

# Canadian Carbonization Research Association



## 2016-2017 Annual Report



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Appendix 1 - CCRA Technical Committee Planning Tables for 2016-2017	

### **Retirement – Mr. George Chapman, Treasurer**

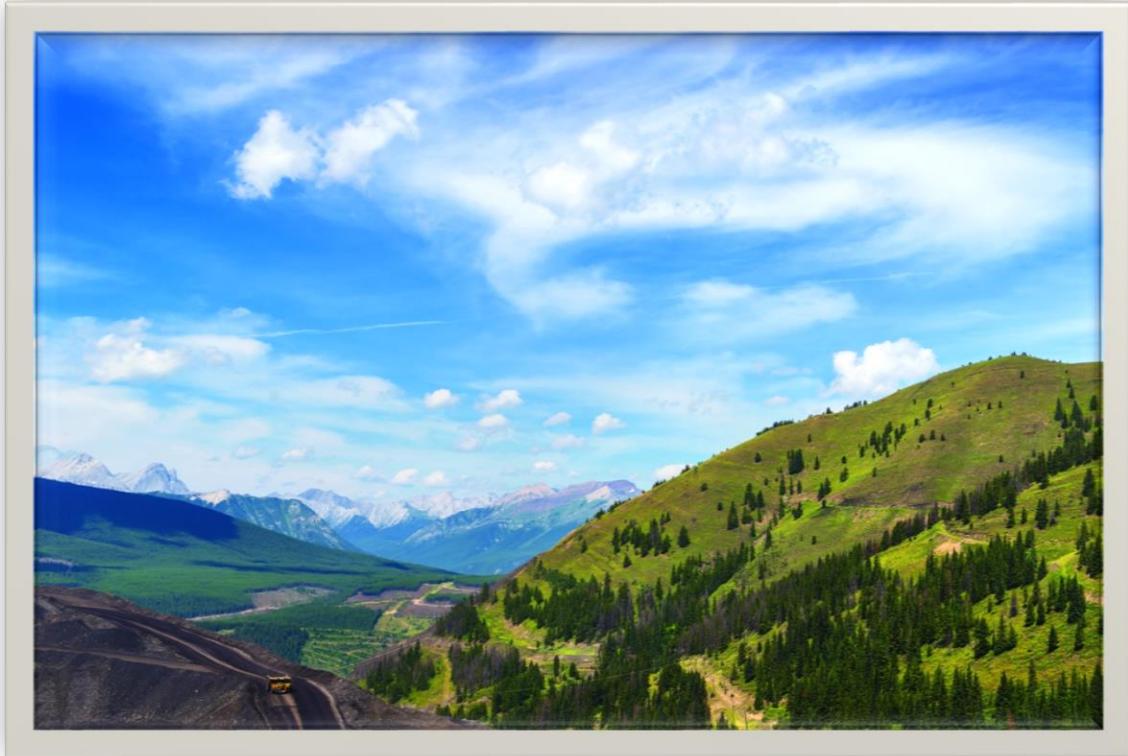
The current Members and Board of Directors of the Canadian Carbonization Research Association would like to publicly acknowledge the significant contributions of Mr. George Chapman who as Treasurer from 1975 to 2016, provided over 40 years of financial and administrative stewardship to CCRA, its Members and its Board of Directors. By providing the necessary stability and continuity for the organization, Mr. Chapman’s service throughout this period was instrumental in the many accomplishments achieved by the Association. CCRA wishes Mr. Chapman a long, healthy and joyful retirement! Thanks George and all the best!



**Mr. George Chapman**

**Treasurer 1975 - 2016**





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## Chairman's Remarks

Since its inception in 1965, the Canadian Carbonization Research Association (CCRA) has provided an excellent framework for technological cooperation between government and industry, which has been very successful for both parties. The CCRA is a unique organization in being Canada's only technical support for the Canadian metallurgical coal and coking industries. This organization continues to be of real value to its member companies and to the financial health of the associated industries. The value of its research is becoming more recognized on a global basis.

The role played by the CCRA in the past and to be continued in the future is to strive to meet its members' needs. The CCRA technical program continues to evolve as the demands of the coal, cokemaking and ironmaking industry change with the issues facing Canada. With new members, arise more ideas leading to potential solutions for some of the technical issues facing the coal and steel industries. It is important to continue sharing our research findings with fellow researchers and industry. The CCRA has again published its work in several international journals and presented papers at both domestic and international conferences. These papers can be found on the CCRA website, [www.cancarb.ca](http://www.cancarb.ca).

With the pilot Energy Recovery Coke Oven construction near completion and the new pulverized coal/fuel test rig up and running, the R&D capability of CCRA and CanmetENERGY has increased tremendously. There is a new wave of research the CCRA is undertaking with the development of bio-based carbon to mitigate GHG emissions in our industries. We look forward to these new technical challenges.

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*"The CCRA is a unique organization in being Canada's only technical support for the Canadian metallurgical coal and coking industries."*

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The CCRA continues to be supported by key members representing the coal sector (Teck), the cokemaking sector (SunCoke Energy) and the integrated ironmaking sector (ArcelorMittal Dofasco and

Stelco). We continue to keep in touch and invite past member companies as they continue to grow their respective companies.

Globally, the Canadian Carbonization Research Association is self-standing in its ability to continue to grow and meet its members' requirements. This remarkable co-operative relationship between the coal industry, steel industry and government is truly unique and its R&D program will continue to address its members needs today and in the future.

Ted Todoschuk,  
Chairman, Board of Directors



## Technical Committee Report

### Technical Committee Meetings

The CCRA Technical Committee held four meetings during Fiscal Year 2016-17:

Meeting No.	Location	Date
235	Ottawa, ON	June 6-7, 2016
236	Vancouver, BC	September 20-21, 2016
237	Ottawa, ON	December 6-7, 2016
238	Vancouver, BC	March 21-22, 2017

The 2016-17 Research Program consisted of four main research areas:

1. Energy and CO<sub>2</sub> Reduction in the Coal and Steel Industry
2. Energy and Environment
3. Fundamental Aspects of Coal and Coke Utilization
4. Database, Standards and Procedures

In total, 14 projects were part of the Research Program although several projects were not progressed.

### Major accomplishments/highlights:

1. During FY 2016-17, the CCRA published papers on (1) Carbon type differentiation technique for diagnosing PCI efficiency in Ironmaking and Steelmaking journal (nominated for AISI Medal 2017) and (2) Effects of organic liquids on coking properties of higher-inert Western Canadian coal in Fuel Processing Technology journal. CCRA also wrote four papers for presentation at AISTech 2017 in Nashville, USA. It made presentations on use of Bio-Carbon for Canadian Iron and Steel Production to the Ontario Centres of Excellence at Bio-Carbon for Steel and Iron Making Meeting (June 2016) and BioCleanTech Symposium (November 2016) and on work accomplished on Coal Washing (Organic/Non-Organic liquids) and Moisture in Coal at CoalSMART 2017.
2. On **Blast Furnace energy reduction initiatives** (CCRA 91), it was proposed to carry out numerical experiments (CFD modeling) with a similar set of experimental conditions as the rig experiments in an actual blast furnace blowpipe-tuyere-raceway to obtain such a relationship. This could help predict the burnout at the actual tuyere-raceway level from the rig PCI experiment. The new TGA-FTIR system from Netzsch was installed at CanmetENERGY-Ottawa and some preliminary routines were investigated to develop methods for evaluating char reactivity and carbon form differentiation/analysis in blast furnace dust/sludge. Also, preliminary test results on co-injection of coal and natural gas showed that natural gas did not enhance burnout nor flame temperature.
3. On the use of **Renewable energy for the steel industry** (CCRA 70), CanmetENERGY-Ottawa Met Fuels successfully secured federal government funding for 5 years for Biocarbon for Canadian Steel Industry through Energy Innovation Program. During 2016-17, several meetings, including participation in Biocarbon symposium and BioCleantech Forum held respectively in Ottawa in June and November 2016 with policy makers, large GHG emitters, NGOs, and biomass feedstock and *technology* suppliers. These meetings and contacts made



acted as a springboard to address future work at Met Fuels and possible collaboration with groups outside CanmetENERGY such as municipalities, provincial governments, the CSPA, SunCoke, Teck, CCRA, ArcelorMittal Dofasco, coal producers, CFS, universities, etc. The goal of this project is to assist bio-carbon producers in further expanding their production capacity to carry out industrial scale plant trial in steel mills in 2020-2025. To achieve this goal, close collaboration is required between solid biocarbon producers and steelmakers. The project will also evaluate the value-in-use of solid bio-carbon fuel in steel production. As part of this project, an evaluation compared the suitability of bio-carbon products produced by different pyrolysis technologies and conditions for replacement of PCI. It was demonstrated that pyrolysis technologies chosen for bio-carbon fuel production significantly influence the properties of the resultant bio-carbon. Preliminary work presented showed that biocarbon having the right physical and chemical attributes as well as proper value-in-use could indeed find applications in EAF steelmaking, cokemaking and direct injection in BF ironmaking.

4. On **Energy Recovery Coke Oven** (CCRA 77), CanmetENERGY-Ottawa Met Fuels received federal government support for 3 years under Energy Innovation Program for Adoption of Energy Recovery Cokemaking Technology by the Canadian Steel Industry. Construction of Pilot Oven Facility continued with heat-up anticipated in Q4 2017 followed by commissioning. SunCoke provided coal oven commissioning and indicated, as did AM Chicago, of their availability to provide assistance and expertise with the oven startup process. A plan of research activities for the ERCO, including hot commissioning, gage r & R and potential R&D projects was prepared by AM Chicago and presented to CCRA at March 2017 meeting. The new pilot ERCO facility was the focus of an article published in AIST magazine in February 2017.



5. On **Coal Resource Quality Evaluation** (CCRA 90), the proposal entitled “Producing Clean Coal from Western Canadian Coal Fields using the Water-based Roben Jig Process” was funded by Geoscience BC in December 2016. This is the continuation of the organic liquids project where considerable damage to a higher-inert Western Canadian met coal was observed. With this project, there is possibility of extensive collaboration between CCRA and GBC on a wide range of projects all dealing with western Canadian coal – a 5-10-year R&D plan focusing on small sample evaluation will be submitted to GBC by end of 2017 in attempt to secure longer term funding on work dealing with sample collection, preparation and carbonization. Work on Phase 1 of GBC, to begin in Q1 2017-18, will focus on comparing coal and coke quality after washing four Western Canadian coals (easy/difficult to wash, fine/coarse and coarse samples) with organic liquids (float-sink) and water (jig).
6. On **Mineral matter and coke reactivity** (CCRA 81), a re-examination of the minerals doping experiments carried out by the CCRA in 1994 found that minerals present in the original coal

are usually of more complex form than added minerals, leading to lower coke reactivity. Also, it was found when P and Ca in Western Canadian coals are strongly correlated tying up Ca in apatite, the resulting CRI are low. On the other hand, for coals where P and Ca are unrelated but Ca and Mg are, the probability of Ca being tied up in ankerite increases, resulting in higher CRI as ankerite decomposes during coking. The current CCRA Mineral Addition project found that carbonate minerals (Ca & Fe) can negatively affect CSR and CRI of high CSR MV coking coal from western Canada with fine minerals having a greater effect than coarse ones. A paper was written for AISTech 2017, May 2017 in Nashville USA.

7. On **Standards** (CCRA 54), Transport Canada approved the use of the Modified Proctor/Fagerberg Test (Nov 2016) for determining the Transportable Moisture Limit (TML) of coals loaded at Canadian ports. In controlled test work performed, Canadian coals were found to not liquefy, hence demonstrating that they are safe to transport in ship cargos. Regular updates were presented on the Inter Laboratory Study on coal dilatation led by Canada (J. St James) to enable valid comparisons of dilatation data between different laboratories. That work will be completed during 2017-18 with draft report to be presented at ISO/TC27 meeting in Brisbane, Australia, October 2017. Updates were also presented to the CCRA on CanmetENERGY-Ottawa Met Fuels Lab performance in Round Robins on coal petrography (CoalTech Petrographic Associates), CSR/CRI and Coke Stability/Hardness (LQSi-SGS). Canada will participate in developing the Sapozhnikov test under ISO and revised the ISO standard concerned with determination of mechanical strength of +20 mm coke (Micum/Irsid).
8. On **International Research Collaboration** (CCRA 75), CanmetENERGY-Ottawa Met Fuels participated in ACARP Australia Coking Round Robin in Q3 2016-17. In total, 10 labs including CE-O Met Fuels participated in the CSR Round Robin and 14 labs also including CE-O Met Fuels entered the Coking Round Robin. The coking oven capacity in the Coking RR ranged from a low of 7 kg (SGS Australia) to a high of approx. 500 kg (DMT Germany). CSR results from the Coking RR ranged from 48 (MPI England, 340 kg) to 71 (DMT Germany, 10 kg), with CE-O Met Fuels reporting identical CSR of 64 in both the 18" and Carbolite ovens and CSR of 67 from the sole-heated oven.
9. On **Small-Scale Carbonization Facility for Cold & Hot Coke Strength Determination** (CCRA 88), discussions were held surrounding the pros and cons of the various small oven types and capacities and the need to carefully evaluate options before deciding on a particular design and building of the oven.
10. On **Benchmarking of Movable Wall Ovens** (CCRA 92), the ACARP Australia Coking Round Robin in Q3 2016-17 found appreciable wall pressure difference between the 18in oven and Carbolite oven attributable to inherent designs of the respective ovens. As previously



observed, Carbolite oven produced slightly bigger coke (MCS 53.7 mm) compared to the 18in oven (MCS 52.5 mm) and leading to higher I40 value (55.4 vs 52.1) in the IRSID test. This is attributed to the lower wall temperature of the Carbolite oven and resulting in a longer coke time. The other coke quality parameters including ASTM stability (63.5 Carbolite, 64.0 18in.) and hardness (68.0 Carbolite, 69.5 18 in.), CSR (64.1 vs 64.1) and CRI (28.7, 28.0), and ASG (0.974 vs 0.974) were found to be very similar between the two ovens. The oven benchmarking work will be repeated in FY 2017-18 using the same steelmaker coal blend.

#### **CCRA/CanmetENERGY Papers, 2016-17**

1. Ng, K.W., Giroux, L., MacPhee, J.A., Todoschuk, T., Taggart, L., Scott, G. *“Carbon Type Differentiation Technique for diagnosing Pulverized Coal Injection Efficiency”*, Ironmaking and Steelmaking, (2016) 43:3, 214-219.
2. Holuszko, M.E., Leeder, R., Mackay, M., Giroux, L., MacPhee, J.A., Ng, K.W., Dexter, H. *“Effects of Organic Liquids on Coking Properties of a Higher-Inert Western Canadian Coal”*, Fuel Processing Technology, (2017) 155, 225-231.
3. Ng, K.W., Giroux, L. *“CanmetENERGY’s Experience on Performing High-Temperature Dilatation Measurements”*, AISTech 2017 conference proceedings, Nashville, USA.
4. Ng, K.W., Ray, S., Giroux, L., Bronson, B, Tourigny, G., Dutta, A., Todoschuk, T. *“Suitability of Bio-Chars from Different Production Technologies for Direct Blast Furnace Injection”*, AISTech 2017 conference proceedings, Nashville, USA.
5. Ng, K.W., Giroux, L. *“Factors Affecting Blast Furnace Coke Bed Permeability”*, AISTech 2017 conference proceedings, Nashville, USA.
6. Zhang, Q., Price J.T., Ryan, B., Yang, Y., Giroux, L. *“Effect of Coal Mineral Type and Size on Coke Strength after Reaction”*, AISTech 2017 conference proceedings, Nashville, USA.



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**Facilities Utilization:**

CanmetENERGY oven utilization statistics for 2016-17 (Table 1) shows the following in comparison with 2015-16.

**1. Sole-Heated Ovens**

- CCRA – 20 vs 14 trials (100% SHO3)
- Coal Companies – 166 vs 110 trials (72% SHO3, 28% SHO1)
- Steel Companies – 113 vs 125 (8% SHO3, 92% SHO1)

In total, usage of sole-heated ovens in 2016-17 was 299 trials - compared to 239 trials in 2015-16 (~25% higher).

**2. Sole-Heated Oven Coke Reheats - CSR**

- CCRA – 18 vs 19
- Coal Companies – 8 vs 4
- Steel Companies – 39 vs 66

In total, 65 reheats of sole-heated oven cokes for CSR determination – vs 89 in 2015-16 (27% lower).

**3. MWO CSR Determinations**

- CCRA – 3 vs 20
- Coal Companies – 148 vs 113
- Steel Companies – 25 vs 60

In total, 176 MWO CSR evaluations were performed – vs 193 in 2014-15 (9% lower). In addition, 73 CSR's were done on cokes received at CanmetENERGY-Ottawa Met Fuels (60 CSR's for Steel Companies, 9 CSR's for CCRA and 4 CSR's for Coal Companies). Combining SHO, MWO and cokes received at Met Fuels, 314 CSR tests were done in 2016-17 compared to 282 tests in 2016-2016 (11% higher).

**4. Coke Stabilization**

13 coke stabilization trials were done in 2016-17 vs 1 in 2015-16 (Extended IRSID and extended JIS). 12 were done for coal companies and 1 for steel companies.

**5. Movable Wall Ovens**

- CCRA – 3 vs 5 trials (2 in Carbolite, 1 in 18-inch oven)
- Coal Companies – 162 vs 109 trials (147 in Carbolite, 15 in 18-inch oven)
- Steel Companies – 35 vs 51 trials (All in 18-inch oven)

In total, usage of movable wall ovens in 2016-17 was 200 trials compared to 165 trials in 2015-16 (21% higher).

**6. PCI Test Rig**

- CCRA – 9 vs 7 tests
- Coal Companies – 0 tests (2016-17 & 2015-16)
- Steel Companies – 11 vs 15 tests

In total, 20 PCI tests were done in 2016-17 compared to 22 tests in 2015-16 (9% lower).



**Table 1**  
**Utilization of CanmetENERGY Facilities**

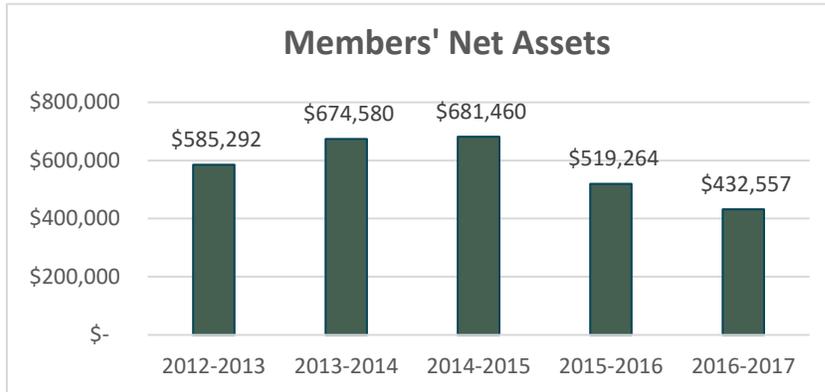
<b>Oven Tests</b>				
<b>April 1, 2016 March 31, 2017</b>				
<b>Oven</b>	<b>CCRA</b>	<b>Coal Companies</b>	<b>Steel Companies</b>	<b>Totals</b>
<b>SHO</b>	<b>20</b>	<b>166</b>	<b>113</b>	<b>299</b>
SHO1	0	47	104	151
SHO3	20	119	9	148
<b>SHO Coke Reheats</b>	<b>18</b>	<b>8</b>	<b>39</b>	<b>65</b>
<b>CSR</b>	<b>30</b>	<b>160</b>	<b>124</b>	<b>314</b>
SHO Coke Reheats/CSR	18	8	39	65
MWO CSR	3	148	25	176
Cokes for CSR	9	4	60	73
<b>Coke Stabilization</b>	<b>0</b>	<b>12</b>	<b>1</b>	<b>13</b>
<b>Movable Wall Oven</b>	<b>3</b>	<b>162</b>	<b>35</b>	<b>200</b>
18 inch	1	15	35	51
Carbolite	2	147	0	149
<b>PCI Test Rig</b>	<b>9</b>	<b>0</b>	<b>11</b>	<b>20</b>



## Year in Review

As a result of continued financial challenges faced by the industry due to lower than desirable commodity prices, CCRA experienced a decline in membership during the 2016-2017 fiscal year typical during periods of low commodity prices.

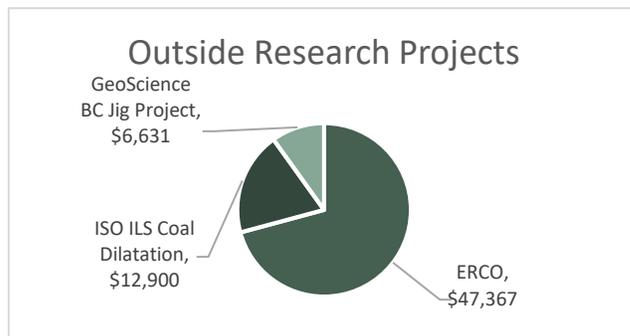
Financially, Members' Net Assets at year end totaled \$432,557 reflecting a 16.7% reduction from



the level reported at the end of the 2015-2016 fiscal year and \$248,903 lower than the most recent peak level of \$681,460 reported at the end of the 2014-2015 fiscal year. This reduction reflects the impact of an \$86,707 deficiency of revenues

versus expenses for the year representing the second consecutive year where expenses exceeded the costs of operations.

As a result of prudent financial planning, CCRA is able to absorb these temporary declines in

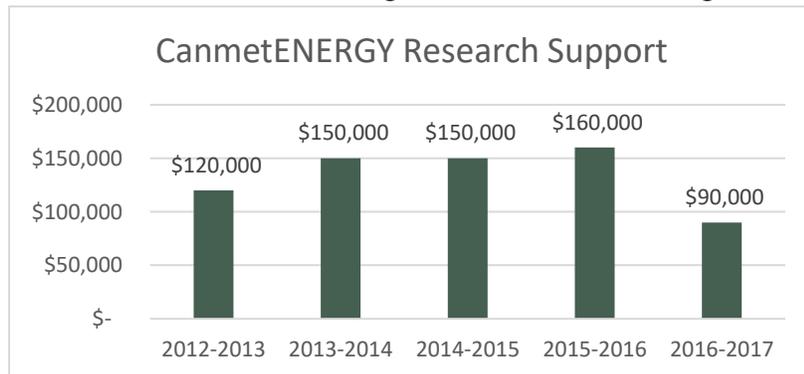


member contributions to ensure it continues as a viable Association supporting CANMET through annual research support payments and confidential oven tests.

This reported deficiency is largely due to an expense of \$47,367 for the Energy Recovery Coke Oven Project funded in previous years and \$12,900 expended on

the ISO ILS Coal Dilatation Project. In addition to these projects, CCRA executed in February 2017, a funding agreement with Geoscience BC for research funding of up to \$209,000 to study producing clean coal from Western Canadian Coal Fields using the Water-based Boner Jig Process.

By the end of the fiscal year, CCRA had already initiated the project and incurred a total of \$6,631 in related project expenditures. In summary, CCRA incurred a total of \$66,898 in Outside Research Projects as outlined above. Total



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revenues in 2016-17 are higher by about \$131,000 largely attributable to a \$206,000 or 21.8% increase in confidential research and development testing at Canmet despite a five-member

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*Although the reduction in active CCRA members resulted in a decrease in the level of CANMET Research Support during 2016-2017, CCRA continues to be a source of reliable support to CANMET activities by investing over the last five years a total of \$670,000 in direct Research Support plus \$5.67 million in Member Confidential Testing contributions.*

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reduction in its active members. Notwithstanding the drop in direct Research Support during 2016-2017, CCRA Members contributed \$1.15 Million in Confidential Oven Testing bringing the total testing completed during the last five years to \$5.67 million.

As CCRA remains in a strong financial position, it is in a good position to continue to initiate and fund research initiatives

supporting the coal and carbonization industries in Canada

Brian D'Amboise, CPA, CA  
Treasurer



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Audited Financial Statements

*crawford  
smith &  
swallow*

**CANADIAN CARBONIZATION RESEARCH  
ASSOCIATION**

**Financial Statements**

**March 31, 2017**





**CANADIAN CARBONIZATION RESEARCH ASSOCIATION**

**Financial Statements**

**March 31, 2017**

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## INDEPENDENT AUDITORS' REPORT

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To the Members of the  
Canadian Carbonization Research Association

We have audited the accompanying financial statements of the Canadian Carbonization Research Association, which comprise the statement of financial position as at March 31, 2017, and the statements of operations and changes in members' net assets and cash flows for the year then ended and a summary of significant accounting policies and other explanatory information.

### *Management's Responsibility for the Financial Statements*

Management is responsible for the preparation and fair presentation of these financial statements in accordance with Canadian accounting standards for not-for-profit organizations, and for such internal control as management determines is necessary to enable the preparation of financial statements that are free from material misstatement, whether due to fraud or error.

### *Auditors' Responsibility*

Our responsibility is to express an opinion on these financial statements based on our audit. We conducted our audit in accordance with Canadian generally accepted auditing standards. Those standards require that we comply with ethical requirements and plan and perform the audit to obtain reasonable assurance about whether the financial statements are free from material misstatement.

An audit involves performing procedures to obtain audit evidence about the amounts and disclosures in the financial statements. The procedures selected depend on the auditors' judgment, including the assessment of the risks of material misstatement of the financial statements, whether due to fraud or error. In making those risk assessments, the auditors consider internal control relevant to the entity's preparation and fair presentation of the financial statements in order to design audit procedures that are appropriate in the circumstances, but not for the purpose of expressing an opinion on the effectiveness of the entity's internal control. An audit also includes evaluating the appropriateness of accounting policies used and the reasonableness of accounting estimates made by management, as well as evaluating the overall presentation of the financial statements.



We believe that the audit evidence we have obtained is sufficient and appropriate to provide a basis for our audit opinion.

*Opinion*

In our opinion, the financial statements present fairly, in all material respects, the financial position of the Canadian Carbonization Research Association as at March 31, 2017, and the results of its operations and its cash flows for the year then ended in accordance with Canadian accounting standards for not-for-profit organizations.



Niagara Falls, Ontario  
June 1, 2017

CRAWFORD, SMITH AND SWALLOW  
CHARTERED ACCOUNTANTS LLP  
LICENSED PUBLIC ACCOUNTANTS

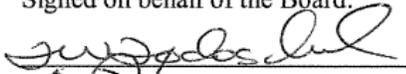
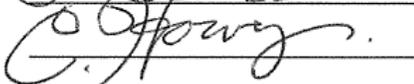


**CANADIAN CARBONIZATION RESEARCH ASSOCIATION****STATEMENT OF FINANCIAL POSITION**

March 31, 2017

<b>Assets</b>	2017	2016
	\$	\$
<b>Current Assets</b>		
Cash	7,947	261,201
Temporary investments	600,933	682,838
Accounts receivable		5
Sales tax recoverable	4,076	36,664
Prepaid expenses	1,710	
	<b>614,666</b>	<b>980,708</b>
<b>Liabilities and Members' Net Assets</b>		
<b>Current Liabilities</b>		
Accounts payable and accrued liabilities	19,940	18,746
Due to CANMET	22,500	442,698
Deferred revenue - note 2	139,669	
	182,109	461,444
<b>Contingent Liability - note 7</b>		
<b>Members' Net Assets</b>	432,557	519,264
	<b>614,666</b>	<b>980,708</b>

Signed on behalf of the Board:

 Director  
 Director

See accompanying notes

**CANADIAN CARBONIZATION RESEARCH ASSOCIATION**  
**STATEMENT OF OPERATIONS AND CHANGES IN MEMBERS' NET ASSETS**

for the year ended March 31, 2017

	2017 \$	2016 \$
<b>Revenue</b>		
Confidential research and development	1,150,794	944,529
Research levies	90,000	165,000
Outside research grants	6,631	
Consulting funding	3,000	6,425
Membership fees	300	800
Interest income	2,737	5,699
	<b>1,253,462</b>	<b>1,122,453</b>
<b>Operating Expenses</b>		
Confidential research and development	1,150,794	944,529
CANMET research support	90,000	160,000
Consulting	4,500	3,000
Outside research	66,898	151,727
Meeting		816
Office	19,884	17,192
Professional fees	7,238	7,385
Insurance	855	
	<b>1,340,169</b>	<b>1,284,649</b>
<b>Deficiency of Revenue over Expenses</b>	<b>(86,707)</b>	<b>(162,196)</b>
<b>Members' Net Assets, Beginning of Year</b>	<b>519,264</b>	<b>681,460</b>
<b>Members' Net Assets, End of Year</b>	<b>432,557</b>	<b>519,264</b>

See accompanying notes

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**CANADIAN CARBONIZATION RESEARCH ASSOCIATION**
**STATEMENT OF CASH FLOWS**

 for the year ended March 31, 2017
 

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	2017	2016
	\$	\$
<b>Operating Activities</b>		
Deficiency of revenue over expenses	(86,707)	(162,196)
Changes in working capital components - note 3	(248,452)	(521,349)
Funds used by operating activities	(335,159)	(683,545)
<b>Investing Activities</b>		
Decrease in temporary investments	81,905	667,575
<b>Decrease in Cash Position</b>	(253,254)	(15,970)
<b>Cash, Beginning of Year</b>	261,201	277,171
<b>Cash, End of Year</b>	7,947	261,201

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See accompanying notes



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**CANADIAN CARBONIZATION RESEARCH ASSOCIATION****NOTES TO FINANCIAL STATEMENTS**for the year ended March 31, 2017

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**Organization**

Canadian Carbonization Research Association (the "Association") is a national organization which initiates, coordinates and provides funding towards research and development having particular importance to the coal and carbonization industries of Canada. The organization was incorporated under the Canada Corporations Act as a not-for-profit association in July 1981. In January 2014, the Association was issued a Certificate of Continuance under the Canada Not-for-profit Corporations Act.

**1. Significant Accounting Policies**

The financial statements of the Association are the representations of management prepared in accordance with Canadian accounting standards for not-for-profit organizations, consistently applied. Because a precise determination of many assets and liabilities is dependent upon future events, the preparation of periodic financial statements necessarily involves the use of estimates and approximations. These have been made using careful judgement in the light of available information. The financial statements have, in management's opinion, been properly prepared within reasonable limits of materiality and within the framework of the accounting policies summarized below:

**Financial reporting framework**

The Association, being a not-for-profit organization, chose to establish their financial statements in accordance with Canadian accounting standards for not-for-profit organizations, issued by the Chartered Professional Accountants of Canada.

**Revenue recognition**

Membership fees, research levies, consulting funding and other income are recognized in the fiscal year for which they have been assessed. Confidential research and development revenues are recognized when the related services are provided. Non-recovery contributions are voluntary in nature and recognized in the year of receipt.

**Financial instruments**

The Association's financial instruments consist of cash, temporary investments, accounts receivable, accounts payable and accrued liabilities and due to CANMET. Financial instruments are initially measured at fair value on acquisition and are subsequently measured at amortized cost. Transaction costs and financial fees associated with financial instruments carried at amortized cost are recorded as adjustments to the initial fair value recognized, and amortized over the life of the financial instrument.



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**CANADIAN CARBONIZATION RESEARCH ASSOCIATION**
**NOTES TO FINANCIAL STATEMENTS**

 for the year ended March 31, 2017
 

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**2. Deferred Revenue**

Deferred revenue represents unspent resources externally restricted for various purposes and restricted funding received in the current year to be spent at some point in the future. Changes in the deferred revenue balance are as follows:

	2017	2016
	\$	\$
Balance, beginning of year		
Add restricted amounts received in the year	146,300	
Less recognized in income during the year	(6,631)	
<b>Balance, end of year</b>	<b>139,669</b>	

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**3. Statement of Cash Flows**

Changes in working capital components include:

	2017	2016
	\$	\$
Accounts receivable	5	1,337
Sales tax recoverable	32,588	(5,222)
Prepaid expenses	(1,710)	
Accounts payable and accrued liabilities	1,194	8,546
Due to CANMET	(420,198)	(526,010)
Deferred revenue	139,669	
	<b>(248,452)</b>	<b>(521,349)</b>

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**4. Financial Instruments**

Transactions in financial instruments expose the Association to certain financial risks and uncertainties. These risks include:

**Interest rate risk**

Interest rate risk is the risk that future cash flows of a financial instrument will fluctuate due to changes in market interest rates. The Association holds investments that earn income at varying rates of return which are dependent upon market conditions. Accordingly, the Association is exposed to the effects of fluctuations in market rates. Interest received in the year amounted to \$ 4,642 (2016 - \$ 8,274). As a result of a decrease in temporary investments during the year, the Association's exposure to interest rate risk has decreased over the prior year.



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**CANADIAN CARBONIZATION RESEARCH ASSOCIATION****NOTES TO FINANCIAL STATEMENTS**for the year ended March 31, 2017

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**5. Related Party Transactions**

Fees amounting to \$ 5,681 (2016 - \$ 13,575) were charged during the year by Burlington Management Services Inc. ("BMSI") for the year. BMSI is owned by the previous Treasurer of the Association.

Fees amounting to \$ 10,530 (2016 - nil) were paid to the treasurer of the Association during the year for management and accounting services.

These transactions were recorded at the exchange amount.

**6. Taxation Status**

The Association is exempt from income taxes as it has complied with the necessary provisions of the Federal and Provincial Tax Acts. Consequently, no provision for income taxes is reflected in the accounts.

**7. Contingent Liability**

As at March 31, 2017, the Association has an outstanding claim against it relating to interest on overdue accounts payable. It is the Association's assertion that adequate defenses are in effect for the settlement of these amounts.

**8. Comparative Figures**

Certain prior year's figures have been reclassified to conform with the current year's presentation.



## CANADIAN CARBONIZATION RESEARCH ASSOCIATION

Schedule 1

## FIVE YEAR FINANCIAL REVIEW

## UNAUDITED STATEMENT OF OPERATIONS AND MEMBERS' NET ASSETS

for the year ended March 31, 2017

	2017	2016	2015	2014	2013
	\$	\$	\$	\$	\$
<b>Revenues</b>					
Confidential research and development	1,150,794	944,529	1,326,422	1,415,184	832,221
Research levies	90,000	165,000	190,000	190,000	210,000
Outside research grant	6,631				
Non-recovery oven contributions				67,000	363,000
Consulting funding	3,000	6,425	6,425	7,710	7,875
Membership fees	300	800	800	700	700
Interest income	2,737	5,699	8,481	7,183	9,615
Other income			55	1,733	169
PWC funding			60,000		
	1,253,462	1,122,453	1,592,183	1,689,510	1,423,580
<b>Operating Expenses</b>					
Confidential research and development	1,150,794	944,529	1,326,422	1,415,184	832,221
CANMET research support	90,000	160,000	150,000	150,000	120,000
Consulting	4,500	3,000	8,857	8,857	8,679
Outside research	66,898	151,727	75,213		180,700
Meeting		816	834		1,523
Office	19,884	17,192	17,562	16,639	12,138
Professional fees	7,238	7,385	6,415	9,542	5,895
Insurance	855				
	1,340,169	1,284,649	1,585,303	1,600,222	1,161,156
<b>Excess (Deficiency) of Revenues over Expenses</b>	(86,707)	(162,196)	6,880	89,288	262,424
<b>Members' Net Assets, Beginning of Year</b>	519,264	681,460	674,580	585,292	322,868
<b>Members' Net Assets, End of Year</b>	432,557	519,264	681,460	674,580	585,292

See accompanying notes

## CANADIAN CARBONIZATION RESEARCH ASSOCIATION

Schedule 1 - continued

## FIVE YEAR FINANCIAL REVIEW

## UNAUDITED STATEMENT OF FINANCIAL POSITION

as at March 31, 2017

	2017	2016	2015	2014	2013
	\$	\$	\$	\$	\$
<b>Assets</b>					
<b>Current Assets</b>					
Cash	7,947	261,201	277,171	361	44,937
Temporary investments	600,933	682,838	1,350,413	1,359,655	1,095,327
Accounts receivable	4,076	36,669	32,784	313,845	40,268
Prepaid expenses	1,710			8,850	
	<b>614,666</b>	<b>980,708</b>	<b>1,660,368</b>	<b>1,682,711</b>	<b>1,180,532</b>
<b>Liabilities and Members' Net Assets</b>					
<b>Current Liabilities</b>					
Accounts payable and accrued liabilities	19,940	18,746	10,200	8,661	7,423
Due to CANMET	22,500	442,698	968,708	979,470	587,817
Deferred revenue	139,669			20,000	
	182,109	461,444	978,908	1,008,131	595,240
<b>Members' Net Assets</b>	<b>432,557</b>	<b>519,264</b>	<b>681,460</b>	<b>674,580</b>	<b>585,292</b>
	<b>614,666</b>	<b>980,708</b>	<b>1,660,368</b>	<b>1,682,711</b>	<b>1,180,532</b>

See accompanying notes

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## CCRA History

### From Concept to Reality

During a visit to the Booth Street lab of Energy Mines & Resources (EMR), F.J. Pearce, who worked for The Steel Company of Canada, Limited was discussing the coke and coal situation with Dr. J. Walsh and J. Chisholm and it was apparent that Industry and EMR should develop a formal Research/Technical relationship. With the approval of senior government and Stelco management, F.J. Pearce was asked to contact all of the Canadian coal and steel companies in order to form the basis for the relationship.

From this initial discussion, the concept of the Canadian Carbonization Research Association was developed from the responses to F.J. Pearce's contacts. Dr. Walsh and J. Chisholm sought the approval of senior government management and A. Ignatieff of EMR was in complete support of the idea, and this cleared the way for the concept to become reality.

The Canadian Carbonization Research Association (CCRA) was formed on September 2, 1965 with the adoption of a Constitution by the Canadian Steel and Coal industries, as a mechanism to promote and establish carbonization research in Canada. The Association's original members were C.W. Drake of Algoma Steel Corporation, W.J. Riva of Canmore Mines Limited, J. John of Crows Nest Industries, J.E. Ludberg of Dominion Foundries and Steel Limited, T.G. Cassidy of Dominion Tar & Chemicals Ltd, R.P. Nicholson of Dosco Steel Ltd, F.J. Pearce of The Steel Company of Canada Limited and J. H. Walsh of The Mines Branch of Energy, Mines and Resources.

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*The Canadian Carbonization Research Association (CCRA) was formed on September 2, 1965 – 50 years of Research supporting the Canadian Coal and Carbonization Industries*

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Others at this founding meeting were H.N. Paulencu of Stelco, A. Ignatieff, J.C. Botham, D.S. Montgomery and J.H. Hudson of CANMET. They were representatives of the major cokemaking steel producers, independent coke producer, major metallurgical coal miners, major coal tar users of the day and the Federal Government area involved with these Industries.

The first Chairman of the Board of Directors was C.W. Drake, with J. Ludberg as Treasurer and J. Walsh as Secretary. The Technical Committee Chairman was F. Pearce with R. Zavitz, R. Nicholson and J. Botham of EMR as Secretary.

CCRA is a unique co-operative research and development effort between Industry and Government which became a model for many other industry/government R&D joint efforts. CCRA and CANMET have had different opinions on what R&D priorities should be the focus of the Joint Program, however, through dialogue and discussion, these differences have always resulted in a consensus based program. The winner in this whole matter has been R&D in Canada and we look forward to the continuation of this joint effort for years to come.



### The Early Years

The original members of CCRA and the senior officials of EMR were successful in convincing the Minister of EMR to establish a coal carbonization laboratory in Canada. The first Laboratory was located at The Mines Branch on Booth Street in Ottawa and centered around a 12inch Wide Pilot Coke Oven, a newly designed Sole heated Oven and the BM/AGA Coke Oven. J. Walsh managed this new facility and the other EMR staff helped with the operation including J.C. Botham, who later became the Technical Manager.

At first, the operation of the equipment was often performed by personnel from CCRA member companies and later CCRA employed personnel for this purpose. In 1968, a new facility location was chosen at Bells Corners, 20 km west of downtown Ottawa, where a laboratory was to be built. CCRA played a significant role in getting this new Laboratory. EMR provided the building facilities and CCRA members supplying much of the carbonization equipment for the new lab. The new lab was to center around a new 18 inch silica brick movable wall oven. A 30 pound coke oven was also part of the new facilities and the BM/AGA Oven was redesigned and rebuilt.

In December 1968, the group at the Mines Branch responsible for coal and ironmaking were also relocated to Bells Corners.

### Expanding Activities in the 1970's

In 1970, J. Ludberg of Dofasco became Chairman of the Board. W. Gardner joined the research staff at CANMET and was charged with getting the new 18 inch oven operational, relocating the 12 inch oven to Bells Corners and redesigning the BM/AGA oven. The coal preparation plant from Booth Street was moved to Clover Bar in Western Canada. Research work was managed by J.C. Botham under the direction of the Technical Committee and centered on coal pipelining, additives

to coking charges, hot briquetting, form coking and petrographic methods for all coals.

Arrangements were made to establish a coking facility at Clover Bar to accommodate the western Canadian Coal producers. Algoma arranged to donate their Koppers pilot coke oven with alumina refractory. A mini fluidized bed was constructed for heating coal for hot briquetting as part of the form coke project. By 1974, this



facility was operational. EMR hired Dr. J. Gransden and Dr. J. Price who became the backbone of the Technical program and have gained international recognition as carbonization scientists.



In the early 1970's a major concern of the CCRA research was reliability of petrography to predict the coking quality of Western Canadian coal and considerable work was done to address the issue of reactive semi-fusinite in coal. When the "energy crisis" developed in 1973/74 concern about energy self-sufficiency came to the forefront. A considerable amount of research was done to determine if Western Canadian coal blends could make satisfactory coke for Blast Furnace operations. This crisis also resulted in a number of oil companies getting involved in the coal mining business and Shell Canada, Esso Resources, BP Canada and Gulf Canada became CCRA members.

The organization underwent a substantial change in 1975 when the movable wall coke oven crew, which had grown to six, switched from being CCRA employees to becoming EMR term employees, to conform with Government policy. CCRA established a new Treasurer system to handle the organization's financial affairs and research funding. This change resulted in the Treasurer's position becoming an appointed officer with full financial authority for the Association. Mr. G.A. Chapman was appointed Treasurer.

#### **Incorporation of CCRA & Facility Changes – the 1980's**

CCRA was incorporated under The Canadian Corporations Act on July 16, 1981, as a non-for-profit research association. Letters patent set out the organizational structure with each member company putting forward a representative for election to the Board of Directors, and Active members appointing each a Technical Committee member.

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#### **CCRA Objectives:**

- (1) To conduct Research and Development of importance to the coal and carbonization industries in Canada,*
  - (2) To co-ordinate and support Canadian carbonization Research in and related to steel, foundry, smelting and coal industries,*
  - (3) To affiliate with national and international organizations or associations having similar objectives.*
- 

The administration of CCRA is the responsibility of the Board of Directors to whom the Officers and other appointed positions report. The objectives of CCRA are set out in the Letters patent:

- (1) To conduct Research and Development of importance to the coal and carbonization industries in Canada,
- (2) To co-ordinate and support Canadian carbonization Research in and related to steel, foundry, smelting and coal industries,
- (3) To affiliate with national and international organizations or associations having similar objectives, for the benefit of Canada.

In the early 1980's, new research studies centered around the correlation of coke and processing conditions from pilot ovens with that from industrial ovens. Gas and wall pressure measurements in pilot and industrial coke ovens were emphasized.

This area of study included a unique study which took place at Algoma Steel's battery number 6, which was scheduled to be demolished. The study used the battery to carbonize very high pressure coking blends to determine what the high coking wall pressures would do to an oven and if it could even cause wall failure.



One of the Technical highlights of CCRA has to be the CCRA/NKK Technical Exchanges that took place, in Canada and Japan. Four Technical Exchanges took place where both sides presented papers on their research work. The delegations generally involved 12 to 15 representatives from each country and was highly successful.

The fourth exchange took place, in Tokyo Japan in 1983 with about 20 CCRA representatives participating in the technical meetings and the tours of the Japanese steel mills that followed.

By the latter part of the 1980's the international energy crisis had subsided, coal and steel prices were dropping, and both industries were entering a period of highly competitive markets. Coal injection into the blast furnace was introduced in Europe and Japan. Many new projects were initiated by the Technical Committee in this period, one of which was the upgrading of coking quality of Canadian coals through wash plant control, while others included CSR and carbon texture, vertical temperature distribution in a coke oven, effect of partial oxidation of a component coal on coke quality, to mention a few.

A project to study coal injection into a blast furnace was approved and a special facility was built at Bells Corners. CCRA and Canadian Steel Industries Research Association co-sponsored a study "Strategic Ironmaking Study " with CANMET to review where ironmaking technology might go over the following 20 years. This study was completed in 1990 and became the road map for the steel industry for many years.

#### **Difficult Times in the Coal and Steel Industries – the 1990's**

Canadian coal exports had doubled over the past decade but global warming was becoming a concern because of the effect on the environment. Research was aimed at reducing the cost of coke and energy for Canadian steel makers and finding a niche for Canadian coal. PCI work became



very important to both the coal and steel companies. The PCI facilities at Bells Corners was proving its value in the injection program. A CCRA sponsored project at the University of British Columbia on coke oven modeling was completed and the model now resides at CANMET for all to use.

In 1995, CCRA celebrated the 30th Anniversary of its founding. Because of difficult economic conditions in the coal and steel industries, membership had declined to eight

members and EMR was undergoing a review and CCRA was asked to prepare an Impact statement for their review.

By 1997, the CCRA/CANMET fee structure underwent a significant change with confidential oven test work increasing substantially. The Board of Directors approved By-law Number 2 to create a new category of Membership, the "Connected Member". This was a category for members who were not eligible to join as full members but wished to be part of CCRA.



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### Consolidation of the Coal Industry and the challenges of the 2000's

The year 2000 saw another downturn in steel and coal industries with two of the three Canadian steel company members and one coal producer having to drop their CCRA memberships because of financial considerations. The reduction in members complicated CCRA's financial situation as the Association had to dip into its limited reserves to maintain its commitments to CANMET.

The consolidation of the metallurgical coal producers at the end of 2002 further complicated the financial situation for CCRA as there was now only one coal and steel member. The Association and CANMET co-operated to keep CCRA as a viable entity and hoped that new members could be attracted when the economy in these industries improved. R. Leeder remained as Chairman of the Board of Directors and T. Todoschuk as Chairman of the Technical Committee.

Membership levels are dependent on the number of Companies eligible for membership as well as the business climate. The number of Metallurgical coal producers was substantially reduced in 2002 with the formation of Elk Valley Coal, which incorporated most of the producers under one organization.

The cokemaking industry was down to three steel producers, and because of economic hardships, only one remained a CCRA member. CANMET has a special category membership in CCRA "Associate Member" which carries full representation and voting privileges without CCRA fees. Other membership categories are Connected, Affiliated, and Inactive.

The CCRA /CANMET relationship has evolved over the years and this was formally put into an "Understanding" or Agreement document created in 1984. This document was modified with the latest update completed in 2000.

Over the years, CCRA and CANMET have carried out many research and development programs to improve the metallurgical coal and cokemaking operations of its members. Many of these have had far reaching effects which have been documented in

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*International recognition has been achieved for the R&D work performed through the CCRA/CANMET partnership*

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studies carried out by consultants for the government showing the economic effects of the Joint R&D Program. The benefits to Canadian industry have been substantial, however, it could not have taken place without the joint efforts of CANMET and CCRA. Having a laboratory to conduct carbonization research is beyond the feasibility of any one company so the single shared Canadian lab at Bells Corners has allowed the continuation of R&D in this field in Canada.

The fields of R&D covered by the joint CCRA/CANMET program include energy and fuel conservation, stabilization of supply, GHG reduction, mining, processing, transportation, production of iron, environment, and safety. At any specific time the R&D program places priority on the most pressing problems while not ignoring the long term work necessary for the future.

The CCRA/CANMET R&D program has provided Technical Information to the Canadian metallurgical coal industry that is accepted by their international customers as reliable, accurate and unbiased. This has allowed Canadian metallurgical coal to compete on the International market and retain jobs in Canada. The export of Canadian Coal generates a significant amount of foreign exchange and assists with Canada's balance of payments. Canada is one of the major exporting country of metallurgical coal and supplies a growing proportion of the coking coal used in Eastern Canada.



As CCRA celebrated its 40th Anniversary in 2005, the future looked more promising than it had in the last few previous years, despite the economic ups and downs of the industries represented by the CCRA. The continued CCRA/CANMET partnership benefited Canada as the participating industries gained new information as a result of the R&D. International recognition was achieved for the R&D work performed through the CCRA/CANMET partnership.

At the end of 2006, Dr. Ross Leeder, the longest serving member of the Board retired. Ross had joined the Technical Committee in 1971 when he was a member of the CANMET staff at Bells Corners. He chaired the Technical Committee before



moving to the Board of Directors. Ross became Chairman of the BOD in 1989-90 and again in 1999 to 2006. During the 35 years of his association with CCRA, Ross presented numerous papers on the industry.

In 2007, two new coal companies joined as Connected Members, Peace River Coal and Western Canadian Coal Corp and Dr. Barry Ryan joined as an Individual Connected Member representing the British Columbia Government.

In 2008, George Chapman celebrated his 30th anniversary as Treasurer of the Association. Peace River Coal became a full member of the Association and Essar Steel Algoma Inc. joined as a Connected Member. That same year, after a career spanning 35 years, Dr. John Price took retirement from his position as Senior Research Scientist and Manager of Energy for High Temperature Processes at CANMET.

In early 2009, Dr. John Gransden, also Senior Research Scientist in coal carbonization, retired from CANMET. The departure of Drs. Price and Gransden, both dedicated research scientists, represented a significant loss to the CCRA within a very short time period. CCRA thanked them for their valuable contributions to Carbonization in Canada and wished them all the best in their retirement. In the spring of 2009, the Algoma representative Bob Lamour retired after being a long-standing member on the Technical Committee and Board. Bob was replaced by Ms. Eila Kaukolin. Barry Ryan retired from the BC Government Ministry of Energy, Mines and Petroleum Resources and, as there was no replacement named, the BC Government abandoned its membership.



During 2008 and 2009, the steel and coal industries were faced with difficult economic climate as the world economic downturn caused a dramatic reduction in steel demand which resulted in a drop in metallurgical coal requirements.

For several years prior to 2008-09, Greenhouse gases (GHG) became a major thrust of the joint R&D program and the research program reflected that reality.

In 2009, the Technical Committee and the Board of Directors spent a significant amount of time and effort gathering information on the development and financing of an Energy Recovery Pilot coke oven for the joint CCRA/CANMET program to examine this alternative/new cokemaking technology. The elevated cost for building such a facility led the CCRA to seek Government participation at both the Federal and Provincial levels and include other parties such as Ontario Hydro Generation as partners.

### **The Current Decade**

The 45th anniversary of CCRA's creation was celebrated in 2010. CCRA continued to advocate for an energy recovery pilot coke oven by meeting with the Minister of NRCan in December of that year. Shortly thereafter, a new Minister of NRCan was appointed and the letter authorizing the initiative was delayed. Work on the project however continued and an engineering study to develop a proposal and cost for the pilot facility was initiated. In 2010-2011, the Association started on a very ambitious project to carry out engineering, design, construction and commissioning of an Energy Recovery Pilot Coke Oven (ERCO) at Bells Corners. The ERCO technology is an alternate approach to traditional slot coke oven and pilot facilities using ERCO technology are essentially non-existent, so R&D cannot be carried out. CCRA's goal for this project was to put Canada at the leading edge of this technology by having a facility where its members are able to investigate how coal behaves in this type of oven and determine information needed to allow the Canadian steel industry to evaluate this technology for controlling emissions and coke product quality. This facility would also be used to showcase the cokemaking merits of Western Canadian coals using this technology globally.

The projected budget for the ERCO facility was nearly \$1 million. It was hoped that funding would come from a variety of sources: Industry, Federal and Provincial governments and power generation firms as a feature of this technology is co-generation.

The 2011–2012 fiscal year produced an increase in CCRA members as US Steel Canada, SunCoke Energy, Inc. joined. Grande Cache Coal Corp., Alberta also rejoined the Association after being absent for some years.

CCRA signed a contract with Hatch Engineering, Mississauga, Ontario to undertake the preliminary design of a pilot scale Energy Recovery Coke Oven with the final report due in the summer of 2012. Funds for this project were raised by some of the CCRA members contributing to a fund for this specific purpose. CCRA also signed a Non Repayable Contribution Agreement with Natural Resources Canada to assist with the costs. The Canadian Steel Producers Association (CSPA) also contributed to the project. The goal was to secure the funding to enable the construction of the facility during fiscal year 2012-13. The new ERCO is to be located at Bells Corners CanmetENERGY facility with the other coking facilities. In 2011-12, SunCoke ENERGY was invited to join CCRA as a strategic partner in developing the energy recovery cokemaking technology as they have owned and operated commercial ovens using this technology for many years.



With the design of the pilot ERCO completed, planning on the location and support facilities were undertaken with one of the existing movable wall ovens (Carbolite) relocated to facilitate the required laboratory space for construction of the ERCO.

During the 2013/2014 fiscal year, CCRA was obligated to transition from its original “letters patent” legal structure to comply with the requirements of the new “Not-for-Profit” Corporations Act. As of January 1, 2013 CCRA received it’s “Certificate of Continuance” as Corporation Number 117455-0 Industry Canada.

CCRA has joined with CanmetENERGY to provide a web site for Canadian Carbonization Research Association. The web site can be accessed at [www.cancarb.ca](http://www.cancarb.ca) and contains timely information on the activities of CCRA/CanmetENERGY research and development programs and other information on the Canadian Coal and Coke industry as a whole.

CCRA celebrated its 50<sup>th</sup> year milestone of providing research support to the Coal and Carbonization industries on September 2, 2015.

On September 30, 2016, Mr. George Chapman retired as Treasurer of CCRA. Mr. Chapman provided financial and administration stewardship of CCRA and support to the Board of Directors and Members since 1975 providing over 40 years of dedicated service to the Association. The Board of Directors appointed Mr. Brian D’Amboise CPA, CA to succeed Mr. Chapman as Treasurer effective October 1, 2017. Although new to the role, Mr. D’Amboise has over 25 years of involvement with CCRA as the former external auditor to the Association and in recent years providing Mr. Chapman assistance in completing the fiscal year end and related tax returns.

CCRA pursued a number of outside research initiatives during the 2016-2017 fiscal year. In addition to the completion of the Energy Recovery Coke Oven project which was initiated in 2012, the Association continued work on the ISO ILS Coal Dilatation project initiated in 2015-2016 and entered into a new research funding arrangement with Geoscience BC to fund up to \$209,000 to study producing clean coal from Western Canadian Coal Fields using the Water-based Boner Jig Process.



## Chair of the Board of Directors CCRA

Year	Name	Company
1965 – 1966	C.W. Draker	Algoma Steel Limited
1967 – 1968	F.J. Pearce	The Steel Company of Canada Limited
1969 – 1970	J.E. Ludberg	Dominion Foundries and Steel Limited
1971 – 1972	J.S. Anslow	The Steel Company of Canada Limited
1973 – 1974	J.O. Thomas	DEVCO
1975 – 1976	A.M. Cameron	Algoma Steel Limited
1977-1977	J.T. Collier	DEVCO-SYSCO
1978 – 1979	W.A. Riva	Kaiser Resources Limited
1980 – 1980	J.E. Ludberg	Dofasco Limited
1981 – 1982	A. Johnson	Gulf Resources Limited
1983 – 1984	A.W. Kay	Stelco Inc.
1985 – 1986	R. Sagi	Denison Mines Limited
1987 – 1988	W. Becken	Dofasco Inc.
1989 – 1990	W.R. Leeder	Denison Mines Limited
1991 – 1992	K. Carnes	Fording Coal Limited
1993 – 1994	H. Stelmach	Line Creek Resources Limited
1995 – 1996	T. Benner	Dofasco Inc.
1997 – 1998	W. Jonasson	Algoma Inc.
1999 – 2000	W.R. Leeder	Teck Corporation
2001 – 2002	W.R. Leeder	TeckCominco Corp.
2003 – 2006	W.R. Leeder	Elk Valley Coal Limited
2007 – Current	T. Todoschuk	ArcelorMittel Dofasco Inc.



## 2016-2017 Corporate Officers

COMPANY	NAME	PHONE (FAX)	CCRA POSITION
<b>ArcelorMittal Dofasco Inc.</b>	Mr. Ted Todoschuk Principal Researcher ArcelorMittal Dofasco Global R&D - Hamilton <a href="mailto:ted.todoschuk@arcelormittal.com">ted.todoschuk@arcelormittal.com</a>	905-548-4796 (905-548-4653)	Chair
<b>Teck</b>	Mr. Cam Howey Global Manager Technical Marketing Teck Coal Ltd. <a href="mailto:cam.howey@teck.com">cam.howey@teck.com</a>	403-806-7730 Cell: 403-921-4403 (403-263-7923)	Vice Chair
<b>Brian G. D'Amboise Chartered Accountant</b>	Mr. Brian D'Amboise, CPA, CA Brian G. D'Amboise Chartered Accountant <a href="mailto:BGDCA@sympatico.ca">BGDCA@sympatico.ca</a>	905-938-2984	Treasurer
<b>CanmetENERGY</b>	Dr. Louis Giroux Research Scientist, Industrial Energy Systems Industrial Innovation Group CanmetENERGY Natural Resources Canada <a href="mailto:lgiroux@nrcan.gc.ca">lgiroux@nrcan.gc.ca</a>	613-996-7638 (613-995-9728)	Secretary



## 2016-2017 Board of Directors

COMPANY	NAME	PHONE (FAX)
<b>CanmetENERGY</b>	Dr. Brian Farnand S&T Director, Industrial Innovation Group CanmetENERGY Natural Resources Canada <a href="mailto:bfarnand@nrcan.gc.ca">bfarnand@nrcan.gc.ca</a>	613-996-7977 (613-995-9728)
<b>ArcelorMittal Dofasco Inc.</b>	Mr. Ted Todoschuk Principal Researcher ArcelorMittal Dofasco Global R&D - Hamilton <a href="mailto:ted.todoschuk@arcelormittal.com">ted.todoschuk@arcelormittal.com</a>	905-548-4796 (905-548-4653)
<b>Teck</b>	Mr. Cam Howey Global Manager Technical Marketing Teck Coal Ltd. <a href="mailto:cam.howey@teck.com">cam.howey@teck.com</a>	403-806-7730 Cell: 403-921-4403 (403-263-7923)
<b>SunCoke Energy, Inc.</b>	Dr. John Quanci Vice President, Engineering and Technology SunCoke Energy, Inc. <a href="mailto:jfquanci@suncoke.com">jfquanci@suncoke.com</a>	630-824-1941 Cell: 610-496-5989



## 2016-2017 Technical Committee Members

COMPANY	NAME	PHONE(FAX)
CanmetENERGY	<b>CHAIR:</b> Dr. Louis Giroux Research Scientist CanmetENERGY Natural Resources Canada <a href="mailto:lgiroux@nrcan.gc.ca">lgiroux@nrcan.gc.ca</a>	613-996-7638 (613-995-9728)
ArcelorMittal Dofasco Inc.	<b>VICE CHAIR:</b> Mr. Ted Todoschuk Principal Researcher ArcelorMittal Dofasco Global R&D - Hamilton <a href="mailto:ted.todoschuk@arcelormittal.com">ted.todoschuk@arcelormittal.com</a>	905-548-4796 (905-548-4653)
CanmetENERGY	<b>SECRETARY:</b> Dr. Tony MacPhee Research Scientist CanmetENERGY Natural Resources Canada <a href="mailto:tmacphee@nrcan.gc.ca">tmacphee@nrcan.gc.ca</a>	613-996-4440 (613-995-9728)
Teck	Dr. Qun Zhang Senior Researcher Teck Metals Inc. <a href="mailto:Qun.zhang@teck.com">Qun.zhang@teck.com</a>	250-364-4422 Cell: 250-921-4269
SunCoke Energy, Inc.	Dr. Jonathan Perkins Coal/Coke Modeling Specialist SunCoke Energy, Inc. <a href="mailto:jhperkins@suncoke.com">jhperkins@suncoke.com</a>	630-824-1938 Cell: 610-858-7706
Pearson Coal Petrography	Mr. Rich Pearson President, Pearson Coal Petrography <a href="mailto:rpearson@coalpetrography.com">rpearson@coalpetrography.com</a>	312-953-7996
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## Appendix 1 – CCRA Technical Committee Planning Tables for 2016-2017

### Active Programs for 2016-2017

Program	Program Objectives	Projects	Project Objectives and Deliverables	Specific Project Activity	Status of Current Work	Outstanding Issues
1. <i>Energy and CO<sub>2</sub> Reduction in the Coal and Steel Industry</i>	<i>To develop the technical understanding to improve energy efficiency and coke quality for higher productivity and lower coke rate blast furnace operation</i>	<b>CCRA 91 Blast Furnace Energy Reduction Initiatives</b>	<ol style="list-style-type: none"> <li>To address importance of PCI burnout of different rank coals in simulated Blast Furnace tuyere-raceway rig.</li> <li>To develop analytical method to quantify source of carbon (coal, char, coke) in Blast Furnace dust &amp; sludge.</li> </ol>	<ol style="list-style-type: none"> <li>Rank coals for burnout in horizontal bench-scale PCI simulator rig.</li> <li>Examine BF dust &amp; sludge for their sources of carbon.</li> </ol>	<ol style="list-style-type: none"> <li>Abstract on injection of various biocarbons in CanmetENERGY PCI rig submitted to AISTech 2017 in Aug 2016.</li> <li>Results of test runs in PCI rig and C form analysis in Netzsch TGA-FTIR were presented in 2016.</li> </ol>	<ol style="list-style-type: none"> <li>Paper on injection of biocarbons from various technologies required for AISTech 2017 conference.</li> <li>Benchmark results from PCI rig to industrial BF tuyere.</li> <li>Conduct coal &amp; NG injection tests as per CCRA matrix.</li> <li>Inject Bio-chars produced from different pyrolysis technologies.</li> <li>Pursue TGA trials to quantify amounts of carbon (char, coke &amp; soot) in BF dust &amp; sludge.</li> </ol>
		<b>CCRA 70 Renewable Energy for the Steel Industry</b>	<ol style="list-style-type: none"> <li>To investigate solutions for utilizing bio carbon in iron and steel making.</li> </ol>	<ol style="list-style-type: none"> <li>Bio-carbon addition to blends for PCI, EAF and biocokemaking.</li> </ol>	<ol style="list-style-type: none"> <li>EIP funded Biocarbon project update provided at Dec 2016 CCRA TC meeting. This project consists of three parts: PCI, EAF and biocokemaking.</li> <li>Partners and potential partners on Bio carbon project met at BioCleantech forum, Ottawa, Nov 2016.</li> </ol>	<ol style="list-style-type: none"> <li>For EIP project, complete Biocarbon project table and establish team and partners from industry, provincial and federal government.</li> </ol>
2. <i>Energy and Environment</i>	<i>To determine options for alternative cokemaking in Canada</i>	<b>CCRA 77 Coke and Power - Energy Recovery Cokemaking</b>	<ol style="list-style-type: none"> <li>To prepare Canadian steel industry transition to ERCO cokemaking technology</li> <li>To improve energy efficiency and reduction of criteria air contaminants and particulates emissions of Canadian steel industry.</li> </ol>	<ol style="list-style-type: none"> <li>Construction of pilot ERCO and develop R&amp;D plan</li> </ol>	<ol style="list-style-type: none"> <li>Pilot ERCO construction &amp; financial update provided to CCRA during 2016.</li> <li>Coal required for oven commissioning delivered at CanmetENERGY in October 2016.</li> </ol>	<ol style="list-style-type: none"> <li>Complete construction of pilot ERCO in Q4 2017 with power on followed by commissioning tests. SunCoke to provide direction/expertise in performing oven heat-up and commissioning.</li> <li>Research plan needed with input from SunCoke.</li> </ol>
3. <i>Fundamental Aspects of Coal and Coke Utilization</i>	<i>To understand the fundamental science of coal and coke utilization to improve energy efficiency</i>	<b>CCRA 90 Coal Resource Quality Evaluation</b>	<ol style="list-style-type: none"> <li>To investigate the effects of organic liquids, Boner Jig and alternative liquids in the coal washing process on coal and coke quality.</li> <li>To determine which "oxidation/aging" parameters best reflect the caking/coking ability of each circuit and coal.</li> </ol>	<ol style="list-style-type: none"> <li>Conduct work as per proposal to Geoscience BC (July, Sep 2016)</li> </ol>	<ol style="list-style-type: none"> <li>Detailed proposal prepared and submitted to Geoscience BC in July and Sep 2016 for securing funding for this work.</li> </ol>	<ol style="list-style-type: none"> <li>Begin work in January 2017 as per proposal details to GBC.</li> </ol>
		<b>CCRA 81 Mineral Matter and Coke Reactivity</b>	<ol style="list-style-type: none"> <li>To study the effects of coal (coke) mineral matter on CRI and CSR.</li> <li>To determine if high strength after reaction can be achieved with highly reactive coke.</li> </ol>	<ol style="list-style-type: none"> <li>Study effects of adding various minerals at different sizes on CSR/CRI of a selected western Canadian coal.</li> </ol>	<ol style="list-style-type: none"> <li>Progress updates on mineral addition project in 2016.</li> <li>Abstract on mineral addition project submitted to AISTech 2017 in Oct 2016.</li> </ol>	<ol style="list-style-type: none"> <li>Complete analyses including CSR on CCRA mineral addition project.</li> <li>Paper required for AISTech 2017 conference.</li> <li>Examine effect of mineral addition on CSR/CRI for US Appalachian blend.</li> </ol>

Program	Program Objectives	Projects	Project Objectives and Deliverables	Specific Project Activity	Status of Current Work	Outstanding Issues
						4. Continue mining CanmetENERGY db for examining mineral forms in WC coals and influence on CRI and CSR.
		<b>CCRA 82 Factors affecting Coke Bed Permeability</b>	1. To determine how bed permeability changes with size and shape consist.	1. Measure size and shape of WCC and US Appalachian cokes from 18" and Carbolite pilot ovens	1. Abstract on coke bed permeability work submitted to AISTech 2017 in Aug 2016.	1. Paper on coke bed permeability required for AISTech 2017 conference. 2. Evaluate size and shape of WCC and US Appalachian cokes from oven benchmarking project.
<b>4. Database, Standard and Procedures</b>	<i>To develop standards or procedures to enhance the knowledge and utilization of Canadian coal and coke</i>	<b>CCRA 54 Standards</b>	1. The CanmetENERGY business plan includes the development of standards and procedures pertaining to Canadian Coal and Steel industries.	1. To participate in ASTM and ISO meetings. 2. To participate in the development of ASTM and ISO standards to ensure that Canadian coals and interests are not undermined by new or modified standards.	1. International Laboratory Study on Coal Dilatation as part of ISO TC/27. 2. Standards and Transportable Moisture Limits of Coal updates presented to CCRA in 2016. Transport Canada re-assessing use of modified PF test for Western Canadian coals.	1. Completion of ILS on coal dilatation. 2. ERCO commissioning plan from SunCoke. 3. Develop automated coke texture analysis in collaboration with AM Dofasco and Pearson. 4. Commissioning of Sapozhnikov plastometer at CanmetENERGY. 5. Examination of coal oxidation information (CCRA consultants).
	<i>To perform co-operative research with National &amp; International Research Leaders in the fields of study</i>	<b>CCRA 75 Research Collaboration</b>	1. To establish technical exchanges or co-operative research studies with National and International Research groups.	1. To collaborate with national and foreign R&D institutions involved in similar work as the CCRA.	1. Meeting with potential partners in Bio Carbon project.	1. Develop relationship with universities and research institutes on Bio carbon and ERCO. 2. Expose CanmetENERGY globally. 3. Engage with ACARP, CSIRO, MEFOS, DMT and Aachen.
	<i>To develop the use of small-scale carbonization apparatus for valuable coke quality indicators</i>	<b>CCRA 88 Small-Scale Carbonization Facility for Cold &amp; Hot Coke Strength Determination</b>	1. To develop the use of small-scale carbonization apparatus for yielding valuable and meaningful coke quality indicators.	1. Explore the use of small-scale carbonization ovens.	1. CanmetENERGY currently a participant in international coking round robin.	1. Comparison of large and small coke ovens based on current international coking round robin. 2. Start work on box-charging machine. 3. Continue develop model for predicting CSR from pilot scale oven using properties of small scale (SHO) coke.
	<i>To conduct annual benchmarking of CanmetENERGY movable wall ovens using standard steelmaker blend to ensure reliable/repeatable performance</i>	<b>CCRA 92 Benchmarking of Movable Wall Ovens</b>	1. To ensure reliable and repeatable pilot oven wall and gas pressure measurements along with coke quality data.	1. Conduct tests in CanmetENERGY 18" and Carbolite pilot ovens annually to ensure repeatable wall and gas pressures and related coke quality.	1. On-going.	1. Benchmarking of CanmetENERGY 18" and Carbolite ovens using US Appalachian blend to be done in duplicate in Q4 2016-17.



## Inactive Programs 2016-2017

Program	Program Objectives	Projects	Project Objectives and Deliverables	Specific Project Activity	Status of Current Work	Outstanding Issues
<b>1. Energy and CO<sub>2</sub> Reduction in the Coal and Steel Industry</b>	<i>To develop the technical understanding to improve energy efficiency and coke quality for higher productivity and lower coke rate blast furnace operation</i>	<b>CCRA 84 Coke Fissuration</b>	<ol style="list-style-type: none"> <li>To establish and understand coke fissuration mechanisms.</li> <li>To determine how coke fissuration affect coke quality including size, shape, strength and stabilization.</li> </ol>	<ol style="list-style-type: none"> <li>Review existing literature on the topic.</li> <li>Investigate rate of contraction phenomena.</li> </ol>	<ol style="list-style-type: none"> <li>The high-temperature dilatometer work was discontinued in December 2015.</li> <li>A summary report was tabled at CCRA March 2016 meeting.</li> <li>Abstract summarising work done on HT dilatometer at CanmetENERGY submitted to AISTech 2017 in Aug 2016.</li> </ol>	<ol style="list-style-type: none"> <li>Paper on HT dilatometer work required for AISTech 2017 conference.</li> <li>A3 plan required for future work on coke fissuration including Pearson involvement on carbon form technique/analysis.</li> </ol>
<b>3. Fundamental Aspects of Coal and Coke Utilization</b>	<i>To understand the fundamental science of coal and coke utilization in order to improve energy efficiency</i>	<b>CCRA 86 Performance of Canadian Coals in High-Inert Blends</b>	<ol style="list-style-type: none"> <li>To understand how western Canadian coals behave in high-inert blends.</li> </ol>	<ol style="list-style-type: none"> <li>Evaluate the performance of high-inert Canadian blends under different pilot oven charge densities and with wet/dry quenching of coke.</li> <li>Investigate potential advantages of microstructure and microtexture in cokes from WC coals.</li> </ol>	<ol style="list-style-type: none"> <li>Phase 1 and Phase 2 work completed between 2011 and 2013.</li> </ol>	<ol style="list-style-type: none"> <li>Program to be tabled in 2017-18 to assess Phase 3 work.</li> </ol>
		<b>CCRA 87 Technical Merits of Western Canadian Coals</b>	<ol style="list-style-type: none"> <li>To develop fundamental studies showing the technical merits of Western Canadian coals.</li> <li>To package existing technical information/data and gather new analysis data for highlighting the fact that Canadian coals prove to make good quality cokes for modifying perception of marketing representatives.</li> </ol>	<ol style="list-style-type: none"> <li>To collect key information and generate new data to illustrate the technical merits of Western Canadian coals.</li> </ol>	<ol style="list-style-type: none"> <li>Phase 1 to Phase 5 work completed between 2011 and 2015.</li> </ol>	<ol style="list-style-type: none"> <li>Next phase is carbonization of Canadian &amp; Australian blends – no work anticipated during 2016-17.</li> </ol>
<b>4. Database, Standard and Procedures</b>	<i>To generate industrial intelligence from historical data.</i>	<b>CCRA 76 Database Analysis</b>	<ol style="list-style-type: none"> <li>To develop relationships for coal and coke properties from existing CanmetENERGY data.</li> </ol>	<ol style="list-style-type: none"> <li>To develop a coke strength prediction model based on coal properties.</li> </ol>	<ol style="list-style-type: none"> <li>Examination of mineral type in WCC and effect on CSR.</li> </ol>	<ol style="list-style-type: none"> <li>Examination of coal oxidation information (CCRA consultants).</li> <li>Mining of CanmetENERGY database and use of PLS model for mineral characteristics of WCC and foreign coals and influence on CSR/CRI.</li> </ol>

