRC-P60964 - CRC-P Round 4
<u>CRC-P Title:</u>	High performance energy storage alternative to lithium ion batteries
<u>Lead Participant Entity Name:</u>	FIRST GRAPHENE LIMITED
<u>Funding Period:</u>	01/01/2018 to 30/06/2020
<u>Reporting Period:</u>	July to September (Quarter 1) – 2018/19

## Notes:

This report has a number of purposes which include but are not limited to:

- Providing a basis for making payments;
- Recording the progress of the CRC Project against the Funding Agreement;
- Completing a Program Data Questionnaire (end of financial year); and
- End of Project reporting requirements (final quarterly report).

Information contained in this report may be used by the department for the Minister, the CRC Advisory Committee and other stakeholders.

## 1. Project and Milestone progress

### a. Project progress

Please provide a brief outline of Project progress undertaken in the quarter, including any real or potential challenges or issues, and any major achievements.

In the September quarter Swinburne University of Technology has achieved the following objectives:

- Development of layer by layer stacking system with optimised layer thickness, separator thickness and alignment completed.
- Development of optimal electrolyte injection and sealing strategy and testing the performance and leakage completed.
- Design and fabrication of prototype regulation circuitry to maintain the output voltage completed.

There is a requirement of the designed stacking process to be carried out. The stacking process needs to be further optimised in order to decide the exact geometry.

During the quarter Flinders University went to Swinburne and tested the spreading of some of their graphene oxide (GO) material. Deficiencies were found in this process and Dr Kasturi Vimalanathan from Flinders has proceeded to modify the VFD process to achieve the GO required by SUT. This first meeting of Flinders & SUT was very useful in understanding what was required from each party.

A further meeting and trial will occur during the coming quarter.

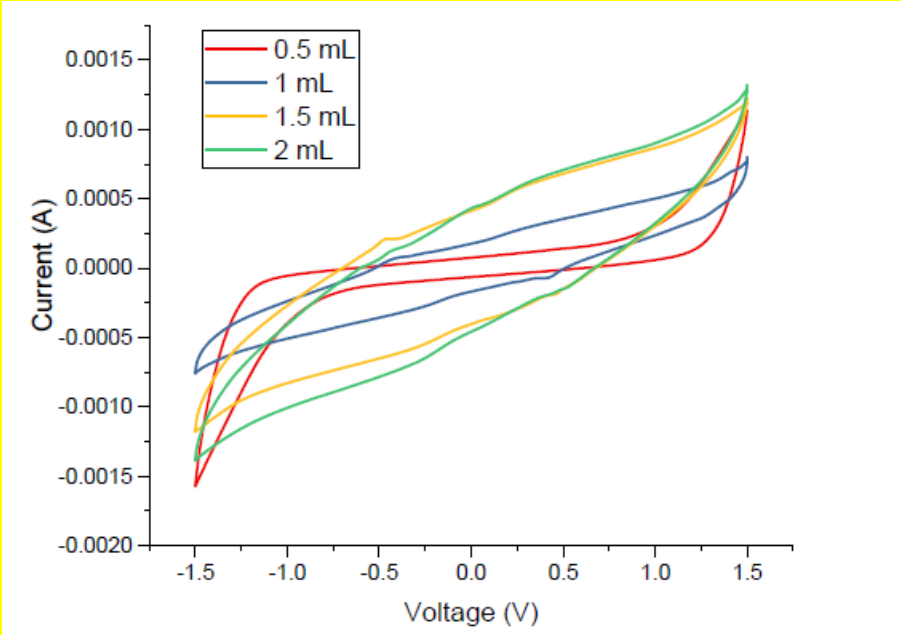
## b. Milestone progress

Complete the table below and comment on each project milestone [Schedule 2]<sup>1</sup>

Notes:

1. Items in [square brackets] refer to the relevant section of your Funding Agreement.
2. Percentage complete at the time of the end of the review period for this report. If already completed, enter '100%'.
3. End date as per the Funding Agreement.
4. Actual or expected completion date.
5. If a future milestone has not yet commenced, enter 'Yet to commence'. In addition to progress comments, if the agreed end date is unlikely to be met, outline:
  - the reasons for the delay on the project milestone, the expected impact of the delay will have on the project milestone; and
  - actions taken or proposed to ensure that the project milestone is achieved.

No	Project Milestone	% Complete <sup>2</sup>	End Date <sup>3</sup> Agreed	Completion Date <sup>4</sup> Expected/Actual
1	GO reduction and production completed	20	30/06/2018	
<b>Progress Comments</b> – work undertaken and impact of any delay <sup>5</sup>				
The VFD has produced GO. Work is now being undertaken with an improved First Graphene product, PureGRAPH™ 5, and it is expected the oxygenation levels will increase.				
2	Supercapacitor production and testwork completed	25	31/12/2018	
<b>Progress Comments</b> – work undertaken and impact of any delay <sup>5</sup>				
<p>The requirements to design the stacking process was carried out. The stacking process needs to be further optimised in order to decide the exact geometry. There are three possible solutions:</p> <ul style="list-style-type: none"> <li>• Continue with the current company on customising the design of the automatic process and machinery. (highest cost, high accuracy, require a fixed set of parameters, longer lead time, impressive, customisation, but no flexibility)</li> <li>• Do in-house design and manufacturing (medium cost, high accuracy, run in parallel with the process development, customisation, high flexibility, less impressive)</li> <li>• Buy commercial stacking machine (medium cost, low accuracy, need separator which decreases the volume ratio of the supercapacitor, short lead time, impressive, no flexibility, no customisation)</li> </ul> <p>At a stakeholders meeting in August it was agreed to proceed with the second choice.</p>				

3	GO supercapacitor assembly completed	25	30/06/2019	
<b>Progress Comments</b> – work undertaken and impact of any delay <sup>5</sup>				
<p>Development of optimal electrolyte injection and sealing strategy and testing the performance and leakage was undertaken. Injection of the minimum electrolyte required.</p> <p>Goal</p> <p>The cost of the electrolyte in this project, the ionic liquid, is high. Our goal is to determine the optimal amount of electrolyte, establishing the minimum electrolyte required for achieving the high performance of the supercapacitors. Test work has indicated 2 ml supercapacitor gives the largest area of the CV (current/voltage) curves.</p> 				
4	Testing of supercapacitor and GO product development completed	15	30/06/2020	
<b>Progress Comments</b> – work undertaken and impact of any delay <sup>5</sup>				
<p>As mentioned earlier in this report the GO produced by Flinders was not suitable for the supercapacitor. Dr Kasturi Vimalanathan is now working with a new FGR product and initial test results indicate a higher level of oxygenation is being achieved. It is necessary to obtain repeatability of these results prior to providing further details on the GO material or providing it to Swinburne for testing.</p>				
5	Industry education and training activities completed	20	30/06/2020	
<b>Progress Comments</b> – work undertaken and impact of any delay <sup>5</sup>				
<p>FGR provides regular updates to equity markets on the progress of work being undertaken through the CRC-P program. FGR will be a speaker at the first Australian-EU workshop on Graphene and Related Materials (GRM), which will be held on 17 October 2018 in Adelaide. Co-organised by the Australian Research Council (ARC) Hub for Graphene Enabled Industry Transformation, Commonwealth Scientific and Industrial Research Organisation (CSIRO) and the European Graphene Flagship project, this workshop provides a platform for discussing the common challenges in moving graphene from research labs to commercial products and identify opportunities for future collaborations</p>				

## 2. Financial Progress

Please fill in the tables below [Schedule 4].

### a. Participant Contributions

Recipient/Lead Participant: FIRST GRAPHENE LIMITED			
Contribution type	This quarter	Contracted for current FY	Total contracted over the life of the CRC-P
Cash	275,000	\$470,020	\$1,120,000
FTE	.11	0.44	1.06
FTE Value (= FTE x \$250,000)	27,500	\$110,000	\$265,000
Non-staff in-kind	17,000	\$68,000	\$155,000
Total value of contributions	319,500	\$648,020	\$1,540,000

Notes, please include any relevant details:

s 22 attends all monthly meetings at Swinburne on behalf of the FGR to provide feedback and guidance.

Participant: Swinburne University of Technology			
Contribution type	This quarter	Contracted for current FY	Total contracted over the life of the CRC-P
Cash		\$0	\$0
FTE	.08	0.30	0.75
FTE Value (= FTE x \$250,000)	20,000	\$75,000	\$187,500
Non-staff in-kind	-	\$0	\$0
Total value of contributions	20,000	\$75,000	\$187,500

Notes, please include any relevant details:

One staff member has left SUT and is being replaced.

Participant: Flinders University of South Australia			
Contribution type	This quarter	Contracted for current FY	Total contracted over the life of the CRC-P
Cash		\$0	\$0
FTE	.05	0.20	0.5
FTE Value (= FTE x \$250,000)	12,500	\$50,000	\$125,000
Non-staff in-kind		\$0	\$0
Total value of contributions	12,500	\$50,000	\$125,000

Notes, please include any relevant details:

Additional staff resources are being applied to this area to speed up the work being performed.

<b>Participant: KREMFORD (VIC) PTY LTD</b>			
<b>Contribution type</b>	<b>This quarter</b>	<b>Contracted for current FY</b>	<b>Total contracted over the life of the CRC-P</b>
Cash		\$0	\$0
FTE	.04	0.15	0.38
FTE Value (= FTE x \$250,000)	10,000	\$37,500	\$95,000
Non-staff in-kind	-	\$0	\$0
<b>Total value of contributions</b>	<b>10,000</b>	<b>\$37,500</b>	<b>\$95,000</b>

Notes, please include any relevant details:

Kremford's FTE position remains unchanged.

<b>Total Participant Contributions</b>			
<b>Contribution type</b>	<b>This quarter</b>	<b>Contracted for current FY</b>	<b>Total contracted over the life of the CRC-P</b>
Cash	275,000	\$470,020	\$1,120,000
FTE	.28	1.09	2.69
FTE Value (= FTE x \$250,000)	70,000	\$272,500	\$672,500
Non-staff in-kind	17,000	\$68,000	\$155,000
<b>Total value of contributions</b>	<b>362,000</b>	<b>\$810,520</b>	<b>\$1,947,500</b>

Notes, please include any relevant details:

[Click here to enter text.](#)

## b. Heads of Expenditure

<b>Heads of Expenditure</b>			
<b>Expense type</b>	<b>This quarter</b>	<b>Contracted for current FY</b>	<b>Total contracted over the life of the CRC-P</b>
Employee		\$0	\$0
Supplier	275,000	\$897,000	\$2,465,000
Capital		\$0	\$0
Other	17,000	\$68,000	\$155,000
<b>Total Expenditure</b>	<b>292,000</b>	<b>\$965,000</b>	<b>\$2,620,000</b>

Notes, please include any relevant details:

[Click here to enter text.](#)

### 3. Other matters

Are there any other matters not covered at Section 1, which may affect your compliance with the Funding Agreement, for example:

Matter	Yes	No
Are there any proposed or actual changes to the recipient company/incorporated trustee ownership/control/structure?	<input type="checkbox"/>	<input checked="" type="checkbox"/>
Are there any change to the Participants?	<input type="checkbox"/>	<input checked="" type="checkbox"/>
Are there any changes to a Participant's future contributions?	<input type="checkbox"/>	<input checked="" type="checkbox"/>
Are there any proposed or actual changes to the Participants Agreement or other contractual arrangements between Participants?	<input type="checkbox"/>	<input checked="" type="checkbox"/>
Are there any proposed or actual changes to intellectual property arrangements, as stipulated in the original application?	<input type="checkbox"/>	<input checked="" type="checkbox"/>
Have you received financial assistance from another government source for, or in connection with, activities you have been contracted to undertake under the Funding Agreement?	<input type="checkbox"/>	<input checked="" type="checkbox"/>
Are there any conflicts of interest arising for the CRC-P in meeting its obligations under the Funding Agreement?	<input type="checkbox"/>	<input checked="" type="checkbox"/>
Are there any additional/new risks factors that will influence the likelihood of successfully completing the Project?	<input type="checkbox"/>	<input checked="" type="checkbox"/>
Are there any additional/new risks that will influence the likelihood of successfully completing the Project that are not already covered above?	<input type="checkbox"/>	<input checked="" type="checkbox"/>

If you answered 'Yes' to any of the above, please provide details:

[Click here to enter text.](#)

#### 4. Certification and Payment

Payment of funds for this reporting period will be made by the Commonwealth via a Recipient Created Tax Invoice subject to the acceptance and approval of this quarterly report, in accordance with the Funding Agreement and any guidelines issued by the Commonwealth. You will be advised on the approval of this quarterly report by the department.

I Peter Richard Youd being duly authorised by the Funding Agreement hereby certify that the information contained in this report is true and correct and that the Funds have been expended only for the Project in accordance with the Funding Agreement.

s22  


Signed:

Date: 29<sup>th</sup> October 2018

Name of Signatory: Peter Richard Youd

Position: Executive Director, Chief Financial Officer & Company Secretary

Organisation: First Graphene Limited



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- Providing a basis for making payments;
- Recording the progress of the CRC Project against the Funding Agreement;
- Completing a Program Data Questionnaire (end of financial year); and
- End of Project reporting requirements (final quarterly report).

Information contained in this report may be used by the department for the Minister, the CRC Advisory Committee and other stakeholders.

## 1. Project and Milestone progress

### a. Project progress

Please provide a brief outline of Project progress undertaken in the quarter, including any real or potential challenges or issues, and any major achievements.

#### **Overview**

In this quarter, we established a stable set of operating conditions at First Graphene's R&D facility, which is based at the Graphene Engineering Innovation Centre (GEIC) in the United Kingdom. As a result, we have proven that the Vortex Fluidics Technology is transferable between sites and can produce a consistent product. We have also identified the scale up parameters, identified how we can resolve processing issues and have identified a novel way of introducing functionality on graphene platelets using a commercially available Ultraviolet water treatment unit.

The following report was issued: **Technical report- Process Development of the Vortex Fluidic Device**

#### **Applications**

We have had further discussions with the research groups based in Manchester (UK) and Austria. We have a better understanding of the requirements for membrane technology – a key issue being few layer platelets with an oxidation level of, say, 20 – 25%. The oxidation level is achievable using VFD and / or UV treatment technology, however obtaining few layer platelets in sufficient quantities to make process viable will be challenging.

The team at the Austrian Institute of Technology have started some preliminary work to make electronic devices using Green Graphene Oxide, but results have been mixed, so we are awaiting further

feedback.

### **Process scale up**

First Graphene Ltd has developed the capability to operate the equipment and produce oxidised graphene platelets. Through our collaborative work between First Graphene and Flinders University, we have identified potential routes to scaling up the process and understanding product quality. We need to assess whether a Class 4 laser is required, whether we can eliminate hold up in the equipment and to understand how the product can be used in end applications. Also, we have an opportunity to optimise the continuous UV treatment unit developed at the GEIC to functionalise graphene platelets, either prior to further treatment at the VFD using alternative routes. The positive news is that none of these issues are insurmountable, so we have a route to scaleup.

### **Product characterisation**

Characterisation of the product made at the GEIC has been carried out. The results to date indicate we are adding functional groups to the graphene platelets which is a positive outcome. We have used a number of techniques, including Raman, XPS and Thermogravimetric Analysis to understand the nature of surface groups on the graphene platelets. Encouragingly, we have been able to link our analytical results with the operating conditions in the VFD, which means we have enhanced our understanding of the reaction processes in the VFD.

## **b. Milestone progress**

Complete the table below and comment on each project milestone [Schedule 2]<sup>1</sup>

#### Notes:

1. Items in [square brackets] refer to the relevant section of your Funding Agreement.
2. Percentage complete at the time of the end of the review period for this report. If already completed, enter '100%'.
3. End date as per the Funding Agreement.
4. Actual or expected completion date.
5. If a future milestone has not yet commenced, enter 'Yet to commence'. In addition to progress comments, if the agreed end date is unlikely to be met, outline:
  - the reasons for the delay on the project milestone, the expected impact of the delay will have on the project milestone; and
  - actions taken or proposed to ensure that the project milestone is achieved.

No	Project Milestone	% Complete <sup>2</sup>	End Date <sup>3</sup> Agreed	Completion Date <sup>4</sup> Expected/Actual
1	GO reduction and production completed	80%	30/06/2018	Expected 30/11/19
<b>Progress Comments</b> – work undertaken and impact of any delay <sup>5</sup>				
<p>Integrating Dr Kasturi Vimalanathan from Flinders University with the Process Development group at the GEIC is working well – as the combined skill sets from the multidisciplinary team has allowed us to make good progress in scaling up our production process and understanding the product characteristics.</p> <p>We have achieved the following outcomes:</p> <ul style="list-style-type: none"> <li>• We have demonstrated the ability to oxidise the surface of the graphene / graphite platelets, using a two-step process involving ultraviolet radiation and energy from a Near Infrared Laser;</li> <li>• We have shown that feed rate is a potential route towards controlling the surface oxidation to suit applications;</li> <li>• Fluorescence observed post processing adds confidence to the data that there is introduction of surface functional groups and the material consists of both sp<sup>2</sup> and sp<sup>3</sup> hybridised carbon;</li> <li>• We have increased our understanding of the end product requirements (oxidation level and platelet size);</li> <li>• We are looking into alternatives to the use of the near infrared laser – for example will simply heating the dispersion with a standard heating system be sufficient. This will make the scale up simpler and make for a more economically viable and safer product.</li> </ul>				
2	Supercapacitor production and test work completed	25	31/12/2018	
<b>Progress Comments</b> – work undertaken and impact of any delay <sup>5</sup>				
<p>As outlined to the CRC-P management in January 2019, there has been no meaningful development in the supercapacitor field and FGR has elected to withdraw further funding on this project.</p> <p>A submission has been made to CRC-P management for a contract variation.</p>				
3	GO supercapacitor assembly completed	25	30/06/2019	
<b>Progress Comments</b> – work undertaken and impact of any delay <sup>5</sup>				
4	Testing of supercapacitor and GO product development completed	15	30/06/2020	
<b>Progress Comments</b> – work undertaken and impact of any delay <sup>5</sup>				

5	Industry education and training activities completed	40	30/06/2020	
<b>Progress Comments</b> – work undertaken and impact of any delay <sup>5</sup>				
<p>Dr Kasturi Vimalanathan has completed the technology transfer of the VFD process from Flinders to the United Kingdom, obtaining results that are in line with expectations. This shows that the technology is transferable and reproducible.</p> <p>s22 [redacted] gave a presentation to the technical team at the Graphene Engineering Innovation Centre (GEIC), Manchester where he discussed the progress that has been made with the equipment.</p> <p>s22 [redacted] has discussed the positive results from the unit with a range of academics at Manchester University, including those from the National Graphene Institute and the Chemistry Department – this has given us an opportunity to explore potential new areas where the product from the VFD can be used.</p>				

## 2. Financial Progress

Please fill in the tables below [Schedule 4].

### a. Participant Contributions

<b>Recipient/Lead Participant: FIRST GRAPHENE LIMITED</b>			
<b>Contribution type</b>	<b>This quarter</b>	<b>Contracted for current FY</b>	<b>Total contracted over the life of the CRC-P</b>
Cash	100,000	\$435,620	\$1,120,000
FTE	.25	0.44	1.06
FTE Value (= FTE x \$250,000)	62,500	\$110,000	\$265,000
Non-staff in-kind		\$78,000	\$155,000
<b>Total value of contributions</b>	<b>162,500</b>	<b>\$623,620</b>	<b>\$1,540,000</b>

Notes, please include any relevant details:

During the period 1 July – 30 September the FGR staff at GEIC spent the FTE of 1.37 working on the VFD green graphene oxide project.

<b>Participant: Swinburne University of Technology</b>			
<b>Contribution type</b>	<b>This quarter</b>	<b>Contracted for current FY</b>	<b>Total contracted over the life of the CRC-P</b>
Cash		\$0	\$0
FTE		0.30	0.75
FTE Value (= FTE x \$250,000)		\$75,000	\$187,500
Non-staff in-kind		\$0	\$0
<b>Total value of contributions</b>		<b>\$75,000</b>	<b>\$187,500</b>

Notes, please include any relevant details:

FGR has elected to withhold further funding on this project as the commercial parameters on which it was based are not going to be achieved

<b>Participant: Flinders University of South Australia</b>			
<b>Contribution type</b>	<b>This quarter</b>	<b>Contracted for current FY</b>	<b>Total contracted over the life of the CRC-P</b>
Cash	6,290	\$0	\$0
FTE	.08	0.20	0.5
FTE Value (= FTE x \$250,000)	20,000	\$50,000	\$125,000
Non-staff in-kind		\$0	\$0
<b>Total value of contributions</b>	<b>26,290</b>	<b>\$50,000</b>	<b>\$125,000</b>

Notes, please include any relevant details:

During this period Dr Vimalathan spent the entire month of August at GEIC working on the VFD project.

<b>Participant: KREMFOR D (VIC) PTY LTD</b>			
<b>Contribution type</b>	<b>This quarter</b>	<b>Contracted for current FY</b>	<b>Total contracted over the life of the CRC-P</b>
Cash		\$0	\$0
FTE		0.15	0.38
FTE Value (= FTE x \$250,000)		\$37,500	\$95,000
Non-staff in-kind		\$0	\$0
<b>Total value of contributions</b>		<b>\$37,500</b>	<b>\$95,000</b>

Notes, please include any relevant details:

No contribution was made by Kremford (Vic) Pty Ltd during the quarter

<b>Participant: 2D FLUIDICS PTY LTD</b>			
<b>Contribution type</b>	<b>This quarter</b>	<b>Contracted for current FY</b>	<b>Total contracted over the life of the CRC-P</b>
Cash	6,873	\$0	\$0
FTE		0.15	0.38
FTE Value (= FTE x \$250,000)		\$37,500	\$95,000
Non-staff in-kind		\$0	\$0
<b>Total value of contributions</b>	<b>6,873</b>	<b>\$37,500</b>	<b>\$95,000</b>

<b>Total Participant Contributions</b>			
<b>Contribution type</b>	<b>This quarter</b>	<b>Contracted for current FY</b>	<b>Total contracted over the life of the CRC-P</b>
Cash	113,163	\$435,620	\$1,120,000
FTE	.33	1.09	2.69
FTE Value (= FTE x \$250,000)	82,500	\$272,500	\$672,500
Non-staff in-kind		\$78,000	\$155,000
<b>Total value of contributions</b>	<b>195,663</b>	<b>\$786,120</b>	<b>\$1,947,500</b>

Notes, please include any relevant details:

[Click here to enter text.](#)

## b. Heads of Expenditure

<b>Heads of Expenditure</b>			
<b>Expense type</b>	<b>This quarter</b>	<b>Contracted for current FY</b>	<b>Total contracted over the life of the CRC-P</b>
Employee		\$0	\$0
Supplier		\$1,057,000	\$2,465,000
Capital		\$0	\$0

Other	17,300	\$78,000	\$155,000
Total Expenditure	17,300	\$1,135,000	\$2,620,000

Notes, please include any relevant details:

[Click here to enter text.](#)

### 3. Other matters

Are there any other matters not covered at Section 1, which may affect your compliance with the Funding Agreement, for example:

Matter	Yes	No
Are there any proposed or actual changes to the recipient company/incorporated trustee ownership/control/structure?	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Are there any change to the Participants?	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Are there any changes to a Participant's future contributions?	<input checked="" type="checkbox"/>	<input type="checkbox"/>
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Have you received financial assistance from another government source for, or in connection with, activities you have been contracted to undertake under the Funding Agreement?	<input type="checkbox"/>	<input checked="" type="checkbox"/>
Are there any conflicts of interest arising for the CRC-P in meeting its obligations under the Funding Agreement?	<input type="checkbox"/>	<input checked="" type="checkbox"/>
Are there any additional/new risks factors that will influence the likelihood of successfully completing the Project?	<input type="checkbox"/>	<input checked="" type="checkbox"/>
Are there any additional/new risks that will influence the likelihood of successfully completing the Project that are not already covered above?	<input type="checkbox"/>	<input checked="" type="checkbox"/>

If you answered 'Yes' to any of the above, please provide details:

#### **Issues with Swinburne University of Technology**

- Original project predicated on replacement of AA and AAA batteries.
- To achieve 900 farads there are now 500 layers x 30µm plus separation layers, so in excess of 15mm. This is too large to be rolled into the volume of a AA or AAA, which is 6,1003 mm.
- The target was 3.5 volts, but the capacitor is only achieving 1.5 volts.
- A pouch battery started being pursued (unilaterally) by SUT. However, this is only achieving 1,000 m/amp hours and an iPhone battery, for example, requires 3,400 m/amp hours.
- We have been told further work would be required on the ionic electrolyte liquid, and SUT have advised this would have to be another project with separate funding. They would require a electrolyte suitable for 5 volts to surpass a Li-ion battery.



- When Dr Kasturi Vimalanathan and s22 went to SUT to test the gGO™ produced by Flinders, s22 and s22 were unco-operative. This is despite them being aware that Flinders University's gGO™ project formed a portion of the CRC-P project.

### **Conclusion**

FGR does not believe SUT can achieve the original objectives of the project and has discontinued funding the CRA.

#### Status of Flinders University Project

- Considerable progress has been made on the development of gGO™ with the Vortex Fluidic Device (VFD).
- Levels of oxidation are approaching those produced by Spanish group Graphenea. Graphenea has invested >€10m in its GO production.
- Expansion of the gGO™ program will continue, with the next stage being production of a larger VFD.

### **Conclusion**

As funding partner FGR is comfortable with the progress being made by Flinders University.

#### Next Steps

- FGR has ceased funding of the supercapacitor project with SUT
- Through its involvement as a Tier 1 participant at the University of Manchester's Graphene Engineering & Innovation Centre (GEIC),

#### 4. Certification and Payment

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I **Peter Richard Youd** being duly authorised by the Funding Agreement hereby certify that the information contained in this report is true and correct and that the Funds have been expended only for the Project in accordance with the Funding Agreement.

s22



Signed:

Date: 31 / 10 / 2019

Name of Signatory: Peter Richard Youd  
Position: Executive Director, Chief Financial Officer & Company Secretary  
Organisation: First Graphene Limited

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### a. Project progress

Please provide a brief outline of Project progress undertaken in the quarter, including any real or potential challenges or issues, and any major achievements.

In the December quarter Flinders University continued to develop the production of green Graphene Oxide (gGO™). Work was conducted comparing both the graphite ore and PureGraph™ 5 as the starting material. Interestingly, it was determined the graphite ore is a better starting material in terms of achieving a high yield of graphene oxide with the average percentage oxidation to be at about 32-40%. Having tried a number of experimental conditions this year, this method just requires the use of the VFD and the laser at a power of ~650 mJ. It is also able to work at a reasonably high concentration, at the moment being 20mg/mL, with potential of further increasing this concentration. PureGraph™ 5 seems to be more reactive in the presence of a laser and thus makes it quite challenging for scale up at this stage. Measurement has been conducted on a number of films to measure conductivity and resistance, and the gGO™ produced in the VFD has a resistance of ~0.7 Mohms. The Graphene Oxide produced by Graphenea, has a resistance of ~1.0 Mohms, so the gGO is approaching that level.

### Future plans

- Currently the particles of the graphite ore being used are ~1mm in size. Reducing this size to ~500 microns may further increase the yield of the gGO™ produced.
- XRD is a challenge. Work will continue on purifying the gGO™ and separating the bulk graphite via centrifugation. The graphite peak is slowly disappearing but we are still not seeing the peak at about 2theta 10-12 degrees. Further work is required.

- Further scale up studying properties and application. Is the gGO™ being produced comparable or maybe better than the GO produced using the Hummers method.
- Determining how much material can be made within a time period for sale and determining the associated cost.

## **b. Milestone progress**

Complete the table below and comment on each project milestone [Schedule 2]<sup>1</sup>

### Notes:

1. Items in [square brackets] refer to the relevant section of your Funding Agreement.
2. Percentage complete at the time of the end of the review period for this report. If already completed, enter '100%'.
3. End date as per the Funding Agreement.
4. Actual or expected completion date.
5. If a future milestone has not yet commenced, enter 'Yet to commence'. In addition to progress comments, if the agreed end date is unlikely to be met, outline:
  - the reasons for the delay on the project milestone, the expected impact of the delay will have on the project milestone; and
  - actions taken or proposed to ensure that the project milestone is achieved.

No	Project Milestone	% Complete <sup>2</sup>	End Date <sup>3</sup> Agreed	Completion Date <sup>4</sup> Expected/Actual
1	GO reduction and production completed	35	30/06/2018	
<b>Progress Comments</b> – work undertaken and impact of any delay <sup>5</sup>				
<p>Measurement has been conducted on a number of films to measure conductivity and resistance, and the gGO™ produced in the VFD has a resistance of ~0.7 Mohms. The Graphene Oxide produced by Graphenea, has a resistance of ~1.0 Mohms, so the gGO is approaching that level. Dr Kasturi Vimalanathan from Flinders University will be seconded to First Graphene's facility at the University of Manchester's (UoM) Graphene Engineering &amp; Innovation Centre (GEIC) for a period of three months, commencing in March 2019.</p> <p>This will enable interaction with the UoM scientists on the development of gGO™.</p> <p>FGR is also installing a Vortex Fluidic Device (VFD) in its GEIC laboratory which will be used as a science tool and also displayed for potential sales.</p>				
2	Supercapacitor production and testwork completed	25	31/12/2018	
<b>Progress Comments</b> – work undertaken and impact of any delay <sup>5</sup>				
<p>As outlined to the CRC-P management in January, there has been no meaningful development in the supercapacitor field and FGR has elected to withdraw further funding on this project.</p> <p>As discussed, an alternative project is being reviewed and a submission will be made to CRC-P management in the coming weeks.</p>				
3	GO supercapacitor assembly completed	25	30/06/2019	
<b>Progress Comments</b> – work undertaken and impact of any delay <sup>5</sup>				
4	Testing of supercapacitor and GO product development completed	15	30/06/2020	
<b>Progress Comments</b> – work undertaken and impact of any delay <sup>5</sup>				

5	Industry education and training activities completed	25	30/06/2020	
<b>Progress Comments</b> – work undertaken and impact of any delay <sup>5</sup>				
<p>During this period Dr Kasturi Vimalanathan from Flinders University gave a presentation to visiting participants from the European Union Graphene Flagship. The presentation was entitled “<i>Graphene and graphene oxide production using thin film technology</i>”. Since January 2018 the following publications have been issued through Flinders University on the development of thin film technology.</p> <p><a href="#"><u><i>Integrating thin film microfluidics in developing a concise synthesis of DGJNAc: A potent inhibitor of <math>\alpha</math>-N-acetylgalactosaminidases</i></u></a></p> <p>SS Wills, CL Raston, KA Stubbs, Bioorganic &amp; medicinal chemistry letters 28 (23-24), 3748-3751</p> <p><a href="#"><u><i>Controlled slicing of single walled carbon nanotubes under continuous flow</i></u></a></p> <p>TMD Alharbi, K Vimalanathan, WD Lawrance, CL Raston, Carbon 140, 428-432</p> <p><a href="#"><u><i>Vortex fluidic mediated direct transesterification of wet microalgae biomass to biodiesel</i></u></a></p> <p>EK Sitepu, K Corbin, X Luo, SJ Pye, Y Tang, SC Leterme, K Heimann, C L Raston, W Zhang, Bioresource technology 266, 488-497</p> <p><a href="#"><u><i>Shear stress mediated scrolling of graphene oxide</i></u></a></p> <p>TMD Alharbi, D Harvey, IK Alsulami, N Dehbari, X Duan, RN Lamb, W D Lawrance, C L Raston, Carbon 137, 419-424</p> <p><a href="#"><u><i>Laser-Ablated Vortex Fluidic-Mediated Synthesis of Superparamagnetic Magnetite Nanoparticles in Water Under Flow</i></u></a></p> <p>X Luo, AHM Al-Antaki, TMD Alharbi, WD Hutchison, Y Zou, J Zou, A Sheehan, W Zhang, C L Raston</p> <p>ACS Omega 3 (9), 11172-11178</p> <p><a href="#"><u><i>Methods and compositions for protein purification and enzyme reaction</i></u></a></p> <p>GA Weiss, J Britton, CL Raston, US Patent App. 15/754,797</p> <p><a href="#"><u><i>Vortex fluidic mediated synthesis of macroporous bovine serum albumin-based microspheres</i></u></a></p> <p>X Luo, AHM Al-Antaki, DP Harvey, Y Ruan, S He, W Zhang, CL Raston, ACS applied materials &amp; interfaces 10 (32), 27224-27232</p> <p><a href="#"><u><i>Angled Vortex Fluidic Mediated Multicomponent Photocatalytic and Transition Metal-Catalyzed Reactions</i></u></a></p> <p>LA Ho, CL Raston, KA Stubbs, Chemistry–A European Journal</p> <p><a href="#"><u><i>High-Shear-Imparted Tunable Fluorescence in Polyethylenimines</i></u></a></p> <p>X Luo, AHM Al-Antaki, S Pye, R Meech, W Zhang, CL Raston, ChemPhotoChem 2 (4), 343-348</p> <p><a href="#"><u><i>Continuous flow synthesis of phosphate binding h-BN@ magnetite hybrid material</i></u></a></p> <p>AHM Al-antaki, X Luo, A Duan, RN Lamb, E Eroglu, W Hutchison, YC Zou, J Zou, C L Raston, RSC Advances 8 (71), 40829-40835</p> <p><a href="#"><u><i>Continuous hydrothermal flow synthesis of graphene quantum dots</i></u></a></p> <p>S Kellici, J Acord, KE Moore, NP Power, V Middelkoop, DJ Morgan, T Heil, P Coppo, I-A Baragau, C L Raston, Reaction Chemistry &amp; Engineering 3 (6), 949-958</p> <p><a href="#"><u><i>Continuous flow biodiesel production from wet microalgae using a hybrid thin film microfluidic platform</i></u></a></p>				

EK Sitepu, DB Jones, Y Tang, SC Leterme, K Heimann, W Zhang, C L Raston, Chemical Communications 54 (85), 12085-12088

*Controlling the growth of fullerene C60 cones under continuous flow*

I Alsulami, T Alharbi, D Harvey, CT Gibson, CL Raston, Chemical Communications

*Laser irradiated vortex fluidic mediated synthesis of luminescent carbon nanodots under continuous flow*

X Luo, AHM Al-Antaki, K Vimalanathan, J Moffatt, K Zheng, Y Zou, J Zou, X Duan, R N Lamb, S Wang, Q Li, W Zhang, C L Raston, Reaction Chemistry & Engineering 3 (2), 164-170

*Organic oxidations promoted in vortex driven thin films under continuous flow*

SJ Pye, SJ Dalgarno, JM Chalker, CL Raston, Green Chemistry 20 (1), 118-124

## 2. Financial Progress

Please fill in the tables below [Schedule 4].

### a. Participant Contributions

<b>Recipient/Lead Participant: FIRST GRAPHENE LIMITED</b>			
<b>Contribution type</b>	<b>This quarter</b>	<b>Contracted for current FY</b>	<b>Total contracted over the life of the CRC-P</b>
Cash	-	\$470,020	\$1,120,000
FTE	.11	0.44	1.06
FTE Value (= FTE x \$250,000)	27,500	\$110,000	\$265,000
Non-staff in-kind	17,000	\$68,000	\$155,000
<b>Total value of contributions</b>	<b>44,500</b>	<b>\$648,020</b>	<b>\$1,540,000</b>

Notes, please include any relevant details:

A payment of \$247,500 was made to Swinburne University of Technology during the quarter by FGR's subsidiary, Graphene Solutions Pty Ltd. This had been funded by FGR in a previous quarter.

<b>Participant: Swinburne University of Technology</b>			
<b>Contribution type</b>	<b>This quarter</b>	<b>Contracted for current FY</b>	<b>Total contracted over the life of the CRC-P</b>
Cash		\$0	\$0
FTE		0.30	0.75
FTE Value (= FTE x \$250,000)		\$75,000	\$187,500
Non-staff in-kind		\$0	\$0
<b>Total value of contributions</b>		<b>\$75,000</b>	<b>\$187,500</b>

Notes, please include any relevant details:

No meaningful contribution was reported by Swinburne University of Technology during the quarter

<b>Participant: Flinders University of South Australia</b>			
<b>Contribution type</b>	<b>This quarter</b>	<b>Contracted for current FY</b>	<b>Total contracted over the life of the CRC-P</b>
Cash		\$0	\$0
FTE	.08	0.20	0.5
FTE Value (= FTE x \$250,000)	20,000	\$50,000	\$125,000
Non-staff in-kind		\$0	\$0
<b>Total value of contributions</b>	<b>20,000</b>	<b>\$50,000</b>	<b>\$125,000</b>

Notes, please include any relevant details:



The work conducted at Flinders University is exceeding the minimal requirements established under the CRC-P

<b>Participant: KREMFORMD (VIC) PTY LTD</b>			
<b>Contribution type</b>	<b>This quarter</b>	<b>Contracted for current FY</b>	<b>Total contracted over the life of the CRC-P</b>
Cash		\$0	\$0
FTE		0.15	0.38
FTE Value (= FTE x \$250,000)		\$37,500	\$95,000
Non-staff in-kind		\$0	\$0
<b>Total value of contributions</b>		<b>\$37,500</b>	<b>\$95,000</b>

Notes, please include any relevant details:

No meaningful contribution was conducted by Kremford (Vic) Pty Ltd during the quarter

<b>Total Participant Contributions</b>			
<b>Contribution type</b>	<b>This quarter</b>	<b>Contracted for current FY</b>	<b>Total contracted over the life of the CRC-P</b>
Cash		\$470,020	\$1,120,000
FTE	.19	1.09	2.69
FTE Value (= FTE x \$250,000)	47,500	\$272,500	\$672,500
Non-staff in-kind	17,000	\$68,000	\$155,000
<b>Total value of contributions</b>	<b>64,500</b>	<b>\$810,520</b>	<b>\$1,947,500</b>

Notes, please include any relevant details:

[Click here to enter text.](#)

## b. Heads of Expenditure

<b>Heads of Expenditure</b>			
<b>Expense type</b>	<b>This quarter</b>	<b>Contracted for current FY</b>	<b>Total contracted over the life of the CRC-P</b>
Employee		\$0	\$0
Supplier		\$897,000	\$2,465,000
Capital		\$0	\$0
Other	17,000	\$68,000	\$155,000
<b>Total Expenditure</b>	<b>17,000</b>	<b>\$965,000</b>	<b>\$2,620,000</b>

Notes, please include any relevant details:

[Click here to enter text.](#)

### 3. Other matters

Are there any other matters not covered at Section 1, which may affect your compliance with the Funding Agreement, for example:

Matter	Yes	No
Are there any proposed or actual changes to the recipient company/incorporated trustee ownership/control/structure?	<input type="checkbox"/>	<input checked="" type="checkbox"/>
Are there any change to the Participants?	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Are there any changes to a Participant's future contributions?	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Are there any proposed or actual changes to the Participants Agreement or other contractual arrangements between Participants?	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Are there any proposed or actual changes to intellectual property arrangements, as stipulated in the original application?	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Have you received financial assistance from another government source for, or in connection with, activities you have been contracted to undertake under the Funding Agreement?	<input type="checkbox"/>	<input checked="" type="checkbox"/>
Are there any conflicts of interest arising for the CRC-P in meeting its obligations under the Funding Agreement?	<input type="checkbox"/>	<input checked="" type="checkbox"/>
Are there any additional/new risks factors that will influence the likelihood of successfully completing the Project?	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Are there any additional/new risks that will influence the likelihood of successfully completing the Project that are not already covered above?	<input type="checkbox"/>	<input checked="" type="checkbox"/>

If you answered 'Yes' to any of the above, please provide details:

#### Issues with Swinburne University of Technology

- Original project predicated on replacement of AA and AAA batteries.
- To achieve 900 farads there are now 500 layers x 30µm plus separation layers, so in excess of 15mm. This is too large to be rolled into the volume of a AA or AAA, which is 6,100<sup>3</sup> mm.
- The target was 3.5 volts, but the capacitor is only achieving 1.5 volts.
- A pouch battery started being pursued (unilaterally) by SUT. However, this is only achieving 1,000 m/amp hours and an iPhone battery, for example, requires 3,400 m/amp hours.
- We have been told further work would be required on the ionic electrolyte liquid, and SUT have advised this would have to be another project with separate funding. They would require a electrolyte suitable for 5 volts to surpass a Li-ion battery.

- When Dr Kasturi Vimalanathan and s22 went to SUT to test the gGO™ produced by Flinders, s22 and s22 were unco-operative. This is despite them being aware that Flinders University's gGO™ project formed a portion of the CRC-P project.

### Conclusion

FGR does not believe SUT can achieve the original objectives of the project and will not be continuing to fund the CRA.

### Status of Flinders University Project

- Considerable progress has been made on the development of gGO™ with the Vortex Fluidic Device (VFD).
- Levels of oxidation are approaching those produced by Spanish group Graphenea. Graphenea has invested >€10m in its GO production.
- Expansion of the gGO™ program will continue, with the next stage being production of a larger VFD.

### Conclusion

As funding partner FGR is comfortable with the progress being made by Flinders University.

### Next Steps

- FGR will be looking to stop funding of the supercapacitor project with SUT
- Through its involvement as a Tier 1 participant at the University of Manchester's Graphene Engineering & Innovation Centre (GEIC), FGR will be undertaking a project in a graphene based supercapacitor. Already the GEIC has produced a prototype for FGR.



Button "battery" supercapacitor made with FGR's PureGRAPH™ 5, 10 and 20 products

Ten VFD's have been produced for sale by 2D Fluidics Pty Ltd. These will be offered to universities worldwide as a research tool.



Vortex Fluidic Devices prepared for sale

- Dr Kasturi Vimalanathan will be seconded to FGR (UK) for a three month period to work with FGR's UK engineers and UoM scientists for further development of the VFD's graphene oxide potential.
- Professor Colin Raston, inventor of the VFD, will be giving lectures at the UoM on or about 28th February 2019.

#### 4. Certification and Payment

Payment of funds for this reporting period will be made by the Commonwealth via a Recipient Created Tax Invoice subject to the acceptance and approval of this quarterly report, in accordance with the Funding Agreement and any guidelines issued by the Commonwealth. You will be advised on the approval of this quarterly report by the department.

I **Peter Richard Youd** being duly authorised by the Funding Agreement hereby certify that the information contained in this report is true and correct and that the Funds have been expended only for the Project in accordance with the Funding Agreement.

s22

Signed:

Date:30 / 01 /2019

Name of Signatory: Peter Richard Youd  
Position: Executive Director, Chief Financial Officer & Company Secretary  
Organisation: First Graphene Limited

# Cooperative Research Centres Projects (CRC-P) Quarterly Report

<u>CRC-P &amp; Selection Round Number:</u>	CRC-P60964 - CRC-P Round 4
<u>CRC-P Title:</u>	High performance energy storage alternative to lithium ion batteries
<u>Lead Participant Entity Name:</u>	FIRST GRAPHENE LIMITED
<u>Funding Period:</u>	01/01/2018 to 30/06/2020
<u>Reporting Period:</u>	October to December (Quarter 2) – 2019/20

## Notes:

This report has a number of purposes which include but are not limited to:

- Providing a basis for making payments;
- Recording the progress of the CRC Project against the Funding Agreement;
- Completing a Program Data Questionnaire (end of financial year); and
- End of Project reporting requirements (final quarterly report).

Information contained in this report may be used by the department for the Minister, the CRC Advisory Committee and other stakeholders.

## 1. Project and Milestone progress

### a. Project progress

Please provide a brief outline of Project progress undertaken in the quarter, including any real or potential challenges or issues, and any major achievements.

#### **Outline of progress**

We continue to make progress in a wide range of areas, building on the recent work carried out in Q2. The progress made in the key areas is summarised below.

#### **Applications**

##### **Membrane technology**

The team at the Graphene Engineering Innovation Centre at the University of Manchester have engaged with world-leading academic authorities in Membrane Technology (<https://www.research.manchester.ac.uk/portal/rahul.html>). The key findings are:

- There are key players in the filtration industry who we will need to engage with and influence (e.g. GE / BASF / Dow / Millipore (Merck)). A key challenge is these players are very conservative and will require extensive pilot scale testing to validate the GGO prior to adoption. This is a potential barrier but is also an opportunity because to the best of our knowledge, there are currently no established large-scale producers of consistent GO platelets.

- For barrier properties, the research group indicated we require:
  - o A minimum of approx. 15% surface oxygen content to make the material compatible with the membrane surface.
  - o If surface oxygen content is too high, the graphene becomes too water soluble, potentially causing it to be “washed away” with the permeate.
  - o Ideally, we require 5 – 10-layer platelets. As indicated in the last report this will be the key technical challenge.
- The GGO process we have established is a potential, scalable route to consistent material and will make this one of our key end applications.

### **Semi-conductor technology**

We have now obtained some initial quantitative feedback from the use of GGO produced from the VFD and First Graphene’s standard PureGRAPH® 5 (PG5) product in a semi-conductor application, with the work being carried out under NDA at the Austrian Institute of Technology (AIT).

- GGO (*ex VFD*) formed agglomerates and had an extremely high (infinite) resistance. This meant it was unsuitable for this application.
- PG5 solution formed a viscous suspension which required pre-treatment. This removed a significant quantity of the active material. When applied to the semi-conductor the measured resistance was 3 orders of magnitude higher than required with patchy surface coverage compared to the standard product (*ex Hummer’s Method*).
- The PG5 chip gave a response to the applied gate voltage, suggesting potential viability in certain biosensing applications. Unfortunately for this application the PG5 chip’s response was not sensitive enough, making it unsuitable in its current format.
- We have a potential way forward if we can increase the amount of reduction (reduced resistance) and increase surface coverage (more concentrated solution needed).

We will continue to work with the AIT progress this application.

### **Photoluminescence (fluorescence)**

Photoluminescence refers to light emission following absorption of photons from electromagnetic radiation, with blue photoluminescence being of specific interest in low cost opto-electronic devices, as described by Chowella *et al* (*Adv. Mater.* 2010, 22, 505–509). We have recently demonstrated GGO shows blue photoluminescence properties with emissions at 370nm and 396 nm, which is promising and could therefore provide a route to low cost materials for this application.

### **Toxicity testing**

We have tested GGO at various concentrations levels against breast cancer cells. Initial results are comparable to that reported in the literature, with GGO showing low toxicity at low dosages. We are also investigating potential anti-bacterial properties. It should be noted these are preliminary results and we will need to conduct much more in-depth work with technical experts to validate our results, prior to reporting externally.

## Process Scale Up

### Intellectual property review

We have continued to stay abreast of the Intellectual Property (IP) landscape, reviewing relevant patent publications as required. This quarter, we have reviewed the following published patents:

- PCT/CN2018/094585 – Apparatus for preparing graphene by means of laser irradiation in liquid. This refers to growth of graphene on a copper foil substrate – therefore a very different process so it is not expected to affect our freedom to practise.
- US 20180201509 A1 - Large scale production of oxidised graphene. Whilst it appears to be scalable, it is a fundamentally different process which also produces a different product, so we it is not expected it to affect our freedom to practise.

### VFD Process

We are still progressing the use of an LED lamp attachment as an alternative to the use of a laser. As previously reported, this will make the process inherently safer and simpler, especially when combined with the use of UV lamps.

### Thin film turbo units

We will be progressing the use of the thin film turbo unit as an alternative platform to the VFD. We are preparing 2 units to be shipped to the team at the GEIC for further trials.

### Product Characterisation

- The team at Flinders have carried out additional Raman measurements, conductivity testing and atomic force microscopy to assess the thickness distribution and level of oxidation of the graphene platelets produced by the VFD to validate the effect of processing conditions on product quality. This will feed into the ongoing scale up work.
- We have carried out further measurements of the zeta potential. The measurements obtained (~-35.6 mV) indicates moderate stability in water which is encouraging.

### Completion of Milestones

FGR is engaging a full time technician at the GEIC to work on the VFD/TFT development to ensure we have completed the activities by 30 June 2020.

## b. Milestone progress

Complete the table below and comment on each project milestone [Schedule 2]<sup>1</sup>

#### Notes:

1. Items in [square brackets] refer to the relevant section of your Funding Agreement.
2. Percentage complete at the time of the end of the review period for this report. If already completed, enter '100%'.
3. End date as per the Funding Agreement.
4. Actual or expected completion date.
5. If a future milestone has not yet commenced, enter 'Yet to commence'. In addition to progress comments, if the agreed end date is unlikely to be met, outline:
  - the reasons for the delay on the project milestone, the expected impact of the delay will have on the project milestone; and
  - actions taken or proposed to ensure the project milestone is achieved.

No	Project Milestone	% Complete <sup>2</sup>	End Date <sup>3</sup> Agreed	Completion Date <sup>4</sup> Expected/Actual
1	GO reduction and production completed	80%	30/06/2018	Expected 30/06/2020
<b>Progress Comments</b> – work undertaken and impact of any delay <sup>5</sup>				
Following on from the work described in Section 1A (above) and that reported in Q1 2019/2020, we are actively looking to recruit a research technician who will be based with the team at the GEIC (University of Manchester) to progress the scale up of the VFD, focussing on process optimisation and improvements building on the work reported in Q2. This is a positive step as it represents a move from early stage R&D to later stage process intensification, supported by Process Engineering and Scale-Up experience from the UK team. This will incur a delay; however, we still expect to complete this work package by end of Jun 2020.				
2	Supercapacitor production and testwork completed	25	31/12/2018	
<b>Progress Comments</b> – work undertaken and impact of any delay <sup>5</sup>				
As outlined to the CRC-P management in January 2019, there has been no meaningful development in the supercapacitor field and FGR has elected to withdraw further funding on this project. A submission has been made to CRC-P management for a contract variation and the variation document was executed on 14 January 2020.				
3	GO supercapacitor assembly completed	25	30/06/2019	
<b>Progress Comments</b> – work undertaken and impact of any delay <sup>5</sup>				
As outlined to the CRC-P management in January 2019, there has been no meaningful development in the supercapacitor field and FGR has elected to withdraw further funding on this project.				
4	Testing of supercapacitor and GO product development completed	15	30/06/2020	
<b>Progress Comments</b> – work undertaken and impact of any delay <sup>5</sup>				
As outlined to the CRC-P management in January 2019, there has been no meaningful development in the supercapacitor field and FGR has elected to withdraw further funding on this project.				
5	Industry education and training activities completed	60	30/06/2020	
<b>Progress Comments</b> – work undertaken and impact of any delay <sup>5</sup>				
We continue to promote the work carried out on an opportune basis and have discussed the technology with a number of academic researchers at the University of Manchester. A press release describing the progress to date has been drafted and will be issued in Q3 (Jan – Mar 2020)				



## 2. Financial Progress

Please fill in the tables below [Schedule 4].

### a. Participant Contributions

Recipient/Lead Participant: FIRST GRAPHENE LIMITED			
Contribution type	This quarter	Contracted for current FY	Total contracted over the life of the CRC-P
Cash	100,000	\$435,620	\$1,120,000
FTE	.25	0.44	1.06
FTE Value (= FTE x \$250,000)	62,500	\$110,000	\$265,000
Non-staff in-kind	-	\$78,000	\$155,000
Total value of contributions	162,500	\$623,620	\$1,540,000

Notes, please include any relevant details:

[Click here to enter text.](#)

Participant: Flinders University of South Australia			
Contribution type	This quarter	Contracted for current FY	Total contracted over the life of the CRC-P
Cash	-	\$0	\$0
FTE	.08	0.20	0.50
FTE Value (= FTE x \$250,000)	20,000	\$50,000	\$125,000
Non-staff in-kind	-	\$0	\$0
Total value of contributions	20,000	\$50,000	\$125,000

Notes, please include any relevant details:

[Click here to enter text.](#)

Participant: 2D Fluidics Pty Ltd			
Contribution type	This quarter	Contracted for current FY	Total contracted over the life of the CRC-P
Cash	7,875	\$0	\$0
FTE	.05	0.10	0.13
FTE Value (= FTE x \$250,000)	12,500	\$25,000	\$32,500
Non-staff in-kind	-	\$0	\$0
Total value of contributions	20,375	\$25,000	\$32,500

Notes, please include any relevant details:

[Click here to enter text.](#)

<b>Participant: University of Manchester</b>			
<b>Contribution type</b>	<b>This quarter</b>	<b>Contracted for current FY</b>	<b>Total contracted over the life of the CRC-P</b>
Cash	-	\$0	\$0
FTE	.05	0.20	0.20
FTE Value (= FTE x \$250,000)	12,500	\$50,000	\$50,000
Non-staff in-kind	-	\$0	\$0
<b>Total value of contributions</b>	<b>12,500</b>	<b>\$50,000</b>	<b>\$50,000</b>

Notes, please include any relevant details:

[Click here to enter text.](#)

<b>Total Participant Contributions</b>			
<b>Contribution type</b>	<b>This quarter</b>	<b>Contracted for current FY</b>	<b>Total contracted over the life of the CRC-P</b>
Cash	107,875	\$435,620	\$1,120,000
FTE	0.43	0.94	2.24
FTE Value (= FTE x \$250,000)	107,500	\$235,000	\$560,000
Non-staff in-kind	-	\$78,000	\$155,000
<b>Total value of contributions</b>	<b>215,375</b>	<b>\$748,620</b>	<b>1,835,000</b>

Notes, please include any relevant details:

[Click here to enter text.](#)

## b. Heads of Expenditure

<b>Heads of Expenditure</b>			
<b>Expense type</b>	<b>This quarter</b>	<b>Contracted for current FY</b>	<b>Total contracted over the life of the CRC-P</b>
Employee		\$0	\$0
Supplier		\$1,057,000	\$2,465,000
Capital		\$0	\$0
Other		\$78,000	\$155,000
<b>Total Expenditure</b>		<b>\$1,135,000</b>	<b>\$2,620,000</b>

Notes, please include any relevant details:

There was no expenditure in this quarter, however Q3 and Q4 will have considerable expenditure as the project is moved to finalisation.

### 3. Other matters

Are there any other matters not covered at Section 1, which may affect your compliance with the Funding Agreement, for example:

Matter	Yes	No
Are there any proposed or actual changes to the recipient company/incorporated trustee ownership/control/structure?	<input type="checkbox"/>	<input checked="" type="checkbox"/>
Are there any change to the Participants?	<input type="checkbox"/>	<input checked="" type="checkbox"/>
Are there any changes to a Participant's future contributions?	<input type="checkbox"/>	<input checked="" type="checkbox"/>
Are there any proposed or actual changes to the Participants Agreement or other contractual arrangements between Participants?	<input type="checkbox"/>	<input checked="" type="checkbox"/>
Are there any proposed or actual changes to intellectual property arrangements, as stipulated in the original application?	<input type="checkbox"/>	<input checked="" type="checkbox"/>
Have you received financial assistance from another government source for, or in connection with, activities you have been contracted to undertake under the Funding Agreement?	<input type="checkbox"/>	<input checked="" type="checkbox"/>
Are there any conflicts of interest arising for the CRC-P in meeting its obligations under the Funding Agreement?	<input type="checkbox"/>	<input checked="" type="checkbox"/>
Are there any additional/new risks factors which will influence the likelihood of successfully completing the Project?	<input type="checkbox"/>	<input checked="" type="checkbox"/>
Are there any additional/new risks which will influence the likelihood of successfully completing the Project which are not already covered above?	<input type="checkbox"/>	<input checked="" type="checkbox"/>

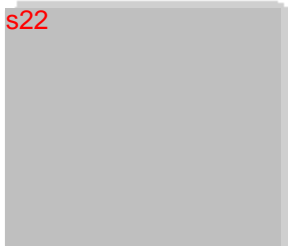
If you answered 'Yes' to any of the above, please provide details:

[Click here to enter text.](#)

#### 4. Certification and Payment

Payment of funds for this reporting period will be made by the Commonwealth via a Recipient Created Tax Invoice subject to the acceptance and approval of this quarterly report, in accordance with the Funding Agreement and any guidelines issued by the Commonwealth. You will be advised on the approval of this quarterly report by the department.

I Peter Richard Youd being duly authorised by the Funding Agreement hereby certify the information contained in this report is true and correct and the Funds have been expended only for the Project in accordance with the Funding Agreement.

s22  


Signed:

Date: 21 / 02 / 2020

Name of Signatory: Peter Richard Youd  
Position: Executive Director, Chief Financial Officer & Company Secretary  
Organisation: First Graphene Limited

# Cooperative Research Centres Projects (CRC-P) Quarterly Report

<u>CRC-P &amp; Selection Round Number:</u>	CRC-P60964 - CRC-P Round 4
<u>CRC-P Title:</u>	High performance energy storage alternative to lithium ion batteries
<u>Lead Participant Entity Name:</u>	FIRST GRAPHENE LIMITED
<u>Funding Period:</u>	01/01/2018 to 30/06/2020
<u>Reporting Period:</u>	January to March (Quarter 3) – 2017/18

## Notes:

This report has a number of purposes which include but are not limited to:

- Providing a basis for making payments;
- Recording the progress of the CRC Project against the Funding Agreement;
- Completing a Programme Data Questionnaire (end of financial year); and
- End of Project reporting requirements (final quarterly report).

Information contained in this report may be used by the department for the Minister, the CRC Advisory Committee and other stakeholders.

## 1. Project and Milestone progress

### a. Project progress

Please provide a brief outline of Project progress undertaken in the quarter, including any real or potential challenges or issues, and any major achievements.

During the March quarter both projects made steady progress. The details are contained on the following pages.

At Flinders University progress on the production of graphene oxide (GO) continued, however the amount of oxidation is not as high as the partners are seeking and trials will need to continue.

At Swinburne the BEST™ supercapacitor has progressed in line with the milestones. Difficulties have been encountered in using ultrasonic welding for collector attachment. In the short term, these have been solved by inserting a gold layer between the reduced graphene oxide layer and collector. However, SUT appreciates this is not a long term solution and further options will need to be explored.

### b. Milestone progress

Complete the table below and comment on each project milestone [Schedule 2]<sup>1</sup>

## Notes:

1. Items in [square brackets] refer to the relevant section of your Funding Agreement.
2. Percentage complete at the time of the end of the review period for this report. If already completed, enter '100%'.
3. End date as per the Funding Agreement.
4. Actual or expected completion date.
5. If a future milestone has not yet commenced, enter 'Yet to commence'. In addition to progress comments, if the agreed end date is unlikely to be met, outline:
  - the reasons for the delay on the project milestone, the expected impact of the delay will have on the project milestone; and
  - actions taken or proposed to ensure that the project milestone is achieved.

No	Project Milestone	% Complete <sup>2</sup>	End Date <sup>3</sup> Agreed	Completion Date <sup>4</sup> Expected/Actual
1	GO reduction and production completed	5%	30/06/2018	
<b>Progress Comments</b> – work undertaken and impact of any delay <sup>5</sup>				
Graphite dispersed in aqueous H <sub>2</sub> O <sub>2</sub> . Upon sonication for approximately 1 minute, the dispersion was reacting and bubbling quite vigorously. XPS analysis shows a 9.70% surface oxidation. One of the main challenges with the processing is the left over graphite along the borosilicate glass tube post VFD processing. Pulsing the rotational speed and recycling the solution multiple times are a few techniques used to minimise the loss of material. Next steps are: <ul style="list-style-type: none"> <li>• Scalability- increase concentration</li> <li>• 40% oxidation- show reproducibility</li> <li>• Systematic controls to understand mechanism</li> <li>• Additional characterisation (Raman, XRD, elemental analysis)</li> <li>• Conductivity test</li> </ul>				
2	Supercapacitor production and testwork completed	5%	31/12/2018	
<b>Progress Comments</b> – work undertaken and impact of any delay <sup>5</sup>				
SUT are making good progress on milestone to design laser apparatus for parallel fabrication of 25 supercapacitors. The three technical updates (procedures) provided by SUT are an important step forward in transitioning the technology from the laboratory to commercial manufacture.				
3	GO supercapacitor assembly completed	5%	30/06/2019	
<b>Progress Comments</b> – work undertaken and impact of any delay <sup>5</sup>				
The ultrasonic welding strategy is reported as an relevant agreed milestones achieved. However, SUT also noted that further work is required - Initial attempts to use this strategy were successful for very thin RGO but not for thicker film.				
4	Testing of supercapacitor and GO product development completed	5%	30/06/2020	
<b>Progress Comments</b> – work undertaken and impact of any delay <sup>5</sup>				
This aspect is dependent on Flinders achieving higher oxidation levels. Flinders have the specification of the GO currently being used at SUT and are seeking to produce a GO with the same characteristics. In the next quarter SUT and Flinders staff will meet to discuss this aspect.				
5	Industry education and training activities completed	5%	30/06/2020	
<b>Progress Comments</b> – work undertaken and impact of any delay <sup>5</sup>				
FGR has continued to update equity markets on the progress of the work covered in the CRC-P. In April 2018 FGR staff attended the IDTechEx conference in Berlin. It received considerable interest for all of its developing technologies, including the supercapacitor and GO production.				

## 2. Financial Progress

Please fill in the tables below [Schedule 4].

### a. Participant Contributions

Recipient/Lead Participant: FIRST GRAPHENE LIMITED			
Contribution type	This quarter	Contracted for current FY	Total contracted over the life of the CRC-P
Cash	204,000	\$214,360	\$1,120,000
FTE	.09	0.18	1.06
FTE Value (= FTE x \$250,000)	22,500	\$45,000	\$265,000
Non-staff in-kind	4,500	\$9,000	\$155,000
Total value of contributions	231,000	\$268,360	\$1,540,000

Notes, please include any relevant details:

FGR has engaged s 22 to attend monthly meetings at Swinburne University. s 22 had completed the due diligence review prior to FGR committing to the supercapacitor project.

Participant: Swinburne University of Technology			
Contribution type	This quarter	Contracted for current FY	Total contracted over the life of the CRC-P
Cash	-	\$0	\$0
FTE	.08	0.15	0.75
FTE Value (= FTE x \$250,000)	20,000	\$37,500	\$187,500
Non-staff in-kind	-	\$0	\$0
Total value of contributions	20,000	\$37,500	\$187,500

Notes, please include any relevant details:

Swinburne University has now engaged all the staff required for the project.

Participant: Flinders University of South Australia			
Contribution type	This quarter	Contracted for current FY	Total contracted over the life of the CRC-P
Cash	-	\$0	\$0
FTE	.05	0.10	0.5
FTE Value (= FTE x \$250,000)	12,500	\$25,000	\$125,000
Non-staff in-kind	-	\$0	\$0
Total value of contributions	12,500	\$25,000	\$125,000

Notes, please include any relevant details:

There are no variations to the staff commitments from Flinders University.

Participant: KREMFORD (VIC) PTY LTD			
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Contribution type	This quarter	Contracted for current FY	Total contracted over the life of the CRC-P
Cash	-	\$0	\$0
FTE	.04	0.08	0.38
FTE Value (= FTE x \$250,000)	10,000	\$20,000	\$95,000
Non-staff in-kind	-	\$0	\$0
Total value of contributions	10,000	\$20,000	\$95,000

Notes, please include any relevant details:

There are no variations to the Kremford FTE position

Total Participant Contributions			
Contribution type	This quarter	Contracted for current FY	Total contracted over the life of the CRC-P
Cash	204,000	\$214,360	\$1,120,000
FTE	.26	0.51	2.69
FTE Value (= FTE x \$250,000)	65,000	\$127,500	\$672,500
Non-staff in-kind	4,500	\$9,000	\$155,000
Total value of contributions	273,500	\$350,860	\$1,947,500

Notes, please include any relevant details:

[Click here to enter text.](#)

## b. Heads of Expenditure

Heads of Expenditure			
Expense type	This quarter	Contracted for current FY	Total contracted over the life of the CRC-P
Employee	-	\$0	\$0
Supplier	204,000	\$511,000	\$2,465,000
Capital	-	\$0	\$0
Other	4,500	\$9,000	\$155,000
Total Expenditure	208,500	\$520,000	\$2,620,000

Notes, please include any relevant details:

[Click here to enter text.](#)



### 3. Other matters

Are there any other matters not covered at Section 1, which may affect your compliance with the Funding Agreement, for example:

Matter	Yes	No
Are there any proposed or actual changes to the recipient company/incorporated trustee ownership/control/structure?	<input type="checkbox"/>	<input checked="" type="checkbox"/>
Are there any change to the Participants?	<input type="checkbox"/>	<input checked="" type="checkbox"/>
Are there any changes to a Participant's future contributions?	<input type="checkbox"/>	<input checked="" type="checkbox"/>
Are there any proposed or actual changes to the Participants Agreement or other contractual arrangements between Participants?	<input type="checkbox"/>	<input checked="" type="checkbox"/>
Are there any proposed or actual changes to intellectual property arrangements, as stipulated in the original application?	<input type="checkbox"/>	<input checked="" type="checkbox"/>
Have you received financial assistance from another government source for, or in connection with, activities you have been contracted to undertake under the Funding Agreement?	<input type="checkbox"/>	<input checked="" type="checkbox"/>
Are there any conflicts of interest arising for the CRC-P in meeting its obligations under the Funding Agreement?	<input type="checkbox"/>	<input checked="" type="checkbox"/>
Are there any additional/new risks factors that will influence the likelihood of successfully completing the Project?	<input type="checkbox"/>	<input checked="" type="checkbox"/>
Are there any additional/new risks that will influence the likelihood of successfully completing the Project that are not already covered above?	<input type="checkbox"/>	<input checked="" type="checkbox"/>

If you answered 'Yes' to any of the above, please provide details:

[Click here to enter text.](#)

#### 4. Certification and Payment

Payment of funds for this reporting period will be made by the Commonwealth via a Recipient Created Tax Invoice subject to the acceptance and approval of this quarterly report, in accordance with the Funding Agreement and any guidelines issued by the Commonwealth. You will be advised on the approval of this quarterly report by the department.

I Peter Richard Youd being duly authorised by the Funding Agreement hereby certify that the information contained in this report is true and correct and that the Funds have been expended only for the Project in accordance with the Funding Agreement.

s22



Signed:..... Date:30/04/2018

Name of Signatory: Peter Richard Youd  
Position: Executive Director, Chief Financial Officer and Company Secretary  
Organisation: First Graphene Limited

# Cooperative Research Centres Projects (CRC-P) Quarterly Report

<u>CRC-P &amp; Selection Round Number:</u>	CRC-P60964 - CRC-P Round 4
<u>CRC-P Title:</u>	High performance energy storage alternative to lithium ion batteries
<u>Lead Participant Entity Name:</u>	FIRST GRAPHENE LIMITED
<u>Funding Period:</u>	01/01/2018 to 30/06/2020
<u>Reporting Period:</u>	January to March (Quarter 3) – 2018/19

## Notes:

This report has a number of purposes which include but are not limited to:

- Providing a basis for making payments;
- Recording the progress of the CRC Project against the Funding Agreement;
- Completing a Program Data Questionnaire (end of financial year); and
- End of Project reporting requirements (final quarterly report).

Information contained in this report may be used by the department for the Minister, the CRC Advisory Committee and other stakeholders.

## 1. Project and Milestone progress

### a. Project progress

Please provide a brief outline of Project progress undertaken in the quarter, including any real or potential challenges or issues, and any major achievements.

During March Flinders University and commercial partner, 2D Fluidics Pty Ltd, have moved to expand research by installing a VFD in the University of Manchester's Graphene Engineering & Innovation Centre (GEIC).

First Graphene Ltd is a Tier 1 participant at GEIC and has made space available in its laboratory at the centre for the setup of the VFD. FGR's UK based personnel have worked with GEIC staff in determining the safety requirements and FGR UK has purchased the necessary equipment.

During this quarter FGR paid for Dr Kasturi Vimalanathan, the lead Research Associate from Flinders Uni, to be seconded to GEIC to work on the VFD.

#### (a) Applications testing

Dr Vimalanathan has developed 2 methods for fabricating GO in the VFD using different size starting materials provided by FGR. The application tests below will provide a better understanding of the material and the way forward in terms of production method.

- Testing of GO for water filtration: Two different GO samples have been passed to the water filtration team.
- Testing of GO in a resin (for mechanical properties): The GEIC composite team is reviewing this during the next quarter.

(b) Product Characterisation

Dr Vimalanathan has used the time at the GEIC to get training on some of the characterisation equipment. I.e. SEM, DLS, zeta potential.

Work has been conducted with SEM, DLS and zeta potential on the GO dispersed in water. The DLS shows an average particle size of ~300 micron with a zeta potential of about -30–35mV. HDuring the next quarter we should have a full set of data for the GO material we are producing in the VFD

(c) VFD Laser setup in the FGR lab

- Enclosure and laser are schedule to arrive in the next quarter. Meeting with the University of Manchester’s safety teams have been productive, and we have been well advised on the next steps forward in terms of safety and abiding with University regulations.
- Safe operating procedures for both the VFD and Laser have now been completed and the FGR team at the GEIC will be finalising and submitting these to the University.

**b. Milestone progress**

Complete the table below and comment on each project milestone [Schedule 2]<sup>1</sup>

Notes:

1. Items in [square brackets] refer to the relevant section of your Funding Agreement.
2. Percentage complete at the time of the end of the review period for this report. If already completed, enter ‘100%’.
3. End date as per the Funding Agreement.
4. Actual or expected completion date.
5. If a future milestone has not yet commenced, enter ‘Yet to commence’. In addition to progress comments, if the agreed end date is unlikely to be met, outline:
  - the reasons for the delay on the project milestone, the expected impact of the delay will have on the project milestone; and
  - actions taken or proposed to ensure that the project milestone is achieved.

No	Project Milestone	% Complete <sup>2</sup>	End Date <sup>3</sup> Agreed	Completion Date <sup>4</sup> Expected/Actual
1	GO reduction and production completed	50	30/06/2018	
<b>Progress Comments</b> – work undertaken and impact of any delay <sup>5</sup>				
Interaction with the University of Manchester's (UoM) scientists on the development of gGO™ will accelerate development during the June quarter. Dr Vimalanathan being exposed to some of the world's leading graphene scientists will improve her knowledge base and be of great use in the future. Working with the capabilities at the GEIC, 2D Fluidics Pty Ltd and First Graphene Ltd researchers will lead the characterisation of the produced 2D materials and develop scale-up plans for these novel processes.				
2	Supercapacitor production and testwork completed		31/12/2018	
<b>Progress Comments</b> – work undertaken and impact of any delay <sup>5</sup>				
FGR will not fund this component of the project as the commercial parameters on which it was based are not going to be achieved. A submission will be made to CRC-P management in the coming week.				
3	GO supercapacitor assembly completed		30/06/2019	
<b>Progress Comments</b> – work undertaken and impact of any delay <sup>5</sup>				
4	Testing of supercapacitor and GO product development completed		30/06/2020	
<b>Progress Comments</b> – work undertaken and impact of any delay <sup>5</sup>				
5	Industry education and training activities completed		30/06/2020	
<b>Progress Comments</b> – work undertaken and impact of any delay <sup>5</sup>				
Professor Colin Raston from the Flinders University College of Science and Engineering initiated the VFD programme at Manchester with an invited seminar at the University on 28th February 2019, followed by a series of meetings with experts based at the University. Approximately 40 academic personnel attended the seminar.				

## 2. Financial Progress

Please fill in the tables below [Schedule 4].

### a. Participant Contributions

<b>Recipient/Lead Participant: FIRST GRAPHENE LIMITED</b>			
<b>Contribution type</b>	<b>This quarter</b>	<b>Contracted for current FY</b>	<b>Total contracted over the life of the CRC-P</b>
Cash	-	\$470,020	\$1,120,000
FTE	.25	0.44	1.06
FTE Value (= FTE x \$250,000)	62,500	\$110,000	\$265,000
Non-staff in-kind	12,952	\$68,000	\$155,000
<b>Total value of contributions</b>	<b>75,452</b>	<b>\$648,020</b>	<b>\$1,540,000</b>

Notes, please include any relevant details:

During the quarter FGR's UK based staff have provided FTE services for equipment purchases and scientific review.

FGR has also paid for Dr Vimalanathan's flights and accommodation in Manchester and the deposit on a Litron TRLi 650-10 High Energy Q Switched Pulsed Nd:YAG Laser.

<b>Participant: Swinburne University of Technology</b>			
<b>Contribution type</b>	<b>This quarter</b>	<b>Contracted for current FY</b>	<b>Total contracted over the life of the CRC-P</b>
Cash		\$0	\$0
FTE		0.30	0.75
FTE Value (= FTE x \$250,000)		\$75,000	\$187,500
Non-staff in-kind		\$0	\$0
<b>Total value of contributions</b>		<b>\$75,000</b>	<b>\$187,500</b>

Notes, please include any relevant details:

FGR has elected to withhold further funding on this project as the commercial parameters on which it was based are not going to be achieved.

<b>Participant: Flinders University of South Australia</b>			
<b>Contribution type</b>	<b>This quarter</b>	<b>Contracted for current FY</b>	<b>Total contracted over the life of the CRC-P</b>
Cash		\$0	\$0
FTE	.08	0.20	0.5
FTE Value (= FTE x \$250,000)	20,000	\$50,000	\$125,000
Non-staff in-kind		\$0	\$0
<b>Total value of contributions</b>	<b>20,000</b>	<b>\$50,000</b>	<b>\$125,000</b>

Notes, please include any relevant details:

Dr Vimalanathan spent all of March 2019 at GEIC in Manchester.

<b>Participant: KREMFORF (VIC) PTY LTD</b>			
<b>Contribution type</b>	<b>This quarter</b>	<b>Contracted for current FY</b>	<b>Total contracted over the life of the CRC-P</b>
Cash		\$0	\$0
FTE		0.15	0.38
FTE Value (= FTE x \$250,000)		\$37,500	\$95,000
Non-staff in-kind		\$0	\$0
<b>Total value of contributions</b>		<b>\$37,500</b>	<b>\$95,000</b>

Notes, please include any relevant details:

No contribution was made by Kremford (Vic) Pty Ltd during the quarter

<b>Total Participant Contributions</b>			
<b>Contribution type</b>	<b>This quarter</b>	<b>Contracted for current FY</b>	<b>Total contracted over the life of the CRC-P</b>
Cash		\$470,020	\$1,120,000
FTE	.33	1.09	2.69
FTE Value (= FTE x \$250,000)	82,500	\$272,500	\$672,500
Non-staff in-kind	12,952	\$68,000	\$155,000
<b>Total value of contributions</b>	<b>95,452</b>	<b>\$810,520</b>	<b>\$1,947,500</b>

Notes, please include any relevant details:

[Click here to enter text.](#)

## b. Heads of Expenditure

<b>Heads of Expenditure</b>			
<b>Expense type</b>	<b>This quarter</b>	<b>Contracted for current FY</b>	<b>Total contracted over the life of the CRC-P</b>
Employee		\$0	\$0
Supplier		\$897,000	\$2,465,000
Capital		\$0	\$0
Other	12,952	\$68,000	\$155,000
<b>Total Expenditure</b>	<b>12,952</b>	<b>\$965,000</b>	<b>\$2,620,000</b>

Notes, please include any relevant details:

[Click here to enter text.](#)

### 3. Other matters

Are there any other matters not covered at Section 1, which may affect your compliance with the Funding Agreement, for example:

Matter	Yes	No
Are there any proposed or actual changes to the recipient company/incorporated trustee ownership/control/structure?	<input type="checkbox"/>	<input checked="" type="checkbox"/>
Are there any change to the Participants?	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Are there any changes to a Participant's future contributions?	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Are there any proposed or actual changes to the Participants Agreement or other contractual arrangements between Participants?	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Are there any proposed or actual changes to intellectual property arrangements, as stipulated in the original application?	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Have you received financial assistance from another government source for, or in connection with, activities you have been contracted to undertake under the Funding Agreement?	<input type="checkbox"/>	<input checked="" type="checkbox"/>
Are there any conflicts of interest arising for the CRC-P in meeting its obligations under the Funding Agreement?	<input type="checkbox"/>	<input checked="" type="checkbox"/>
Are there any additional/new risks factors that will influence the likelihood of successfully completing the Project?	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Are there any additional/new risks that will influence the likelihood of successfully completing the Project that are not already covered above?	<input type="checkbox"/>	<input checked="" type="checkbox"/>

If you answered 'Yes' to any of the above, please provide details:

#### Issues with Swinburne University of Technology

- Original project predicated on replacement of AA and AAA batteries.
- To achieve 900 farads there are now 500 layers x 30µm plus separation layers, so in excess of 15mm. This is too large to be rolled into the volume of a AA or AAA, which is 6,100<sup>3</sup> mm.
- The target was 3.5 volts, but the capacitor is only achieving 1.5 volts.
- A pouch battery started being pursued (unilaterally) by SUT. However, this is only achieving 1,000 m/amp hours and an iPhone battery, for example, requires 3,400 m/amp hours.
- We have been told further work would be required on the ionic electrolyte liquid, and SUT have advised this would have to be another project with separate funding. They would require a electrolyte suitable for 5 volts to surpass a Li-ion battery.



- When Dr Kasturi Vimalanathan and s22 went to SUT to test the gGO™ produced by Flinders, s22 and s22 were unco-operative. This is despite them being aware that Flinders University's gGO™ project formed a portion of the CRC-P project.

### **Conclusion**

FGR does not believe SUT can achieve the original objectives of the project and has discontinued funding the CRA.

### **Status of Flinders University Project**

- Considerable progress has been made on the development of gGO™ with the Vortex Fluidic Device (VFD).
- Levels of oxidation are approaching those produced by Spanish group Graphenea. Graphenea has invested >€10m in its GO production.
- Expansion of the gGO™ program will continue, with the next stage being production of a larger VFD.

### **Conclusion**

As funding partner FGR is comfortable with the progress being made by Flinders University.

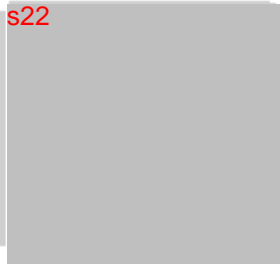
### **Next Steps**

- FGR has ceased funding of the supercapacitor project with SUT
- Through its involvement as a Tier 1 participant at the University of Manchester's Graphene Engineering & Innovation Centre (GEIC),
  - ✓ Dr Kasturi Vimalanathan was seconded to FGR (UK) for a three month period to work with FGR's UK engineers and UoM scientists for further development of the VFD's graphene oxide potential. Dr Vimalanathan will be continuing this secondment during fiscal 2018/19.
  - ✓ Professor Colin Raston, inventor of the VFD, gave lectures at the UoM on 28th February 2019.

#### 4. Certification and Payment

Payment of funds for this reporting period will be made by the Commonwealth via a Recipient Created Tax Invoice subject to the acceptance and approval of this quarterly report, in accordance with the Funding Agreement and any guidelines issued by the Commonwealth. You will be advised on the approval of this quarterly report by the department.

I **Peter Richard Youd** being duly authorised by the Funding Agreement hereby certify that the information contained in this report is true and correct and that the Funds have been expended only for the Project in accordance with the Funding Agreement.

s22  


Signed:

Date:30 / 04 / 2019

Name of Signatory: Peter Richard Youd  
Position: Executive Director, Chief Financial Officer & Company Secretary  
Organisation: First Graphene Limited

# Cooperative Research Centres Projects (CRC-P) End of Financial Year Report

<u>CRC-P &amp; Selection Round Number:</u>	CRC-P60964 - CRC-P Round 4
<u>CRC-P Title:</u>	High performance energy storage alternative to lithium ion batteries
<u>Lead Participant Entity Name:</u>	FIRST GRAPHENE LIMITED
<u>Funding Period:</u>	01/01/2018 to 30/06/2020
<u>Reporting Period:</u>	April to June (Quarter 4, EOFY) – 2017/18

## Notes:

This report has a number of purposes which include but are not limited to:

- Providing a basis for making payments;
- Recording the progress of the CRC Project against the Funding Agreement;
- Completing a Programme Data Questionnaire (end of financial year); and
- End of Project reporting requirements (final quarterly report).

Information contained in this report may be used by the department for the Minister, the CRC Advisory Committee and other stakeholders.

## 1. Project and Milestone progress

### a. Project progress

Please provide a brief outline of Project progress undertaken in the quarter, including any real or potential challenges or issues, and any major achievements.

In the June quarter significant progress was made on the projects. The details are contained on the following pages.

Swinburne University of Technology have overcome difficulties which had been experienced in the ultrasonic welding for collector attachments. The development of the multi-laser reduced graphene oxide (rGO) system has been achieved. During the coming quarter the roll-to-roll coating machine and automatic cross cutting machines will be installed. This portion of the project is currently at a Technology Readiness Level (TRL) of 4 and with the installation of these machines will be in a position to move 5 or 6.

Flinders University have made significant progress in the production of graphene oxide (GO). They have optimised the experimental conditions for the production of graphene oxide devoid of toxic chemicals and surfactants with scalability incorporated into the process. The method involves graphite flakes dispersed in a green, environmentally friendly oxidant, 30% aqueous hydrogen peroxide and processed in a microfluidic platform, the vortex fluidic device (VFD) with a simultaneous Nd:YAG laser beam irradiated producing high concentrations of hydroxyl free radicals. We are able to achieve a reproducible surface oxidation of ca 32-37% with the material collected being stable in water.

## b. Milestone progress

Complete the table below and comment on each project milestone [Schedule 2]<sup>1</sup>

Notes:

1. Items in [square brackets] refer to the relevant section of your Funding Agreement.
2. Percentage complete at the time of the end of the review period for this report. If already completed, enter '100%'.
3. End date as per the Funding Agreement.
4. Actual or expected completion date. If a future milestone has not yet commenced, enter 'Yet to commence'. In addition to progress comments, if the agreed end date is unlikely to be met, outline:
  - the reasons for the delay on the project milestone, the expected impact of the delay will have on the project milestone; and
  - actions taken or proposed to ensure that the project milestone is achieved.

No	Project Milestone	% Complete <sup>2</sup>	End Date <sup>3</sup> Agreed	Completion Date <sup>4</sup> Expected/Actual
1	GO reduction and production completed	10	30/06/2018	
<b>Progress Comments</b> – work undertaken and impact of any delay <sup>5</sup>				
<p>Experimental conditions for the production of GO has been completed</p> <p>Currently working on affording a high yield of material for test work and using LED lamp as an alternative to the laser beam</p>				
2	Supercapacitor production and testwork completed	20	31/12/2018	
<b>Progress Comments</b> – work undertaken and impact of any delay <sup>5</sup>				
<p>SUT has designed and developed the 25-laser diode parallel reduction system setup. The circuitry can be controlled by a single button. While there was an issue with the red lasers supplied by the vendor SUT are confident they can drive all the proposed 25 lasers at the same time as soon as enough workable lasers are at hand.</p> <p>SUT have found the solutions to overcome the challenge of complexity in the parallel system development. The system is composed of 5 modules, including the mechanical module system, electrical module system, laser Blue lasers IR lasers Graphene oxide on glass substrate head system, control module and user interface (UI)/Control. All these modules have been developed. Finally, the parallel reduction of GO film using the lasers is demonstrated.</p>				
3	GO supercapacitor assembly completed	20	30/06/2019	
<b>Progress Comments</b> – work undertaken and impact of any delay <sup>5</sup>				
<p>In the existing method to attach current collectors the metal current collector is directly attach to the surface of the porous RGO structure. As the carbon material does not bind well to any metals, the electrical properties and mechanical strength of the attachment is poor. To further improve the attachment, SUT designed a new attachment scheme. In between the metal current collector and the RGO porous material they have we used vacuum deposition method to coat the RGO with a thin layer of metal (around 200 nm in thickness). Then the bonding of two layers is enhanced by the ultrasonic welding. In this way, both the electrical conductivity and the mechanical strength can be further increased.</p>				
4	Testing of supercapacitor and GO product development completed	10	30/06/2020	
<b>Progress Comments</b> – work undertaken and impact of any delay <sup>5</sup>				
<p>Flinders University have now completed the optimisation of experimental conditions and currently working on fabricating enough material for testing in Swinburne and also using LED lamps instead of the laser.</p>				
5	Industry education and training activities completed	10	30/06/2020	
<b>Progress Comments</b> – work undertaken and impact of any delay <sup>5</sup>				
<p>FGR provides regular updates to equity markets on the progress of the work being undertaken in the CRC-P program. As the energy and power density increase toward the target levels FGR continues to receive interest in the product. With a Technology Readiness Level of 4, and moving toward 6, this product will attract more attention.</p>				

## 2. Financial Progress

Please fill in the tables below [Schedule 4].

### a. Participant Contributions

Recipient/Lead Participant: FIRST GRAPHENE LIMITED			
Contribution type	This quarter	Contracted for current FY	Total contracted over the life of the CRC-P
Cash	\$463,000	\$214,360	\$1,120,000
FTE	.09	0.18	1.06
FTE Value (= FTE x \$250,000)	22,500	\$45,000	\$265,000
Non-staff in-kind	4,500	\$9,000	\$155,000
Total value of contributions	490,000	\$268,360	\$1,540,000

Notes, please include any relevant details:

s 22 has been attending monthly meetings at Swinburne.

Participant: Swinburne University of Technology			
Contribution type	This quarter	Contracted for current FY	Total contracted over the life of the CRC-P
Cash		\$0	\$0
FTE	.08	0.15	0.75
FTE Value (= FTE x \$250,000)	20,000	\$37,500	\$187,500
Non-staff in-kind	-	\$0	\$0
Total value of contributions	20,000	\$37,500	\$187,500

Notes, please include any relevant details:

Swinburne is now fully staffed.

Participant: Flinders University of South Australia			
Contribution type	This quarter	Contracted for current FY	Total contracted over the life of the CRC-P
Cash		\$0	\$0
FTE	.5	0.10	0.5
FTE Value (= FTE x \$250,000)	12,500	\$25,000	\$125,000
Non-staff in-kind		\$0	\$0
Total value of contributions	12,500	\$25,000	\$125,000

Notes, please include any relevant details:

Staff commitments from Flinders University remain unchanged.

<b>Participant: KREMFORD (VIC) PTY LTD</b>			
<b>Contribution type</b>	<b>This quarter</b>	<b>Contracted for current FY</b>	<b>Total contracted over the life of the CRC-P</b>
Cash		\$0	\$0
FTE	.04	0.08	0.38
FTE Value (= FTE x \$250,000)	10,000	\$20,000	\$95,000
Non-staff in-kind		\$0	\$0
<b>Total value of contributions</b>	<b>10,000</b>	<b>\$20,000</b>	<b>\$95,000</b>

Notes, please include any relevant details:

Kremford's FTE position remains unchanged in this quarter. They will be doing more work in future quarters on the development of the electronic design, which include output voltage and current, charge current, ESR (Effective Series Resistance), and self-discharge.

<b>Total Participant Contributions</b>			
<b>Contribution type</b>	<b>This quarter</b>	<b>Contracted for current FY</b>	<b>Total contracted over the life of the CRC-P</b>
Cash	463,000	\$214,360	\$1,120,000
FTE	.26	0.51	2.69
FTE Value (= FTE x \$250,000)	65,000	\$127,500	\$672,500
Non-staff in-kind	4,500	\$9,000	\$155,000
<b>Total value of contributions</b>	<b>532,500</b>	<b>\$350,860</b>	<b>\$1,947,500</b>

Notes, please include any relevant details:

[Click here to enter text.](#)

## b. Heads of Expenditure

<b>Heads of Expenditure</b>			
<b>Expense type</b>	<b>This quarter</b>	<b>Contracted for current FY</b>	<b>Total contracted over the life of the CRC-P</b>
Employee		\$0	\$0
Supplier	463,000	\$511,000	\$2,465,000
Capital		\$0	\$0
Other	4,500	\$9,000	\$155,000
<b>Total Expenditure</b>	<b>467,500</b>	<b>\$520,000</b>	<b>\$2,620,000</b>

Notes, please include any relevant details:

[Click here to enter text.](#)

### 3. Other matters

Are there any other matters not covered at Section 1, which may affect your compliance with the Funding Agreement, for example:

Matter	Yes	No
Are there any proposed or actual changes to the recipient company/incorporated trustee ownership/control/structure?	<input type="checkbox"/>	<input checked="" type="checkbox"/>
Are there any change to the Participants?	<input type="checkbox"/>	<input checked="" type="checkbox"/>
Are there any changes to a Participant's future contributions?	<input type="checkbox"/>	<input checked="" type="checkbox"/>
Are there any proposed or actual changes to the Participants Agreement or other contractual arrangements between Participants?	<input type="checkbox"/>	<input checked="" type="checkbox"/>
Are there any proposed or actual changes to intellectual property arrangements, as stipulated in the original application?	<input type="checkbox"/>	<input checked="" type="checkbox"/>
Have you received financial assistance from another government source for, or in connection with, activities you have been contracted to undertake under the Funding Agreement?	<input type="checkbox"/>	<input checked="" type="checkbox"/>
Are there any conflicts of interest arising for the CRC-P in meeting its obligations under the Funding Agreement?	<input type="checkbox"/>	<input checked="" type="checkbox"/>
Are there any additional/new risks factors that will influence the likelihood of successfully completing the Project?	<input type="checkbox"/>	<input checked="" type="checkbox"/>
Are there any additional/new risks that will influence the likelihood of successfully completing the Project that are not already covered above?	<input type="checkbox"/>	<input checked="" type="checkbox"/>

If you answered 'Yes' to any of the above, please provide details:

[Click here to enter text.](#)



## 4. Program Data Questionnaire

Please answer on each Program Data Questionnaire (PDQ) question below. All data reported through the PDQ must relate to the relevant end of financial year reporting period only (i.e. 1 July to 30 June).

### a. Patents

Were there any patents filed or maintained during the reporting period? If yes report below, otherwise please skip to the next question.

<b>1</b>	<b>Number of new applications for patents filed during the reporting period:</b>	
	<i>In Australia</i>	<i>Overseas</i>
	Nil	Nil
<b>2</b>	<b>Number of patents maintained during the reporting period:</b>	
	<i>In Australia</i>	<i>Overseas</i>
	Nil	Nil

### b. Licences/Options/Assignments (LOAs)

Were there any Licences/Options/Assignments (LOAs) executed during the reporting period? If yes report below, otherwise please skip to the next question.

<b>3</b>	<b>Number of new LOAs executed involving industry-users during the reporting period relating to the Project.</b>	Nil
<b>4</b>	<b>Income (\$000's) from all LOAs active during the reporting period related to the Project.</b>	Nil

### c. Contracts, consultancies, material transfer agreements and direct sales

Were there any contracts, consultancies, material transfer agreements and direct sales undertaken during the reporting period? If yes report below, otherwise please skip to the next question.

<b>5</b>	<b>Number of consultancies, contracts, material transfer agreements and direct sales during the reporting period.</b>	Nil
<b>6</b>	<b>Gross contracted value (\$000's) from consultancies, contracts, material transfer agreements and direct sales during the reporting period.</b>	Nil

### d. Start-up/Spin-off companies

Were there any new operational start-up/spin-off companies created during the reporting period? If yes report below, otherwise please skip to the next question.

<b>7</b>	<b>Number of new operational start-up/spin-off companies related to the Project during the reporting period.</b>	Nil
<b>8</b>	<b>Income (\$000's) (e.g. royalties, contributions, sale of equity) during the reporting period from all start-up/spin-off companies related to the Project.</b>	Nil

**e. Publications and reports for industry-users**

Were there any publications or reports arising from the CRC-P's activities published during the reporting period and produced with the aim of transferring know-how or practical information to industry-users during the reporting period? If yes report below, otherwise please skip to the next question.

<b>9</b>	<b>Number of publications or reports for industry-users published during the reporting period.</b>	Nil
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**f. Industry-focused education and training activities**

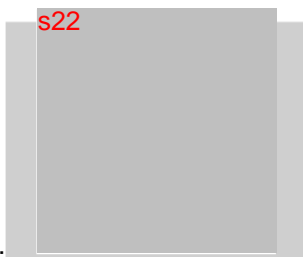
Were there any industry-focused education and training activities with the aim of transferring know-how or practical information to industry during the reporting period? If yes report below, otherwise please skip to the next section.

<b>10</b>	<b>Number of structured professional training courses, conferences, symposia, seminar series or workshops conducted/hosted by the CRC-P participants with the aim of transferring know-how or practical information during the reporting period.</b>	Nil
<b>11</b>	<b>Number of internships and secondments between industry entities and research organisations during the reporting period.</b>	Nil

## 5. Certification and Payment

Payment of funds for this reporting period will be made by the Commonwealth via a Recipient Created Tax Invoice subject to the acceptance and approval of this quarterly report, in accordance with the Funding Agreement and any guidelines issued by the Commonwealth. You will be advised on the approval of this quarterly report by the department.

I Peter Richard Youd being duly authorised by the Funding Agreement hereby certify that the information contained in this report is true and correct and that the Funds have been expended only for the Project in accordance with the Funding Agreement.

s22  


Signed: Date:24/07/2018

Name of Signatory: Peter Richard Youd

Position: Executive Director, Chief Financial Officer and Company Secretary

Organisation: First Graphene Limited

# Cooperative Research Centres Projects (CRC-P) Quarterly Report

<u>CRC-P &amp; Selection Round Number:</u>	CRC-P60964 - CRC-P Round 4
<u>CRC-P Title:</u>	High performance energy storage alternative to lithium ion batteries
<u>Lead Participant Entity Name:</u>	FIRST GRAPHENE LIMITED
<u>Funding Period:</u>	01/01/2018 to 30/06/2020
<u>Reporting Period:</u>	April to June (Quarter 4, EOFY) – 2018/19

## Notes:

This report has a number of purposes which include but are not limited to:

- Providing a basis for making payments;
- Recording the progress of the CRC Project against the Funding Agreement;
- Completing a Program Data Questionnaire (end of financial year); and
- End of Project reporting requirements (final quarterly report).

Information contained in this report may be used by the department for the Minister, the CRC Advisory Committee and other stakeholders.

## 1. Project and Milestone progress

### a. Project progress

Please provide a brief outline of Project progress undertaken in the quarter, including any real or potential challenges or issues, and any major achievements.

#### **Overview of progress in this Quarter:**

In April 2019, Dr Kasturi Vimalathan completed the first stage of her placement at the Graphene Engineering Innovation Centre (GEIC) at the University of Manchester in the United Kingdom. During this period, the focus was on improving our understanding of the process with a view to understanding scale up parameters, product quality and reaction mechanism. A joint report entitled "Vortex Fluidics Device – Process and Product Technology Assessment" was issued. We also identified further work that needed to be carried out at Flinders University to inform the design – in particular, focussing on the energy source which is needed for the process.

Over the course of May 2019, Dr Vimalathan returned to Flinders University where she conducted further range finding trials and she reported back on these. s22, Senior Process Engineer from First Graphene UK Limited, visited Flinders University to discuss the results with Dr Vimalathan and Professor Raston. A follow up set of trials was agreed on.

In Jun 2019, the GEIC team have focussed on installing the test rig and understanding some of the associated product quality parameters. We have also received some initial feedback from potential end users.

#### **Applications Testing:**

We have reviewed feedback from end users. Key points / achievements as follows:

- Whilst we don't have a specific product quality target for the material, we now know there is a trade-off between oxidation level, stability and utility for the end applications;
- For water treatment applications we need a material which can be readily dispersed to provide a uniform film;
- For a potential novel electronic sensor application, again the material needs to be water soluble but we need to minimise the oxidation content to make it compatible with the system's electronic circuit.

#### Product Characterisation

- The zeta potential test protocol, that was co-developed with the GEIC team, is now being used to assess product stability;
- We have carried out some further SEM and XPS analysis on the product.

#### Process Scale up

- A success from this quarter is that we have identified a set of conditions at a reduced power input that will reduce the likelihood of overheating the system and leading to catastrophic damage of the glass tube;
- s22 and Colin Raston have had some in-depth discussion on the underlying theory regarding the fluid mechanics in the thin film. This will be tested in the next quarter.

### b. Milestone progress

Complete the table below and comment on each project milestone [Schedule 2]<sup>1</sup>

#### Notes:

1. Items in [square brackets] refer to the relevant section of your Funding Agreement.
2. Percentage complete at the time of the end of the review period for this report. If already completed, enter '100%'.
3. End date as per the Funding Agreement.
4. Actual or expected completion date.
5. If a future milestone has not yet commenced, enter 'Yet to commence'. In addition to progress comments, if the agreed end date is unlikely to be met, outline:
  - the reasons for the delay on the project milestone, the expected impact of the delay will have on the project milestone; and
  - actions taken or proposed to ensure that the project milestone is achieved.

No	Project Milestone	% Complete <sup>2</sup>	End Date <sup>3</sup> Agreed	Completion Date <sup>4</sup> Expected/Actual
1	GO reduction and production completed	60	30/06/2018	Expected – 30/09/2019
<b>Progress Comments</b> – work undertaken and impact of any delay <sup>5</sup>				
<p>The interaction between Dr Vimalathan, First Graphene Ltd's team and the GEIC and the University of Manchester scientists is working well. By taking a multi-disciplinary approach, working alongside experienced chemical engineers, applications scientists and potential commercial end users, we are taking a more holistic approach to the scale up and commercialisation.</p> <p>We have carried out further work on the system mass balance to understand the process yield – this will inform the economics, scalability and ultimately viability of the system. Whilst the expected completion date has been pushed back, this will lead to a more robust assessment of the process.</p>				
2	Supercapacitor production and testwork completed		31/12/2018	
<b>Progress Comments</b> – work undertaken and impact of any delay <sup>5</sup>				
3	GO supercapacitor assembly completed		30/06/2019	
<b>Progress Comments</b> – work undertaken and impact of any delay <sup>5</sup>				
4	Testing of supercapacitor and GO product development completed		30/06/2020	
<b>Progress Comments</b> – work undertaken and impact of any delay <sup>5</sup>				
5	Industry education and training activities completed		30/06/2020	
<b>Progress Comments</b> – work undertaken and impact of any delay <sup>5</sup>				
<p>s22 (FGR (UK) – GEIC) visited the University of Flinders for a knowledge transfer session.</p> <p>Dr Kasturi Vimalathan discussed the work being done on gGO at the Carbon Science and Technology Workshop, organised jointly between the Curtin Carbon Group and the Australian Carbon Society at Curtin University.</p> <p><a href="https://www.australiancarbonsociety.org/uploads/7/0/1/9/70198919/flyer_workshop.pdf">https://www.australiancarbonsociety.org/uploads/7/0/1/9/70198919/flyer_workshop.pdf</a></p>				

## 2. Financial Progress

Please fill in the tables below [Schedule 4].

### a. Participant Contributions

<b>Recipient/Lead Participant: FIRST GRAPHENE LIMITED</b>			
<b>Contribution type</b>	<b>This quarter</b>	<b>Contracted for current FY</b>	<b>Total contracted over the life of the CRC-P</b>
Cash	100,000	\$470,020	\$1,120,000
FTE	.25	0.44	1.06
FTE Value (= FTE x \$250,000)	62,500	\$110,000	\$265,000
Non-staff in-kind	3,282	\$68,000	\$155,000
<b>Total value of contributions</b>	<b>165,782</b>	<b>\$648,020</b>	<b>\$1,540,000</b>

Notes, please include any relevant details:

[Click here to enter text.](#)

<b>Participant: Swinburne University of Technology</b>			
<b>Contribution type</b>	<b>This quarter</b>	<b>Contracted for current FY</b>	<b>Total contracted over the life of the CRC-P</b>
Cash		\$0	\$0
FTE		0.30	0.75
FTE Value (= FTE x \$250,000)		\$75,000	\$187,500
Non-staff in-kind		\$0	\$0
<b>Total value of contributions</b>		<b>\$75,000</b>	<b>\$187,500</b>

Notes, please include any relevant details:

FGR has elected to withhold further funding on this project as the commercial parameters on which it was based are not going to be achieved.

<b>Participant: Flinders University of South Australia</b>			
<b>Contribution type</b>	<b>This quarter</b>	<b>Contracted for current FY</b>	<b>Total contracted over the life of the CRC-P</b>
Cash		\$0	\$0
FTE	.08	0.20	0.5
FTE Value (= FTE x \$250,000)	20,000	\$50,000	\$125,000
Non-staff in-kind		\$0	\$0
<b>Total value of contributions</b>	<b>20,000</b>	<b>\$50,000</b>	<b>\$125,000</b>

Notes, please include any relevant details:

[Click here to enter text.](#)

<b>Participant: KREMFORD (VIC) PTY LTD</b>			
<b>Contribution type</b>	<b>This quarter</b>	<b>Contracted for current FY</b>	<b>Total contracted over the life of the CRC-P</b>
Cash		\$0	\$0
FTE		0.15	0.38
FTE Value (= FTE x \$250,000)		\$37,500	\$95,000
Non-staff in-kind		\$0	\$0
<b>Total value of contributions</b>		<b>\$37,500</b>	<b>\$95,000</b>

Notes, please include any relevant details:

No contribution was made by Kremford (Vic) Pty Ltd during the quarter

<b>Total Participant Contributions</b>			
<b>Contribution type</b>	<b>This quarter</b>	<b>Contracted for current FY</b>	<b>Total contracted over the life of the CRC-P</b>
Cash	100,000	\$470,020	\$1,120,000
FTE	.33	1.09	2.69
FTE Value (= FTE x \$250,000)	82,500	\$272,500	\$672,500
Non-staff in-kind	3,282	\$68,000	\$155,000
<b>Total value of contributions</b>	<b>185,782</b>	<b>\$810,520</b>	<b>\$1,947,500</b>

Notes, please include any relevant details:

[Click here to enter text.](#)

## b. Heads of Expenditure

<b>Heads of Expenditure</b>			
<b>Expense type</b>	<b>This quarter</b>	<b>Contracted for current FY</b>	<b>Total contracted over the life of the CRC-P</b>
Employee		\$0	\$0
Supplier		\$897,000	\$2,465,000
Capital		\$0	\$0
Other	3,282	\$68,000	\$155,000
<b>Total Expenditure</b>	<b>3,282</b>	<b>\$965,000</b>	<b>\$2,620,000</b>

Notes, please include any relevant details:

[Click here to enter text.](#)



### 3. Other matters

Are there any other matters not covered at Section 1, which may affect your compliance with the Funding Agreement, for example:

Matter	Yes	No
Are there any proposed or actual changes to the recipient company/incorporated trustee ownership/control/structure?	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Are there any change to the Participants?	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Are there any changes to a Participant's future contributions?	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Are there any proposed or actual changes to the Participants Agreement or other contractual arrangements between Participants?	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Are there any proposed or actual changes to intellectual property arrangements, as stipulated in the original application?	<input type="checkbox"/>	<input checked="" type="checkbox"/>
Have you received financial assistance from another government source for, or in connection with, activities you have been contracted to undertake under the Funding Agreement?	<input type="checkbox"/>	<input checked="" type="checkbox"/>
Are there any conflicts of interest arising for the CRC-P in meeting its obligations under the Funding Agreement?	<input type="checkbox"/>	<input checked="" type="checkbox"/>
Are there any additional/new risks factors that will influence the likelihood of successfully completing the Project?	<input type="checkbox"/>	<input checked="" type="checkbox"/>
Are there any additional/new risks that will influence the likelihood of successfully completing the Project that are not already covered above?	<input type="checkbox"/>	<input checked="" type="checkbox"/>

If you answered 'Yes' to any of the above, please provide details:

#### **Issues with Swinburne University of Technology**

- Original project predicated on replacement of AA and AAA batteries.
- To achieve 900 farads there are now 500 layers x 30µm plus separation layers, so in excess of 15mm. This is too large to be rolled into the volume of a AA or AAA, which is 6,1003 mm.
- The target was 3.5 volts, but the capacitor is only achieving 1.5 volts.
- A pouch battery started being pursued (unilaterally) by SUT. However, this is only achieving 1,000 m/amp hours and an iPhone battery, for example, requires 3,400 m/amp hours.
- We have been told further work would be required on the ionic electrolyte liquid, and SUT have advised this would have to be another project with separate funding. They would require a electrolyte suitable for 5 volts to surpass a Li-ion battery.

- When Dr Kasturi Vimalanathan and s22 went to SUT to test the gGO™ produced by Flinders, s22 and s22 were unco-operative. This is despite them being aware that Flinders University's gGO™ project formed a portion of the CRC-P project.

### **Conclusion**

FGR does not believe SUT can achieve the original objectives of the project and has discontinued funding the CRA.

#### Status of Flinders University Project

- Considerable progress has been made on the development of gGO™ with the Vortex Fluidic Device (VFD).
- Levels of oxidation are approaching those produced by Spanish group Graphenea. Graphenea has invested >€10m in its GO production.
- Expansion of the gGO™ program will continue, with the next stage being production of a larger VFD.

### **Conclusion**

As funding partner FGR is comfortable with the progress being made by Flinders University.

#### Next Steps

- FGR has ceased funding of the supercapacitor project with SUT
- Through its involvement as a Tier 1 participant at the University of Manchester's Graphene Engineering & Innovation Centre (GEIC),

## 4. Program Data Questionnaire

Please answer on each Program Data Questionnaire (PDQ) question below. All data reported through the PDQ must relate to the relevant end of financial year reporting period only (i.e. 1 July to 30 June).

### a. Patents

Were there any patents filed or maintained during the reporting period? If yes report below, otherwise please skip to the next question.

1	<b>Number of new applications for patents filed during the reporting period:</b>	
	<i>In Australia</i>	<i>Overseas</i>
	Nil	Nil
2	<b>Number of patents maintained during the reporting period:</b>	
	<i>In Australia</i>	<i>Overseas</i>
	Two	Two

### b. Licences/Options/Assignments (LOAs)

Were there any Licences/Options/Assignments (LOAs) executed during the reporting period? If yes report below, otherwise please skip to the next question.

3	<b>Number of new LOAs executed involving industry-users during the reporting period relating to the Project.</b>	
4	<b>Income (\$000's) from all LOAs active during the reporting period related to the Project.</b>	

### c. Contracts, consultancies. Material transfer agreements and direct sales

Were there any contracts, consultancies, material transfer agreements and direct sales undertaken during the reporting period? If yes report below, otherwise please skip to the next question.

5	<b>Number of consultancies, contracts, material transfer agreements and direct sales during the reporting period.</b>	
6	<b>Gross contracted value (\$000's) from consultancies, contracts, material transfer agreements and direct sales during the reporting period.</b>	

### d. Start-up/Spin-off companies

Were there any new operational start-up/spin-off companies created during the reporting period? If yes report below, otherwise please skip to the next question.

7	<b>Number of new operational start-up/spin-off companies related to the Project during the reporting period.</b>	
8	<b>Income (\$000's) (e.g. royalties, contributions, sale of equity) during the reporting period from all start-up/spin-off companies related to the Project.</b>	

**e. Publications and reports for industry-users**

Were there any publications or reports arising from the CRC-P's activities published during the reporting period and produced with the aim of transferring know-how or practical information to industry-users during the reporting period? If yes report below, otherwise please skip to the next question.

<b>9</b>	<b>Number of publications or reports for industry-users published during the reporting period.</b>  <a href="https://www.australiancarbonsociety.org/uploads/7/0/1/9/70198919/flyer_workshop.pdf">https://www.australiancarbonsociety.org/uploads/7/0/1/9/70198919/flyer_workshop.pdf</a>	One
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**f. Industry-focused education and training activities**

Were there any industry-focused education and training activities with the aim of transferring know-how or practical information to industry during the reporting period? If yes report below, otherwise please skip to the next section.

<b>10</b>	<b>Number of structured professional training courses, conferences, symposia, seminar series or workshops conducted/hosted by the CRC-P participants with the aim of transferring know-how or practical information during the reporting period.</b>	One
<b>11</b>	<b>Number of internships and secondments between industry entities and research organisations during the reporting period.</b>	-

## 5. Certification and Payment

Payment of funds for this reporting period will be made by the Commonwealth via a Recipient Created Tax Invoice subject to the acceptance and approval of this quarterly report, in accordance with the Funding Agreement and any guidelines issued by the Commonwealth. You will be advised on the approval of this quarterly report by the department.

I **Peter Richard Youd** being duly authorised by the Funding Agreement hereby certify that the information contained in this report is true and correct and that the Funds have been expended only for the Project in accordance with the Funding Agreement.

s22

A large grey rectangular redaction box covers the signature area. The text 's22' is written in red at the top left corner of the box.

Signed:

Date: 31/ 07 / 2019

Name of Signatory: Peter Richard Youd

Position: Executive Director, Chief Financial Officer & Company Secretary

Organisation: First Graphene Limited



**Australian Government**  
**Department of Industry,  
Innovation and Science**

GPO Box 2013, CANBERRA ACT 2601

**RECIPIENT CREATED TAX INVOICE**

Recipient's ABN: 74 599 608 295

Suppliers ABN: 50007870760

FIRST GRAPHENE LIMITED  
SUITE 3  
9 HAMPDEN ROAD  
NEDLANDS WA 6009

**Invoice No:** RC014539

**Date:** 5/01/2018

**Creditor Id:** C021470

**Due Date:** 5/01/2018

**Page :** 1 of 1

Attention: PETER YOUD

<i>Quantity</i>	<i>Quantity and Description</i>	<i>Unit Amount</i>	<i>Exclusive GST</i>	<i>GST</i>	<i>Total Amount</i>
	Cooperative Research Centre Projects GRANT No:CRC-P60964 GRANT CONTACT: PETER YOUD <span style="background-color: #cccccc; color: red;">s22</span>		76,410.00	7,641.00	84,051.00
<b>Total Amount Due:</b>			\$76,410.00	\$7,641.00	\$84,051.00

C021470  
FIRST GRAPHENE LIMITED

**Invoice No:** RC014539

**Date:** 5/01/2018

**Exclusive GST:** \$76,410.00

**GST:** \$7,641.00

**Amount:** \$84,051.00

Please tick here if a receipt is required:



**Australian Government**  
**Department of Industry,  
Innovation and Science**

GPO Box 2013, CANBERRA ACT 2601

**RECIPIENT CREATED TAX INVOICE**

Recipient's ABN: 74 599 608 295  
Suppliers ABN: 50007870760

FIRST GRAPHENE LIMITED  
SUITE 3  
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NEDLANDS WA 6009

**Invoice No:** RC015753  
**Date:** 03/05/2018  
**Creditor Id:** C021470  
**Due Date:** 04/05/2018  
**Page :** 1 of 1

Attention: PETER YOUD

<i>Quantity</i>	<i>Quantity and Description</i>	<i>Unit Amount</i>	<i>Exclusive GST</i>	<i>GST</i>	<i>Total Amount</i>
	COOPERATIVE RESEARCH CENTRE PROJECTS GRANT NO: CRC-P60964 MR PETER YOUD EMAIL: PETER.YOUD@s22		76,410.00	7,641.00	84,051.00
	<b>Total Amount Due:</b>		\$76,410.00	\$7,641.00	\$84,051.00

C021470  
FIRST GRAPHENE LIMITED

Please tick here if a receipt is required:

**Invoice No:** RC015753  
**Date:** 03/05/2018  
**Exclusive GST:** \$76,410.00  
**GST:** \$7,641.00  
**Amount:** \$84,051.00



**Australian Government**  
**Department of Industry,  
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**RECIPIENT CREATED TAX INVOICE**

Recipient's ABN: 74 599 608 295  
Suppliers ABN: 50007870760

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**Invoice No:** RC016935  
**Date:** 01/08/2018  
**Creditor Id:** C021470  
**Due Date:** 03/08/2018  
**Page :** 1 of 1

Attention: PETER YOUD

<i>Quantity</i>	<i>Quantity and Description</i>	<i>Unit Amount</i>	<i>Exclusive GST</i>	<i>GST</i>	<i>Total Amount</i>
	COOPERATIVE RESEARCH CENTRE PROJECTS GRANT NO: CRC-P60964 MR PETER YOUD EMAIL: PETER.YOUD@s22		152,820.00	15,282.00	168,102.00
	<b>Total Amount Due:</b>		\$152,820.00	\$15,282.00	\$168,102.00

C021470  
FIRST GRAPHENE LIMITED

**Invoice No:** RC016935  
**Date:** 01/08/2018  
**Exclusive GST:** \$152,820.00  
**GST:** \$15,282.00  
**Amount:** \$168,102.00

Please tick here if a receipt is required:





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**Department of Industry,  
Innovation and Science**

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**RECIPIENT CREATED TAX INVOICE**

Recipient's ABN: 74 599 608 295

Suppliers ABN: 50007870760

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NEDLANDS WA 6009

**Invoice No:** RC017810

**Date:** 01/11/2018

**Creditor Id:** C021470

**Due Date:** 02/11/2018

**Page :** 1 of 1

Attention: PETER YOUD

<i>Quantity</i>	<i>Quantity and Description</i>	<i>Unit Amount</i>	<i>Exclusive GST</i>	<i>GST</i>	<i>Total Amount</i>
	COOPERATIVE RESEARCH CENTRE PROJECTS GRANT NO: CRC-P60964 MR P. YOUD CONTACT NO: s22		123,745.00	12,374.50	136,119.50
	<b>Total Amount Due:</b>		\$123,745.00	\$12,374.50	\$136,119.50

C021470  
FIRST GRAPHENE LIMITED

Please tick here if a receipt is required:

**Invoice No:** RC017810

**Date:** 01/11/2018

**Exclusive GST:** \$123,745.00

**GST:** \$12,374.50

**Amount:** \$136,119.50



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**Department of Industry,  
Innovation and Science**

GPO Box 2013, CANBERRA ACT 2601

**RECIPIENT CREATED TAX INVOICE**

Recipient's ABN: 74 599 608 295  
Suppliers ABN: 50007870760

FIRST GRAPHENE LIMITED  
SUITE 3  
9 HAMPDEN ROAD  
NEDLANDS WA 6009

**Invoice No:** RC020379  
**Date:** 03/05/2019  
**Creditor Id:** C021470  
**Due Date:** 09/05/2019  
**Page :** 1 of 1

Attention: PETER YOUD

<i>Quantity</i>	<i>Quantity and Description</i>	<i>Unit Amount</i>	<i>Exclusive GST</i>	<i>GST</i>	<i>Total Amount</i>
	Cooperative Research Centres Projects		123,745.00	12,374.50	136,119.50
	<span style="background-color: #cccccc;">s22</span> -Mr Peter Youd				
	CRCProjects@industry.gov.au				
	<b>Total Amount Due:</b>		\$123,745.00	\$12,374.50	\$136,119.50

C021470  
FIRST GRAPHENE LIMITED

Please tick here if a receipt is required:

**Invoice No:** RC020379  
**Date:** 03/05/2019  
**Exclusive GST:** \$123,745.00  
**GST:** \$12,374.50  
**Amount:** \$136,119.50



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**RECIPIENT CREATED TAX INVOICE**

Recipient's ABN: 74 599 608 295  
Suppliers ABN: 50007870760

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**Invoice No:** RC021488  
**Date:** 06/08/2019  
**Creditor Id:** C021470  
**Project Id:** CRC-P60964  
**Due Date:** 08/08/2019  
**Page :** 1 of 1

Attention: PETER YOUND

<i>Quantity</i>	<i>Quantity and Description</i>	<i>Unit Amount</i>	<i>Exclusive GST</i>	<i>GST</i>	<i>Total Amount</i>
	Cooperative Research Centres Projects		123,745.00	12,374.50	136,119.50
	s22 -Mr Peter Youd CRCProjects@industry.gov.au				
<b>Total Amount Due (\$AUD):</b>			\$123,745.00	\$12,374.50	\$136,119.50

C021470  
FIRST GRAPHENE LIMITED

**Invoice No:** RC021488  
**Date:** 06/08/2019  
**Exclusive GST:** \$123,745.00  
**GST:** \$12,374.50  
**Amount (\$AUD):** \$136,119.50

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**Department of Industry,  
Innovation and Science**

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**RECIPIENT CREATED TAX INVOICE**

Recipient's ABN: 74 599 608 295  
Suppliers ABN: 50007870760

FIRST GRAPHENE LIMITED  
SUITE 3  
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NEDLANDS WA 6009

**Invoice No:** RC022488  
**Date:** 18/11/2019  
**Creditor Id:** C021470  
**Project Id:** CRC-P60964  
**Due Date:** 21/11/2019  
**Page :** 1 of 1

Attention: PETER YOUND

<i>Quantity</i>	<i>Quantity and Description</i>	<i>Unit Amount</i>	<i>Exclusive GST</i>	<i>GST</i>	<i>Total Amount</i>
	Cooperative Research Centres Projects		174,845.00	17,484.50	192,329.50
	s22 -Mr Peter Youd CRCProjects@industry.gov.au				
<b>Total Amount Due (\$AUD):</b>			\$174,845.00	\$17,484.50	\$192,329.50

C021470  
FIRST GRAPHENE LIMITED

**Invoice No:** RC022488  
**Date:** 18/11/2019  
**Exclusive GST:** \$174,845.00  
**GST:** \$17,484.50  
**Amount (\$AUD):** \$192,329.50

Please tick here if a receipt is required: