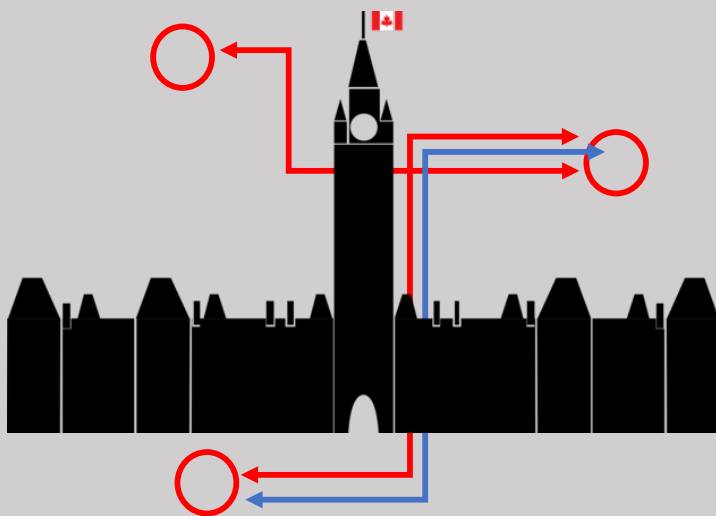


SURP 824

ENERGY AND CITY BUILDING: THE FUTURE OF DISTRICT ENERGY IN THE NATIONAL CAPITAL REGION



Jared Cathro
Stefanie Ekeli
Erin Forzley
Kevin Keresztes
Nicholas Kuhl
Sarah Lumley
Meg Morris
JoAnn Peachey

Supervisor: John Meligrana



QUEEN'S UNIVERSITY, SCHOOL OF URBAN AND REGIONAL PLANNING

SURP 824 PROJECT COURSE — FINAL REPORT, DECEMBER 18, 2017

Standards Limitations

Graduate students at Queen's University in the School of Urban and Regional Planning program developed this report as part of the SURP 824 project course. The report was prepared for Public Services and Procurement Canada and their Energy Services Acquisition Program.

This report does not necessarily reflect the views and policies of Public Services and Procurement Canada, any of its subsidiaries, or affiliates. The contents were developed exclusively by the SURP 824 project course team.

Acknowledgements



SURP 824 Project Team (left to right): Jared Cathro, Erin Forzley, Meg Morris, Sarah Lumley, Nicholas Kuhl, JoAnn Peachey, Stefanie Ekeli, Kevin Keresztes

The SURP 824 project team would like to thank the following people:

Dr. John Meligrana, our faculty supervisor at the Queen's School of Urban and Regional Planning, for his support throughout the project. His guidance and advice has contributed to our successful completion of this report and final presentations.

Ann Tremblay (ESAP Project Director) for bringing this project to the School of Urban and Regional Planning and assisting the team in learning about district energy in the National Capital Region. We want to thank her for her mentorship, advice, and guidance throughout the entire project, without which this report would not have been possible to create.

Carla Restrepo (ESAP Program Coordinator) for providing the logistical support and background information necessary to complete this project.

Public Services and Procurement Canada and the Energy Services Acquisition Program (ESAP) for retaining the team to carry out this project, educating the team on the project context, and taking the time to attend our final presentation and offer valuable feedback.

The National Capital Region, City of Ottawa, and Ville de Gatineau representatives for providing advice in the early stages of the project and helping the team understand the views of the major stakeholders involved.

Angela Balesdent, Kathy Hoover, Jo-Anne Tinlin for their administrative support at Queen's University.

The various individuals and organizations who provided us with important information and advice on district energy in the National Capital Region.



EXECUTIVE SUMMARY



SURP 824 PROJECT COURSE

Objective

As part of the Queen’s University School of Urban and Regional Planning (SURP), the SURP 824 Project Course Team (“the team”) was retained by Public Services and Procurement Canada (PSPC) to evaluate the feasibility of expanding the National Capital Region’s (NCR’s) district energy system (DES). The team conducted a multi-level government policy context analysis, a case study review, a geographic information systems (GIS) land-use analysis, and a Strengths, Weaknesses, Opportunities, and Challenges (SWOC) analysis to form recommendations for the Energy Services Acquisition Program (ESAP). The team worked in partnership with ESAP over a four-month period from September 2017 to December 2017, developing recommendations for moving ESAP forward on the expansion of the NCR’s DES.



The team was tasked with the following:

1. Demonstrate an understanding of the ESAP DES;
2. Evaluate existing planning policy and government context in the NCR and identify key stakeholders;
3. Create a list of “lessons learned” from successful and unsuccessful DES case studies in comparable places to the NCR;
4. Identify potential locations for expansion of the DES in the NCR by analyzing supportive land use policy conditions and potential users; and
5. Recommend next steps for ESAP on how to achieve expansion of the DES in the NCR.

Energy Services Acquisition Program

Phase One of the program includes upgrading the system from steam-powered to low temperature hot water and chilled water. This phase also includes the testing of new carbon-neutral fuels to reduce the system’s environmental impact.

Phase Two includes using the successful alternative fuels as well as the system expansion to new buildings in the NCR.

The Findings

Government Context

A rigorous review of relevant government policies was conducted, in order to gain a complete appreciation for the multi-jurisdictional playing field within which ESAP's DES must function. Policy and legislation from the Government of Canada, National Capital Commission, Provinces of Ontario and Québec, and municipalities of Ottawa and Gatineau were reviewed. Overall, it was found that while all jurisdictions are supportive of the environmental benefits and objectives that ESAP's system provides, they were not always perfectly aligned with, or supportive of the system itself. In many cases, different organizations used different metrics for calculating or determining which environmental initiatives to pursue. In the case of Gatineau, this largely precluded it from future DES expansion due to the municipality's focus on reducing greenhouse gas emissions. Due to HydroQuébec's existing cheap and low emission hydroelectricity, the environmental benefits of connecting to the DES in Gatineau are not the same as elsewhere in the NCR. Conversely, the Province of Ontario's

Provincial Policy Statement was explicitly supportive of DES technology being implemented and included in Ontarian planning. These diverging policy frameworks led to a larger focus on the Ottawa portion of the NCR.



Case Study Review



An analysis of 18 DESs from all over the world were investigated to understand the benefits and drawbacks of implementing district energy systems. By looking at small rural towns, universities, major cities, and everything in-between, the case study analysis proved district energy systems can work at all city sizes and scales. Through this analysis of the challenges and innovations found in district energy around the world, three overarching themes began to emerge. These themes are: Land Use & Expansion, Growing the Client Base, and System Governance. These three themes were pulled out of the case studies because we found that land use policies are intrinsically tied to the success of expanding a DES. Furthermore, the land use policies and patterns also helped in identifying potential clients. This in turn, aided the addition of clients

connecting to district energy. Lastly, the selected case studies consistently proved that a competent and effective model of system governance must be employed in order for the system to run effectively, efficiently, and successfully.

Burnaby British Columbia, Canada	St. Paul Minnesota, USA	Aberdeen United Kingdom
North Vancouver British Columbia, Canada	Nashville Tennessee, USA	Bunhill United Kingdom
Vancouver British Columbia, Canada	Guelph Ontario, Canada	Paris France
Gibsons British Columbia, Canada	Burlington Ontario, Canada	Denmark
Île-des-Chênes Manitoba, Canada	Princeton New Jersey, USA	Vingåker Sweden
Duluth Minnesota, USA	Charlottetown PEI, Canada	Sydney NSW, Australia

SWOC Analysis

A SWOC Analysis was conducted for DES expansion in the NCR with the developed understanding of the existing DES, policy context, projected growth in the NCR, and lessons learned

from the case studies. The most important findings from each of the three themes established in the case study review are detailed in the table below.

	Land Use & Expansion	Growing Client Base	System Governance
Strengths	<ul style="list-style-type: none"> The system is being modernized and will run on renewable energy 	<ul style="list-style-type: none"> Several plants are already located in close proximity to mixed-use, dense areas well suited for connecting 	<ul style="list-style-type: none"> All governments and agencies support green initiatives Private sector connections and engagement have been prioritized
Weaknesses	<ul style="list-style-type: none"> Several opportunities for connecting to greenfield developments near the network have been missed Expansion in highly developed core areas is expensive and disruptive 	<ul style="list-style-type: none"> Several competing DES's exist or are being developed Poor communication with private actors has hindered ESAP's ability to bring in new connections 	<ul style="list-style-type: none"> ESAP is beholden to the in-power government's priorities There is no existing business model for the delivery and expansion of the DES
Opportunities	<ul style="list-style-type: none"> The Government of Canada desires and has the capacity for expansion 	<ul style="list-style-type: none"> The completion of ESAP's phase 1 and 2 can stimulate interest and marketing potential in the DES 	<ul style="list-style-type: none"> ESAP is well-positioned to take a leadership role in initiating expansion and bringing all stakeholders together
Challenges	<ul style="list-style-type: none"> Capitalizing on the existing political support for the environmental objectives DES can serve 	<ul style="list-style-type: none"> Developers need both heating and cooling to connect There is a lack of awareness about ESAP's DES 	<ul style="list-style-type: none"> Meeting divergent environmental priorities across stakeholders Lack of dialogue and buy-in from potential customers

Land Use Analysis – Conceptualizing DES Expansion in the NCR

From the lessons learned in the case studies and SWOC analysis, it was concluded that DES is best supported by a mix of uses, high density, high concentrations of building, and anchor users with high energy demands. The purpose of the land use analysis was to identify areas with land use policy that supports a mix of uses, and

intensification of density and built form. Following this, areas within those that demonstrate potential for a high concentration of users from planned new development and from existing built form were identified. The results of this analysis yielded the figure below, which highlights the priority areas for DES expansion



1

Tunney's Pasture Master Plan:

- TOD
- High density
- Mix of uses
- Large buildings

2

Scott Street:

- Natural connection between Tunney's and LeBreton
- TOD
- Infill potential
- Large buildings

3

RendezVous LeBreton:

- High density
- Mix of uses
- Large scale under one developer

4

Downtown:

- High concentration of large buildings
- Mix of uses
- Government buildings
- High 'visibility' for marketing and pilot project

5

Centretown Spurs:

- Natural extension to downtown
- High concentration of large buildings

6

Byward Market:

- Natural extension to downtown
- Government buildings and large buildings

Recommendations: A Roadmap for Expansion

From the lessons learned a variety of recommendations for the expansion of ESAP's DES in the NCR were generated. These recommendations come together to form a roadmap charting out a long-term process for expansion. The chart below displays an overview of these recommended steps. Three stages are recommended for long-term implementation: Preparation, including completion and streamlining of the internal federal system and engagement with key stakeholders; Planning,

including further analysis of conditions and the creation of a clear implementation strategy for expansion in the market; and Implementation, which covers the ongoing operation of the DES with an aim of continual expansion and improvement. As an ultimate outcome, DES in the NCR is envisioned as a sustainable, financially feasible product that delivers high quality service to clients while meeting the environmental goals of stakeholders.

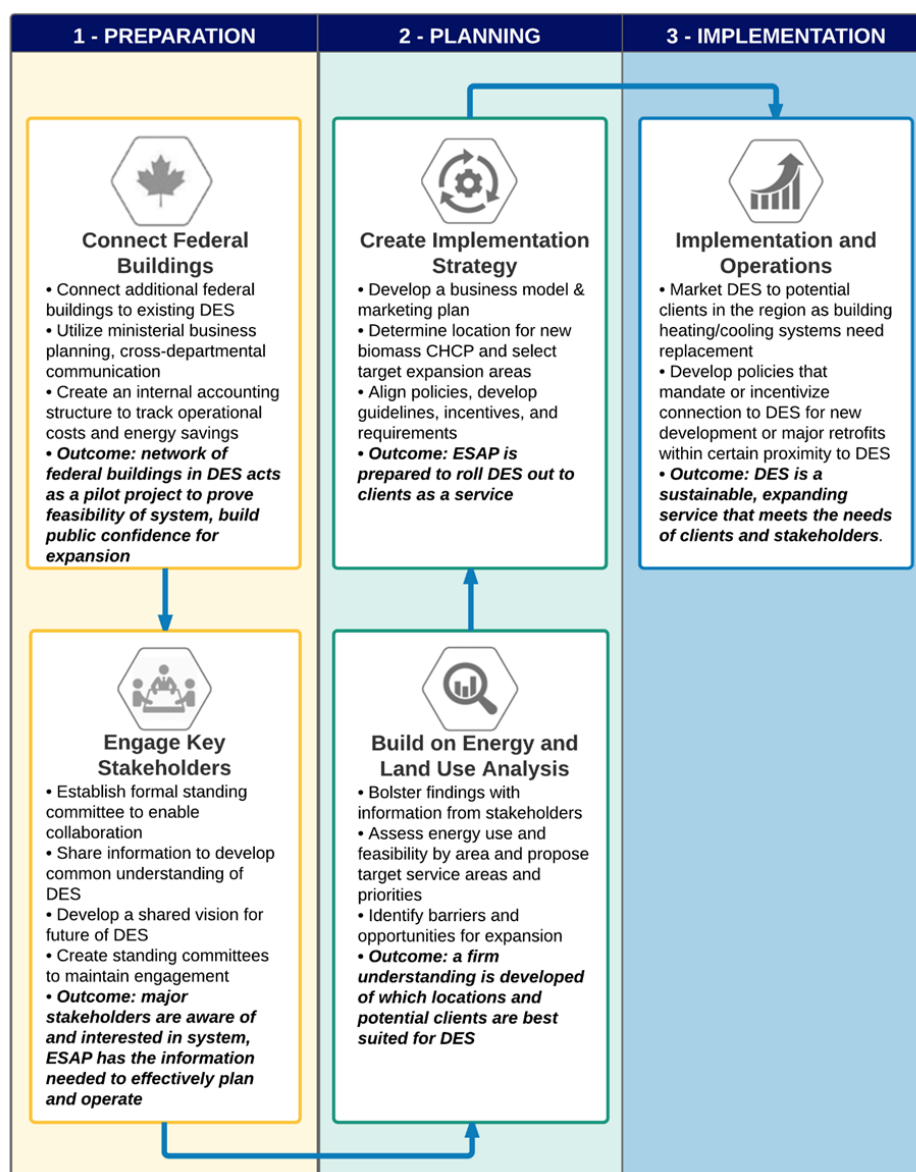


Table of Contents

1.0 Introduction.....	2
1.1 Purpose of the Report.....	2
1.2 Context	2
1.2.1 Client	2
1.2.2 Study Area.....	2
1.2.3 Growth	3
1.2.3.1 General Trends.....	3
1.2.3.2 New Development	4
2.0 District Energy Systems.....	8
2.1 How District Energy Works.....	8
2.2 Benefits of District Energy.....	9
3.0 Current Conditions	12
3.1 NCR DES Current System.....	12
3.2 Energy Services Acquisition Program (ESAP).....	14
3.2.1 Phase 1: Modernization.....	14
3.2.2 Phase 2: Greening and Expansion.....	15
3.3 Government Context	15
3.3.1 Government of Canada.....	16
3.3.2 National Capital Commission	18
3.3.3 Province of Ontario.....	20
3.3.4 City of Ottawa	22
3.3.5 Province of Québec.....	23
3.3.6 Ville de Gatineau.....	25
4.0 Case Study Review.....	30
4.1 Method of Review.....	30
4.2 Land Use and Expansion.....	31
4.2.1 Determining Growth Areas.....	31
4.2.2 Community Planning and DES Expansion.....	33
4.2.3 Timing and Phasing.....	35
4.2.4 Lessons Learned.....	37
4.3 Growing Client Base	38
4.3.1 Identifying Potential Clients.....	38
4.3.2 Financial Tools for Client Attraction.....	40
4.3.3 Attracting Clients for Environmental Sustainability.....	41
4.3.4 District Energy Marketing.....	42
4.3.5 Lessons Learned.....	44

4.4 System Governance	45
4.4.1 Establishing a Governance Model.....	45
4.4.2 Citizen Engagement and Consultation.....	46
4.4.3 Reviewing the Legislative and Policy Context.....	47
4.4.4 Ensuring Successful Operations	48
4.4.5 Lessons Learned.....	49
4.5 Summary of Lessons Learned.....	50
5.0 SWOC Analysis	56
5.1 Land Use and Expansion.....	56
5.2 Growing Client Base.....	57
5.3 System Governance.....	58
6.0 Land Use Analysis	60
6.1 Data and Limitations.....	60
6.2 Supportive Land Use Policy.....	61
6.2.1 Ottawa Official Plan High Density and Mixed-Use Nodes.....	61
6.2.2 Ottawa and Gatineau Transit Oriented Development.....	62
6.2.3 Ottawa Secondary Plan Areas	62
6.3 Supportive Built Environment.....	64
6.3.1 Potential Growth Areas.....	65
6.3.2 Existing Buildings.....	66
6.4 Discussion	70
6.4.1 Phasing	71
6.4.2 Infrastructure Costs	72
6.4.3 Ownership	73
6.4.4 Anchor Users.....	73
6.4.5 DES Compatibility.....	73
6.5 Results.....	74
7.0 Implementation Recommendations	76
7.1 Overview	76
7.2 Preparation	76
7.2.1 Connect Federal Buildings.....	76
7.2.2 Engage Key Stakeholders.....	79
7.3 Planning.....	80
7.3.1 Build Upon Energy and Land Use Analysis.....	81
7.3.2 Create Implementation Strategy.....	82
7.4 Implementation.....	82
8.0 Conclusion.....	85
Appendix A: Acronyms.....	87

Appendix B: Energy Demand Calculations.....	89
Appendix C: Case Studies.....	93
Appendix D: Maps	144

List of Figures

Chapter 1.0

Figure 1: The National Capital Region (NCR)

Figure 2: Map of Light Rail Transit (LRT) line in Ottawa

Chapter 2.0

Figure 1: UBC District Energy Utility Centre

Figure 2: ESAP requirements for building heating and cooling systems connected to PSPC DES

Figure 3: United Nations district energy diagram

Chapter 3.0

Figure 1: CHCP plant locations in the NCR map

Figure 2: Parliamentary and Judicial Precinct map

Chapter 4.0

Figure 1: Selected global case studies map

Figure 2: Guelph, ON heat map

Figure 3: Sydney, Australia low carbon zones map

Figure 4: Burlington's Community Energy Plan's governance organizational structure

Figure 5: Driving forces behind Gibsons, BC DES

Figure 6: Gibsons location and phasing of DES

Figure 7: Phase 1 Gibsons DES

Figure 8: Map of the best potential district energy zones in Vancouver, BC

Figure 9: St. Paul, Minnesota cogeneration plant

Figure 10: Planned, existing and potential heating networks in Islington map

Figure 11: Southeast False Creek energy centre

Figure 12: Princeton's four sources of energy

Figure 13: Metro Nashville connections map

Chapter 6.0

Figure 1: Supportive policy layers analysis

Figure 2: Supportive policy areas GIS map for DES in Ottawa

Figure 3: Identified new development areas map

Figure 4: Large buildings in supportive areas map

Figure 5: Priority areas for DES expansion map

Figure 6: Four factors establishing the land use assessment framework

Chapter 7.0

Figure 1: Strategic plan for DES expansion diagram

Figure 2: Roadmap for expansion

Figure 3: Land use assessment framework

Figure 4: Recommended inputs to target expansion locations and clients

Figure 5: Three key initiatives of the recommended implementation strategy

Chapter 8.0

Figure 1: Parliament Hill in the NCR

List of Tables

Chapter 1.0

Table 1: Summary of major new/proposed developments in the NCR

Chapter 3.0

Table 1: CHCP current information

Table 2: Governing policy context for the DES

Chapter 4.0

Table 1: Key lessons learned from 18 case studies

Chapter 5.0

Table 1: Land Use and Expansion SWOC

Table 2: Growing Client Base SWOC

Table 3: System Governance SWOC

Chapter 6.0

Table 1: Supportive and unsupportive Ottawa secondary plans

Table 2: Policy characteristics summary

Table 3: Characteristics and challenges of new development areas

Table 4: Areas with a high concentration of large buildings

Table 5: Building concentrations within secondary plans

Table 6: Key priority area

Table 7: DES piping installation costs