The Business Case for Site C and It’s Place in BC Hydro’s Renewable Energy Portfolio

David Ince, P. Eng.

David has 38 years of experience in the electricity and natural gas industries, primarily in long-term planning and energy procurement. Mr. Ince has a deep understanding of the electricity industry in Alberta, British Columbia and the Yukon. This includes the technical, regulatory, financial and political aspects of the industry.

He has designed and implemented green energy procurement programs for a major utility, and was most recently involved in designing green energy contracting rules and processes for the Yukon. While working for BC Hydro, Mr. Ince was a key participant in a number of energy procurement processes, including the clean and green power calls, the bioenergy call, and standing offer program.

Mr. Ince successfully testified 5 times before provincial and federal regulators with respect to the approval of energy projects including BC Hydro’s Site C hydroelectric project. In addition to many internal and provincial project reviews leading up to the ‘go’ decision, this process required Mr. Ince to testify before the joint provincial and federal review panel in 2014, leading to the successful approval of the project.

Mr. Ince is currently an intervenor in BC Hydro’s current Long Term Resource Plan, which will shape the future of the electricity industry in BC for decades to come.
Outline:

• The background: the project and the history
• Essential concepts: a few
• The alternatives
• The need (?)
Sales Points from BC Hydro:

Site C will provide 1,100 megawatts of dependable capacity and generate about 5,100 gigawatt hours of energy each year — enough to power the equivalent of 450,000 homes.

Many renewable energy sources — such as wind and solar — are intermittent. This means they are not always available to generate electricity and may not be available at times of peak demand. Site C will always be available to provide electricity when needed and will add capacity to B.C.’s system.

The project benefits from the upstream storage of the W.A.C. Bennett and Peace Canyon dams – this means that the same water is used three times to generate electricity. The project will generate approximately one-third of the Bennett Dam’s energy, with a reservoir about five per cent the size of Williston reservoir.
Project Components
Portion of Peace River Valley
The Peace River Hydroelectric System
The Peace River Reservoir Profile

Williston Reservoir

W.A.C. Bennett Dam

Peace Canyon Dam

Dinosaur Reservoir

Site C

The BC ‘Grid’

BC Hydro’s System Transmission and Generation May 2019

- Hydro Dam and Generating Station
- Hydro Dam – no Generating Station
- Thermal Generating Station
- Diesel Generating Station
- 330 kV Substation
- 287 kV Substation
- 500 kV Substation

Key locations and stations include:
- Bear Creek
- Coquihalla
- Duncan
- Hugh Keenleyside
- Quesnel
- Salmon River
- Skeena
- Tatlayoko
- Telkwa
- Telkwa
- Telkwa
- Telkwa
- Telkwa
- Telkwa
- Telkwa
Essential Concepts

Essential concepts:
- Energy and capacity: GWh and MW: the auto analogy
- Necessary metrics:
  - Levelized energy cost: $/MWh
  - Capacity cost: $/kW-yr.

Essential Background before we talk about Site C:
- The provincial and regional electricity grids
- What is ‘the market’?
- Where provincial generation is located versus load
- Breakdown of provincial generation by resource type
- The seasonal shape of demand and generation
- The ‘pinch’ or ‘overlap’ curves
More Background: the External Environment

- The regional electricity grid: WECC
- The cost of electricity on the grid
- The market and surplus electricity
- Reliability standards
- BC energy self-sufficiency requirements
The Legal/Regulatory Environment

• Regulation:
• The British Columbia Utilities Commission:
  • Approves rates
  • Approves major capital projects
  • Approves long-term electricity purchase agreements
  • Approves Long-Term Resource Plans (LTRP or LTP)
Main works: June 2020

View of the spillway headworks, stilling basin, intakes, penstocks and powerhouse. (June 2020)

https://www.sitecproject.com/
In-river construction begins at the dam site, to prepare for river diversion in the fall. (June 2020)
Future Bank of Earthfill Dam

This slope has been flattened to remove excess material to ensure stability and will be the future left bank of the earthfill dam. (April 2020)
Peace River Inflows

David Ince
Information Request No. 1.7.9 Dated: May 1, 2019
British Columbia Hydro & Power Authority
Response issued June 6, 2019
Columbia River Inflows

David Ince
Information Request No. 1.7.9 Dated: May 1, 2019
British Columbia Hydro & Power Authority
Response issued June 6, 2019
The Most Important Single Graphic at BC Hydro

BC Hydro 2020 Load, EPA Deliveries, System Inflow and Min Gen

- **Total Load Including Coordination Obligations**
- **Total EPAs**
- **Total EPAs + System Inflow**
- **Min Gen Including EPAs**

**Monthly Energy (GWh)**

**January to December**

David Ince Information Request No. 1.7.8 Dated: May 1, 2019 British Columbia Hydro & Power Authority Response issued June 6, 2019

British Columbia Hydro & Power Authority Fiscal 2020 to Fiscal 2021 Revenue Requirements Application
Dollar Commitment of IPP Energy

• BC Hydro reported in its Fiscal 2018 Financial Report that, as of March 31, 2018, existing electricity purchase agreements (EPAs) represent a total outstanding financial commitment estimated at $51.14 billion (nominal) in payments to IPPs over the balance of the contract terms of those agreements.

• The present value of these payments is approximately $21.15 billion in fiscal 2019 dollars.

• The present value calculation uses a 6 per cent nominal discount rate, which reflects BC Hydro’s weighted average cost of capital.
# Cost of Energy to BC Hydro

## Cost of Energy ($ million)

### Line Reference

<table>
<thead>
<tr>
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### Unit Costs ($/MWh)

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<td>16</td>
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<td>40.5</td>
<td>38.5</td>
<td>26.6</td>
<td>28.1</td>
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<td>21</td>
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<td>(28.6)</td>
<td>(40.3)</td>
<td>(36.1)</td>
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<td>22</td>
<td>Total Weighted Cost</td>
<td>32.0</td>
<td>33.5</td>
<td>35.2</td>
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### Non-Heritage Energy ($ million)

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<th>Column</th>
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<td>30</td>
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<td>31</td>
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<td>33</td>
<td>Total</td>
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<td>1,476.5</td>
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<td>1,641.1</td>
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Clean Energy Association of B.C. Information Request No. 1.18.2 Dated: May 2, 2019 British Columbia Hydro & Power Authority Response issued June 6, 2019
Alternative Portfolio to Site C

Alternative energy portfolio would require roughly three more wind farms the size of Meikle near Tumbler Ridge.
Pumped Storage
## Commission Portfolio Sensitivities

<table>
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<tr>
<th>Commission Portfolio Sensitivities</th>
<th>Benefit Site C Portfolio vs. Alt. Resources Portfolio (PV - $ billion)</th>
<th>Site C Portfolio Unit Energy Cost ($/MWh)</th>
<th>Alternative Resources Portfolio UEC ($/MWh)</th>
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</thead>
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<td>Mid Gap - UEC Sensitivities</td>
<td>6.2</td>
<td>73</td>
<td>96</td>
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<tr>
<td>+10% Site C Project Cost</td>
<td>5.8</td>
<td>75</td>
<td>96</td>
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<tr>
<td>+20% Site C Project Cost</td>
<td>5.4</td>
<td>76</td>
<td>96</td>
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<tr>
<td>+50% Site C Project Cost</td>
<td>4.3</td>
<td>81</td>
<td>96</td>
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<td>Mid Gap - UEC Sensitivities + Low Market Prices</td>
<td>6.0</td>
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<td>Mid Gap - UEC Sensitivities + BCH Financing of Alternates</td>
<td>4.7</td>
<td>62</td>
<td>79</td>
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<td>Mid Gap - UEC Sensitivities + BCH Financing of Alternates + Low Cost Wind Renewals</td>
<td>4.6</td>
<td>61</td>
<td>78</td>
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<tr>
<td>Mid Gap - UEC Sensitivities + BCH Financing of Alternates + Low Cost Wind Renewals + Low Market Prices</td>
<td>4.1</td>
<td>65</td>
<td>81</td>
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<tr>
<td>Small Gap – UEC Sensitivities</td>
<td>6.1</td>
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<td>73</td>
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<td>4.7</td>
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<td>70</td>
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<td>Small Gap – UEC Sensitivities + Low Market Prices + BCH Financing of Alternates + Low Cost Wind Renewals</td>
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<td>34</td>
<td>59</td>
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<tr>
<td>+10% Site C Project Cost</td>
<td>3.4</td>
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<td>3.0</td>
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<tr>
<td>+50% Site C Project Cost</td>
<td>1.9</td>
<td>43</td>
<td>59</td>
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<tr>
<td>Large Gap – UEC Sensitivities</td>
<td>9.7</td>
<td>128</td>
<td>154</td>
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**Note:** The three project cost sensitivities are applied to the: “Mid Gap - UEC Sensitivities” and “Small Gap – UEC Sensitivities + Low Market Prices + BCH Financing of Alternates + Low Cost Wind Renewals” scenarios.

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David Ince  
Information Request No. 1.5.2 Dated: May 1, 2019  
British Columbia Hydro & Power Authority  
Response issued June 6, 2019
BC Hydro: long term demand

• Load Forecast
• Load Resource Balance:
• When is Site C ‘needed’?
• Pandemic effects?
• The ‘Great Recession’ of 2008-09 and follow-up
BC Hydro Historical Energy Demand

Total Gross Requirements

David Ince 4.5.0 Dated: October 30, 2019
British Columbia Hydro & Power Authority Response
issued December 13, 2019
Load Resource Balance for BC Hydro - Energy

Long-term need for energy
Without new resources

Load Resource Balance for BC Hydro - Capacity

Long-term need for capacity
Without new resources

Capacity supply gap

Uncertainty Range  Heritage Hydro  Existing IPPs  2016 Load Forecast Before Incremental Conservation w. LNG
Total Integrated System Energy

- March 2020 Uncertainty
- April 2020 COVID-19 Reference
- Actuals
- June 2019 Mid (Reference)
Economic Recovery from Covid?

Growth dynamics: the myth of economic recovery by Valerie Cerra and Sweta Chaman Saxena Monetary and Economic Department March 2007
Back to the Outline:

• The background: the project and the history
• Essential concepts: a few
• The need (?)
• The alternatives

• Next steps: BC Hydro’s Long-Term Resource Plan
Appendix – Slides for Possible Reference
BC Hydro background

• Crown Utility
• Breakdown of Hydro costs
• Independent Power Producer production and costs
• Projected rates
When completed, Site C will be the third of four major dams on the Peace River that were initially proposed in the mid-twentieth century. The first project was the flagship W. A. C. Bennett Dam 19 kilometres west of Hudson's Hope. The Bennett Dam began operation in 1968 and formed Williston Reservoir, which is 95% larger than the Site C reservoir will become. Construction of the Peace Canyon Dam was completed in 1980 at a point 23 km downstream of the W. A. C. Bennett dam. The third dam, "Site C," was also proposed at the time for a site 83 km downriver of the Peace Canyon dam, or approximately 7 km southwest of Fort St. John. Site C would flood an 83 km length of the Peace River valley, widening the river by up to three times, as well as a 10 km length of the Moberly River valley and 14 km of the Halfway River valley. The fourth proposed dam on the British Columbia segment of the Peace River, Site E, near the BC–Alberta border, was removed from the planning process during hearings in 1982.

Portion of 80 kilometre stretch of valley planned for flooding

After hearings between 1981 and 1983, the British Columbia Utilities Commission turned down the Site C project. The commission was critical of BC Hydro's forecasting methods, declaring that it neither explicitly took energy prices into account nor relied on statistically significant past patterns of behaviour. BC Hydro then chose to purchase electricity under long-term contracts from independent power producers, and it continues to do so today. As of 2017 these annual purchases are about four times the capacity of Site C. Once the initial contracts with BC Hydro expire, these independent producers may be free to export their electricity.

In April 2010, passage of the Clean Energy Act exempted the project from further BC Utilities Commission review. Site C was being reconsidered by BC Hydro for two years prior as the utility reconsidered expansion of its dam capacity on the Peace. Also in April 2010, the provincial government announced it would move forward on planning for the project, moving it to the regulatory review phase. The review was mandated under the Canadian Environmental Assessment Act, 2012 (CEAA 2012) and the British Columbia Environmental Assessment Act (BCEAA). To avoid duplication, the governments of Canada and British Columbia set up a cooperative federal-provincial environmental assessment, including a joint review panel (JRP) process.

In October 2014, Site C received environmental assessment approvals from the federal and provincial governments after a three-year environmental review, including a federal/provincial Joint Review Panel process. In December 2014, the provincial government announced a final investment decision, approving the construction of the hydroelectric project at a cost of $8.335 billion, as well as a project reserve of $440 million. A notice of Site C construction commencing in 2015 was issued in July 2015. By March 2016, site clearing, attempts at bank stabilization and the search for bedrock took the majority of BC Hydro’s focus - there were no "works" in the ground; the diversion tunnels had not yet been started. BC Premier Christy Clark's stated intention was to get dam construction "to the point of no return" by the time of a scheduled general election in May 2017. The provincial election resulted in the previous Liberal government being defeated and a New Democratic government taking office. The newly elected government requested the BC Utilities Commission 2017 review.

The project has sparked controversy for a number of reasons: First Nations treaty rights are at issue, the dam is thought by many to be economically unviable, and there are concerns about the loss of agriculturally productive land and the overall environmental impact. The federal/provincial Joint Review Panel found that the need for the electricity had not been clearly demonstrated, nor were alternatives to the project evaluated.
Performance Basics of Site C

• Project parameters – energy and capacity
• Cascading hydro system
• Inflow pattern into the Peace river system
• Upstream facilities: GM Shrum and Peace Canyon – energy and capacity
• Water Storage: Williston Reservoir: limits and GWh storage
Cost and Issues around Site C

• Previous iterations of project
• Steps leading up to project approval
• First Nations
• Budgeted cost
• Sunk costs and cost of project cancellation
• Geotechnical problems, and cost of remediation
Electric Vehicles

Strong electric vehicle sales in 2019 resulted in higher reference forecast than June 2019. COVID impacts not incorporated.
Upside to incremental electricity demand

Further policy action and additional LNG could add significant load
COVID-19 Scenario Results

Change from March 2020 Reference Case

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<th>Fiscal Year</th>
<th>COVID-19 Scenario A GWh [%]</th>
<th>COVID-19 Scenario B GWh [%]</th>
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<tr>
<td>F21</td>
<td>-3,422 [-6%]</td>
<td>-7,080 [-12%]</td>
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<tr>
<td>F22</td>
<td>-1,769 [-3%]</td>
<td>-7,560 [-13%]</td>
</tr>
<tr>
<td>F23</td>
<td>-1,534 [-3%]</td>
<td>-5,085 [-8%]</td>
</tr>
</tbody>
</table>

Peak to trough load comparison 2008 Recession vs. Scenarios A & B

<table>
<thead>
<tr>
<th>2008 Recession (F12-F09) GWh, %</th>
<th>COVID-19 Scenario A (F21-F20) GWh, %</th>
<th>COVID-19 Scenario B (F22-F20) GWh, %</th>
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<tbody>
<tr>
<td>-3,442 [-5%]</td>
<td>-1,887 [-4%]</td>
<td>-5,584 [-10%]</td>
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Total Integrated System Peak (coincident)

Moderate growth with high degree of uncertainty
Electric Vehicle Peak Forecast

Peak uncertainty is reflective of charging behavior uncertainty
Summary of Energy Resources

Wind, Natural Gas CCGT* and Solar offer the lowest cost resources based on UEC

* Not inclusive of GHG taxes, which would add ~$18 / MWh to costs
Limited amount of Resource Smart, Natural Gas SCGT, Pumped Hydro and Batteries offer lowest cost capacity resources based on UCC
The Peace River Hydroelectric System
Key Plan Considerations

Key legislated requirements:
• Utility Commission Act (Section 44.1 applies)
• Clean Energy Act

Key policies:
• CleanBC Plan
• Outcomes of the Transformative Review (Government Review Phase 2)
• BCUC must “consider” the legislated energy objectives
• BC Hydro is effectively prohibited from pursuing large hydro projects
• Certain projects, programs and expenditures are exempt: Revelstoke 6 and Section 18 “prescribed undertakings” relating to greenhouse gas reductions in the province
Clean Energy Act: 15 energy objectives

- To achieve self-sufficiency
- To take demand side measures and to conserve energy
- To generate at least 93% of B.C.’s electricity from clean resources
- To use and foster the development of certain innovative technologies
- To ensure BC Hydro’s ratepayers receive the benefit of the heritage assets
- To ensure BC Hydro’s rates remain competitive
- To reduce B.C. greenhouse gas emissions (GHGs)
- To encourage fuel switching that reduces GHGs
- To encourage communities to reduce GHGs and to use energy efficiently
- To reduce waste through the use of waste heat, biogas and biomass
- To encourage economic development and the creation and retention of jobs
- To foster the development of first nation and rural communities through the use and development of clean and renewable resources
- To maximize the value of B.C.’s generation and transmission assets for the benefit of B.C.
- To be a net exporter of clean or renewable electricity
- To not use nuclear
IRP: Key Questions

• How much DSM to pursue – energy efficiency, what is the role of demand response and rate signal?
• What’s the approach for renewing existing electricity purchase agreements?
• What and when is the need for next new resource?
  • Revelstoke Unit 6, pumped storage, batteries (capacity)?
  • Solar, wind (energy)?
  • Transmission?
IRP: Key Uncertainties

What’s needed and when?

LNG?

Electrification?

Customer solar?
History of BC Hydro Energy Demand Forecasts

![Graph showing Total System Gross Requirements After DSM]

David Ince
Information Request No. 4.7.0
Dated: October 30, 2019
British Columbia Hydro & Power Authority
Response issued December 13, 2019
Historical BC Hydro Energy Demand

Historic Load (not weather adjusted)

- 2008 Recession
- Residential
- Light Industrial/Commercial (General Service)
- Industrial

Weather Event

David Ince
Information Request No. 4.4.0 Dated: October 30, 2019
British Columbia Hydro & Power Authority
Response issued December 13, 2019
Provincial GHG reduction targets

Additional GHG reductions are required beyond CleanBC
SITE C RESERVOIR

The Site C Clean Energy Project (Site C) will be the third hydroelectric facility on the Peace River, located downstream of BC Hydro’s existing W.A.C. Bennett and Peace Canyon dams. The Site C reservoir will be approximately 83 kilometres long and will be, on average, two to three times the width of the current river. It will flood approximately 5,550 hectares of land and will have a total surface area, including the current river area, of approximately 9,330 hectares.

The Site C reservoir will be comparatively smaller than BC Hydro’s other major hydroelectric projects because it will rely on the existing Williston Reservoir for water storage.

As the third project on the Peace River, Site C will re-use the same water flowing downstream from the two upstream facilities and simply pass it along. This will enable Site C to generate approximately 35 per cent of the energy produced at the W.A.C. Bennett Dam, with only five per cent of the reservoir area.

“The Panel finds that BC Hydro’s proposed dam would benefit hugely from the upstream storage and regulation, providing firm, seasonally modulated power for many decades beyond its amortization period.”

“The Project would not have any measurable effect on the Peace-Athabasca Delta.”
- Report of the Joint Review Panel, page v

The Site C reservoir will be one of the most stable in the BC Hydro system with relatively little fluctuation in water levels during typical operations.

The proposed maximum normal operating range for the Site C reservoir will be 1.8 metres — between 460.0 metres and 461.8 metres. However, during typical operations the reservoir is expected to fluctuate within a smaller range.
BC Hydro Annual Costs

F2021 Revenue Requirement = $5.29B

- Net Other: $0.25B (5%)
- Finance Charges: $0.68B (13%)
- Net Income: $0.71B (13%)
- Water Rentals: $0.35B (6%)
- Base Operating Costs: $0.79B (15%)
- Capital Amortization: $0.94B (18%)
- Cost of Energy (includes IPPs): $1.57B (30%)

David Ince
Information Request No. 1.13.1 Dated: May 1, 2019
British Columbia Hydro & Power Authority
Response issued June 6, 2019
## Electricity Purchases by BC Hydro (IPPs)

### Table 1: Aggregated Monthly IPP Volumes by Call Process (GWh, for F2014 - F2018 on the Integrated System)

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<th>Call Process (GWh)</th>
<th>Jan</th>
<th>Feb</th>
<th>Mar</th>
<th>Apr</th>
<th>May</th>
<th>Jun</th>
<th>Jul</th>
<th>Aug</th>
<th>Sep</th>
<th>Oct</th>
<th>Nov</th>
<th>Dec</th>
<th>Total</th>
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<td>805</td>
<td>982</td>
<td>1,053</td>
<td>1,435</td>
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<td>2006 Open Call</td>
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<td>854</td>
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<td>2008 Bioenergy Call - Phase 1</td>
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<td>75</td>
<td>75</td>
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<td>2008/10 Standing Offer Program</td>
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