Regina Catholic Schools

Carbon Capture & Storage:
An International Curriculum-Based Resource Development Collaboration

Nominated By:
The Board of Education for the Regina Roman Catholic Separate School Division #81

Submission For:
The Premier's Board of Education Award For Innovation and Excellence in Education

September 2014

Board Chair: Vicky Bonnell
Director of Education: Rob Currie

Carbon Capture & Storage: An International Curriculum-Based Resource Development Collaboration

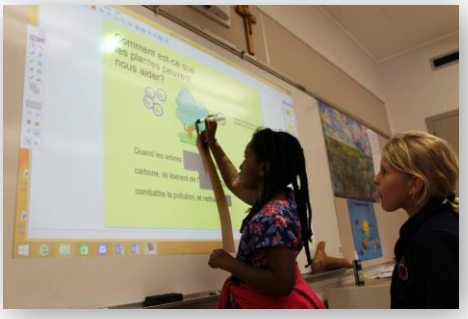
Project Goal

The goal of this project was to create a leading edge, Saskatchewan-based learning resource linking carbon capture and storage (CCS) technology to the curriculum through a development process of shared responsibility, expertise and support between several interest sectors, leading to enhanced educational outcomes, experiences and opportunities for students.

About Our Project

Overview - Teachers from the Regina Catholic Schools (RCS) have created Saskatchewan's first carbon capture and storage (CCS) resource materials for Grade 3, 7 and 10. The fundamental aim of *Science, Technology, Society and the Environment* (STSE) education in Saskatchewan is to equip students with the ability to understand and situate scientific and technological developments in their cultural, environmental, economic, political and social contexts. Science education embracing STSE seeks to examine both the impact of science and technology on society and the environment, while simultaneously examining the impact of society on science as an endeavor.

Distinct Outcomes – Development of this project has produced two distinct yet inter-connected outcomes. The initially intended outcome was the development of a world-class curriculum resource focusing on STSE connections with CCS research and development. This resource succeeded by providing varied learning experiences that address this relationship, including the incorporation of First Nations, Inuit and Métis (FNIM) environmental views. The second and less intended outcome has been the creation of a wide-ranging network of partnerships that have pooled resources to establish, promote and grow this teaching resource.



Grade 3 students engaged in interactive, student-centered components of the CCS learning resource

Value to Educators and Students – The Regina Catholic Schools team of educators, working with government, industry and agency partners have created a targeted and highly accessible teaching resource that supports educators with very little science experience to effectively teach students about low-carbon technologies and their wider energy and climate change contexts while connecting directly with several STSE outcomes. Following international best practice regarding education for sustainable development, this resource examines a much wider social, political, and economic context, encouraging students to consider an array of factors influencing the development of a low-carbon future.

Specific Resource Features – This resource is self-contained, concise and succinct in composition and approach. More specifically, the finished resource package incorporates several features that make it an excellent teaching tool, including:

- *Explicitly articulated links to Saskatchewan curriculum, including STSE connections.*
- *Varied instructional approaches.*
- *A substantive hands-on laboratory based component.*
- *Demonstration of the integrative nature of environmental science.*
- *Real and current Saskatchewan-based data.*
- *Background information for lesson material.*
- *Teacher and student worksheets and lab activities.*
- *Multi-media resources.*

Note: *For more information/detail, visit online at* http://rcsdcarboncapture.weebly.com

Regina Catholic Schools Grade10 students involved in laboratory-based CCS learning

Recent Recognition and Resource Sharing - Most recently, the *Saskatchewan Regional Center of Expertise on Education for Sustainable Development* recognized this project as an "Example of Excellence". This resource was also presented and shared at the *Annual Carbon Capture Utilization and Storage (CCUS) Conference* in Pittsburgh, Pennsylvania in April 2014 and at the *International Workshop on Public Education, Training and Community Outreach for CCUS* in Decatur, Illinois in July 2014 – through a collaborative effort between the Petroleum Technology Research Centre (PTRC) and consultative representation from Regina Catholic Schools.

Furthering the Initiative - Current plans are to expand this curriculum resource tool in terms of general implementation across all schools in the division while developing additional resources and curricular connections. This effort will require continued Board support and ongoing collaboration with established partnerships.

ptrc
Petroleum Technology Research Centre

Evidence of Direct Board Influence and Participation

The Regina Catholic School (RCS) Board has expressed continued support for this initiative in several ways, both directly and indirectly.

Board Emphasis and Influence on Establishment of Quality Partnerships – Historically, the RCS Board has placed significant priority on the creation of community partnerships that positively affect student learning. Quality partnerships form the basic core of this project.

Grade 7 students exploring the science of enhanced oil recovery at the SaskPower CCS Workshop

Board Commitment through Contractual Terms of Reference – To initiate this project, the RCS Board entered into contractual terms of reference with IPAC-CO2 Research Inc. for initial resource development, releasing elementary and high school level teachers to develop a CCS learning resource that aligns with curriculum. Recently, the RCS Board entered into an additional contractual agreement with SaskPower, providing additional release time to give teachers an opportunity to collaborate in the design and development of the *SaskPower Carbon Capture and Storage Workshop and Challenge*, as part of ongoing resource enhancement. Richland Community College also had a collaborative hand in the development of this workshop and challenge activity.

Board Mandate for Excellence in Mathematics and Sciences – The RCS Board further supports the position of Mathematics and Science Consultant within its organizational structure and has supported the investment of time and energy required for this individual to forge critical partnerships and lead educational colleagues throughout all phases of learning resource development.

Board Financial Contributions – In addition to "in kind" financial support through employee participation and administrative support, the RCS Board has contributed $10,500 to this project as outlined in Table 3: Public Funding Sources.

Board Mandate for Inclusion of First Nations, Inuit and Metis Perspectives – The RCS Board has a strong mandate for including the First Nations, Inuit and Métis (FNIM) perspective in all projects implemented within the division. This project reflects a strong FNIM presence.

Board Mandate for Development of Bilingual Resource Materials – the RCS Board has an expressed mandate for developing parallel bilingual resources that support French Immersion programming and instruction. This project realizes complementary French Immersion resource materials.

Qualitative evidence of student learning outcomes

Innovative Nature of the Project

There are two aspects surrounding the development of this curriculum resource that work together to achieve a result greater than the sum of its parts. It is this distinct synergy that makes this initiative unique and innovative.

Teacher Driven and Developed

Unlike other industry derived learning packages, this resource was entirely teacher driven and developed from start to finish. This unique quality ensured that the resource was quality tested prior to distribution, looking to provide necessary background information and tools for teachers in classrooms while making direct links with curricular outcomes including contextual references to STSE concepts.

A Learning Resource with Global Impact and Importance

The topical connection between curriculum and energy research and development, and in particular CCS, is of significant global relevance, adding to the inherent value of this resource. The finished product, made for sharing and available in hard copy, CD and online formats, includes the following resources in English and French:

- *Extensive Curricular Cross-References*
- *Detailed Lesson Plans*
- *Supporting Activities*
- *Mimio® Interactive White Board Files*
- *Supporting AV Materials*
- *Extension: SaskPower CCS Workshop and Challenge*

Mike Monea, SaskPower's President of CCS with 100 RCS students and staff set to explore the CCS resource

Forging of Partnerships with Government, Industry and Non-Government Agencies

Part of the success of this project is owed to the quality of partnerships that have been forged across several stages of development. This project has established a world-class model for working partnerships between public education, governmental and non-governmental agencies and industry. To date, this project has involved meaningful, mutually beneficial and productive partnerships between:

- Regina Catholic School Board
- Saskatchewan Ministry of the Economy
- Saskatchewan Ministry of Education
- Petroleum Technology Research Centre (PTRC)
- Global CCS Institute (CCSI)
- Plains CO_2 Reduction (PCOR) Partnership
- National Sequestration Education Center, Richland Community College
- IPAC-CO2 (original partnership/research agency now defunct)
- SaskPower

Richland COMMUNITY COLLEGE

Sustainability of the Innovation/Project

The project is sustainable in part, due to the ongoing public education mandates of involved partners, many of whom fall under the PCO_2R partnership. Locally, the RCS Board supports furthering this project work on two general fronts including:

Expanded Implementation Across all Classrooms

Implementation to date has occurred in schools with teachers responsible for developing and piloting this resource. Complete resource packages have been created and are now accessible to all teachers in the school division. Continued support for widespread implementation will come from the division consultant and teaching colleagues responsible for developing the resource through the support of Board funds.

Expanding Curricular Connections and Additional Resource Supports

There are further curriculum connections to explore outside of the initial Grade 3, 7 and 10 range including plans for development of resources that serve Environmental Science 20 and Earth Science 30.

Cost Benefits

In consideration of the true partnership nature of this initiative, funding to establish and promote this curriculum resource development project has come from several sources for a variety of purposes ranging from the initial development of the curriculum resource to the further development of resource support activities such as the CCS Challenge. A summary and reporting of related costs is included below:

IPAC-CO2 & Regina Catholic School Board

Marking the beginning of this project, the IPAC-CO2 Research Inc. entered into a contract with the RCS Board of Education on January 21, 2013, to provide the funding for initial curricular resource development as noted in Table 1. IPAC-CO2 Research Inc. dissolved before the completion of contract work and the RCS Board assumed related remaining expenses (see Table 3).

TABLE 1: IPAC-CO2 Research Inc

Expense Item	Cost	Notes
Teacher Salary	$19,200.00	6 Teachers/8 Days
Admin Assistance	$1,450.00	1 Assistant/8 Days
Graphic Designer	$3,000.00	1 Designer/8 Days
Printing	$3,000.00	
Travel	$1,460.00	Site Visit + Per Diem
Food	$600.00	8 Days
Interactive Lessons	$5,400.00	3 Tech Leaders/6 Days
Contingency/Taxes	$500.00	
Admin Fee	$3,460.00	10% (above costs)
Contract Total:	**$38,070.00**	

SaskPower Capture and Storage Workshop and Challenge

Most recently, SaskPower and the Regina Catholic Board of Education entered into an agreement relating to the *Carbon Capture and Storage Workshop and Challenge* that acts as an extension for learning that has occurred through the use of this curricular resource. Related expenses for this project extension are noted in Table 2.

TABLE 2: SaskPower CCS Workshop and Challenge		
Phase 1: Carbon Capture and Storage Challenge		
Expense Item	**Cost**	**Notes**
Program Development	$2,700.00	2 Teachers/3 Days
Curriculum Alignment	$2,700.00	2 Teachers/3 Days
Education Coordinator	$2,100.00	1 Coordinator/4 Days (School Visits)
Phase 1 Total:	$7,500.00	
Phase 2: Carbon Capture and Storage Workshop (September 29, 2014)		
Expense	**Cost**	**Notes**
Preparing Demonstrations	$260.00	2 Teachers/2 Hours
Workshop Run-Through	$1,560.00	2 Educators/4 Hours (Sept 28/14)
CCS Workshop	$2,340.00	6 Educators/6 Hours (Sept 29/14)
Student Transportation	$600.00	5 Buses/100 Students/4 Locations
Substitute Teacher Costs	$1,800.00	6 Teachers/1 Day
Educational Consultant	$750.00	1 Consultant/2 Days/10 Hours
Phase 2 Total:	$7,310.00	
Contract Total:	**$14,810.00**	

Public Funding Sources

Funding from public agencies in support of the development of this resource include the Regina Catholic School Board of Education and the Saskatchewan government.

TABLE 3: Public Funding Sources		
Funding Source	**Amount**	**Funding Note**
Regina Catholic	$1,000.00	Materials/Curriculum Resource Publishing
Regina Catholic	$4,500.00	French Language Translation
Regina Catholic	$5,000.00	In Kind/Salary (Science Consultant)
Ministry of the Economy	$3,500.00	Conference Grant/Pittsburgh Pa.
Ministry of the Economy	$2,000.00	Conference Grant/Decatur Ill.
Public Funding Total:	**$16,000.00**	

Cost Benefits Summary

It is widely understood that curriculum resource development, delivery and program support is an expensive venture. This project has estimated costs of $69,000 to date however; the characteristic that makes this project unique and innovative by design is the level of direct involvement of teaching professionals in every aspect of planning and delivery in full partnership and collaboration with government, non-government and industry partners, both locally and globally. Through continued partner interest, this project has room to grow.

Cost Projections

In addition to any potential partnership enhancements yet to be developed, continued funding toward this program initiative will support local expansion of resource materials across other areas of the curriculum including additional elementary grade levels and Environmental Science 20 and Earth Science 30 courses at the high school level.

Client Support

This project involves several clients, each having unique needs and interest-based perspectives. Evidence to date suggests that client needs have been met and in some instances exceeded, due to both the partnership driven processes followed to date *and* the finished product.

Curricular Resource Support/Teachers – Teachers are beginning to realize that this resource provides an easily accessible and authentic connection between the curriculum and real world applications through a variety of learning approaches.

Student Support – Students are being provided with opportunities to expand and enrich their initial learning through programs such as the *SaskPower Carbon Capture and Storage Workshop and Challenge* (*choose link for CCS Workshop photos and videos*) while connecting and exchanging perspectives and understandings with students globally. Volunteers from RCS, the Ministry of Education, and the CCS Global Institute are leading this event. In addition, the PTRC has provided an interactive touchscreen display of the SaskPower Boundary Dam to showcase this world-class CCS industry project located right here in Saskatchewan.

FNIM Perspectives Support – As an integral part of the RCS Board mandate, First Nations, Inuit and Métis perspectives form part of this resource in print and compelling video format, featuring an interview with Cree Elder Mike Pinay. See http://rcsdcarboncapture.weebly.com/video-resources.html

Industry Support – Industry has a mandate to educate the public on matters pertaining to safe, sustainable and economically viable energy options that address climate change issues. Having this topic addressed in a curricular context at the public education level will assist industry in achieving their educational mandate.

Ministry Support – The Government of Saskatchewan is heavily invested in both quality public education and promotion of economic prosperity through leading practices in industry. This project brings these elements together; creating a more unified understanding carbon capture and storage options among citizens of the province.

Non-Governmental Agency Support – Speaking for the Global CCS Institute, Kirsty Anderson discusses their adoption of this project, noting that, "…we have incorporated best practice learning from the RCSD team's project into all of our international educations programs…and the RCSD team (is) now working diligently with other students internationally using a secure international exchange platform – the CO2Degrees Education Extranet." In addition, Richland Community College, with a mandate to develop international partnerships focusing on K-12 education in areas relating to CCS, is directly involved with this partnership

Evidence of Improved Student Learning

At this early point in project development and implementation, qualitative data indicates both a positive student response as well as the resource filling an identified need by participating teachers. The emergent data comes from the perspectives of teachers initially piloting this resource and surveys conducted among teaching colleagues. Some of these identified needs are noted below in the form of indirect quotes…

- *I'd like to make my course more inquiry based but I just don't know where to start.*
- *Inquiry is in the back of my mind, but it is hard to implement.*
- *I wish there were more resources (inquiry based) but to set it…I just don't have the time.*
- *This is what someone needs to do…stop talking about it (inquiry learning) and create it.*

Educational research is clear – inquiry is a highly effective learning modality. This resource puts inquiry-based learning directly into the hands of teachers in order to improve student outcomes.

Conclusion

This project has resulted in the creation of an outstanding curricular support resource and several outgrowth activities that provide new linkages and opportunities for students, educators, government officials and industry leaders – not just here in Saskatchewan but also for participants across the globe. Partnerships that have been created in the process demonstrate a synergy that sets a standard for working relationships between public education and several other constituents including, but not limited to, government, non-governmental agencies, and industry.