B2-3 The Proposed Daily Amount

Health Canada's examination of the current available information suggests most individuals use an average daily amount of 1 gram to 3 grams of dried marihuana for medical purposes, whether it is taken orally, or inhaled or a combination of both.

a. The proposed daily amount of dried marihuana is less than or equal to 5 grams (use letters to write amount); and

b. the following method and form of administration (please check appropriate box):

☒ Inhalation ☐ Oral

Note to Physicians: For more information on daily amounts, you can refer to the following documents:
- **Information for Health Care Professionals — Marihuana**
- **Daily Amount Fact Sheet**

Both documents can be found on the Health Canada Web site at http://hc-sc.gc.ca/dhp-mps/marihuana/index_e.html or by calling toll free at 1-866-337-7705.

B2-4 Duration

Under the *Marihuana Medical Access Regulations*, an *Authorization to Possess* may be issued for a period of up to 12 months.

If you are signing the authorization for a shorter period, please specify the number of months: 12

B2-5 Medical Practitioner's Declaration and Signature

Please read, sign and date the document in the space provided on Page 3.

1. a. The applicant's symptom(s) listed in Page 1 of this form falls under Category 2 (symptoms that do not fall under Category 1);

   b. conventional treatment(s) for the Category 2 symptom(s) have been tried or considered, and have been found to be ineffective or medically inappropriate for the treatment of the applicant.

2. I am aware that a *Notice of Compliance* has not been issued under the *Food and Drugs Regulations* concerning the safety and effectiveness of marihuana as a drug.

3. a. If you are a medical specialist that your area of medical specialization is relevant to the treatment of the applicant's medical condition, or

   b. if you are not a medical specialist, please declare:

      i. that the applicant's case has been assessed by a specialist;

      ii. the specialist's area of specialization is relevant to the treatment of the applicant's medical condition;

      iii. that the specialist concurs that conventional treatments for the symptom are ineffective or medically inappropriate for the treatment of the applicant; and

      iv. the specialist is aware that marihuana is being considered as an alternative treatment for the applicant.

(signature required on next page)

Name: Dr Clarissa Wallace for pt TANYA BEEMISH

(B2-5 continued)

Please complete the following:

Name of the medical specialist: Clarissa Wallace

The medical specialist's area of specialization: Endocrinology

Date of the specialist's assessment of the applicant's case: Sept 5 / 2013

Note: Under the *Marihuana Medical Access Regulations*, a "practitioner" is a practitioner who is recognized as a practitioner by the medical licencing authority of the province in which the practitioner is authorized to practice medicine and who is not named in a notice given under Section 58 or 59 of the *Narcotic Control Regulations*.

4. I declare that the information contained in this form is correct and complete.

MEDICAL PRACTITIONER'S SIGNATURE

Clarissa Wallace
PRINT NAME

SEP 13 2012
DATE

IMPORTANT:

1. **Please ensure that you have read and understood the declarations.**
2. **Please sign and date the declarations.**
3. **It is important to understand that all mandatory information requested must be provided to avoid unnecessary delays.**
4. **We cannot process the application until *ALL* appropriate forms are received.**
5. **Please retain a photocopy of this form for your files.**

If you have questions regarding this form, please contact Health Canada toll-free at 1-866-337-7705.

Name:

Health Canada Santé Canada

Form D

Application for Licence to Produce Marihuana by a Designated Person

This form is to be completed by the applicant (the person who has applied for an *Authorization to Possess* marihuana) who wishes to have someone else grow the marihuana for them. This application is to be signed by ***both*** the applicant and the person who has been designated as the grower.

Important

1. It is important to understand that all information requested must be provided to avoid unnecessary delays.
2. We cannot process the application until *all* appropriate forms are received.
3. Please retain a photocopy of this form for your files.

If you have any questions regarding this form, please contact Health Canada toll-free at 1-866-337-7705.

Please forward all completed applications to:

Marihuana Medical Access Division
Drug Strategy and Controlled Substances Programme
Health Canada
Address Locator: 3503B
Ottawa, ON K1A 1B9

Canada

D1 Applicant's Information

☐ Mrs. ☒ Miss ☐ Ms. ☐ Mr.

Applicant's full name: Beemish / Tanya / Louise

Date of Birth: 02 / 07th / 1986

Address: 13909 102 ave Apartment Number: 34

City: Surrey Province: BC Postal Code: V3T 5X8

If no street address is available, please provide lot and concession number:

Lot Number:

Concession Number:

Telephone: (604) 614 8116

Fax: ( )

E-mail: ✓

If you already hold an *Authorization to Possess* dried marihuana under these *Marihuana Medical Access Regulations*, please indicate the number of that *Authorization*:

IMPORTANT: If you have not been authorized to possess dried marihuana under the *Marihuana Medical Access Regulations*, you must also submit *Form A: Application for Authorization to Possess Marihuana for Medical Purposes* and the appropriate medical practitioner form (Form B1 or B2).

D2 Designated Person's Information

☐ Mrs. ☐ Miss ☐ Ms. ☑ Mr.

Designated person's full name: HEBERT / DAVID / WESLEY

Date of Birth: 26 / JULY / 1981

Address: 13909 102 AVENUE Apartment Number: 34

City: SURREY Province: BC Postal Code: V3T 5K8

If no street address is available, please provide lot and concession number:

Lot Number:

Concession Number:

Telephone: (778) 808-2858

Fax: ( )

E-mail: dhebert81@gmail.com

Mailing Address (if different from above):

Address or P.O. Box: Apartment Number:

City: Province: Postal Code:

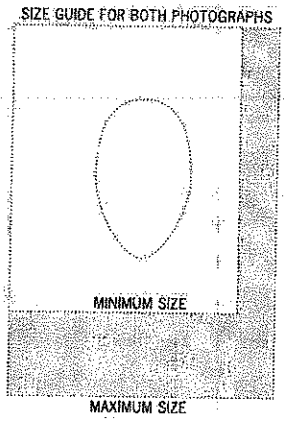
D3 Photograph of Designated Person

Please complete and check both boxes:

☑ Two copies of a current photograph that clearly identifies the designated person have been enclosed.

☑ The back of one photograph of the designated person has been signed by the applicant (not the designated person) certifying that it is a true likeness of the designated person.

SIZE GUIDE FOR BOTH PHOTOGRAPHS



IMPORTANT: A standard passport photograph is preferred but if one is not available, the photograph submitted *must* meet the following standards:

- It must show you alone in the photograph.
- It must show a full frontal view of your head and shoulders against a plain contrasting background.
- It must be at least 43 mm x 54 mm (1 11/16 inches x 2 1/8 inches) and not more than 50 mm x 70 mm (2 inches x 2 3/4 inches), and have a view of your head that is at least 30 mm (1.375 inches) in length.
- It must reveal your face without sunglasses or any other obstructions. Facial hair is permitted, of course.

Note: A photograph is required every year.

D4 Production Site

Please choose one of the following three options:

☑ As the designated person, I plan to produce marihuana at my ordinary place of residence (the address that was provided on Page 1 of this form).

OR

☑ As the designated person, I plan to produce marihuana at the applicant's ordinary place of residence (the address that was provided by the applicant on Page 1 of Form D).
If you make either of these two selections, *please proceed directly to D5*.
If not, please check the box on page 3 and provide the requested information.

OR

(continued on next page)

Name: DAVID HEBERT

(D4 continued)

☐ As the designated person, I plan to produce marihuana somewhere other than either at my ordinary place of residence or at the ordinary residence of the applicant.
If you make this selection, please complete the rest of this page.

Proposed production site:

Address: Apartment Number:

City: Province: Postal Code:

If no street address is available, please provide lot and concession number:

Lot Number:

Concession Number:

This site is owned by either the applicant or the designated person: ☐ Yes ☐ No

IMPORTANT: If the marihuana is to be produced at a site that is not the ordinary residence of and not owned by the applicant or the designated person, the owner(s) of the production site must complete *Form F: Consent of Property Owner*.

D5 Mode of Production

The marihuana will be produced (please choose only one):

☑ entirely indoors;

OR

☐ entirely outdoors;

OR

☐ indoors in the winter and outdoors in the summer.

IMPORTANT:
1. **The Regulations allow you to grow marihuana indoors in the winter and outdoors in the summer. You cannot grow marihuana indoors and outdoors at the same time.**
2. **Please be sure to read the declaration on D8 Part B with respect to growing marihuana near locations frequented by minors if you plan to grow marihuana outdoors.**

D6 Security Measures for Growing and Storing Marihuana

IMPORTANT: *The Marihuana Medical Access Regulations* state that "the holder of an authorization shall maintain measures necessary to ensure the security of marihuana in their possession." (Sec 61(1)).

Please describe the security measures that will be used at the proposed production site to protect your crop of marihuana against loss or theft: • bar single ground level window (120cm x 86cm).
• crop will always be locked in contained system,
• only access is locked door no windows, dead bolt.
• house is wired for alarm, will activate.
• secure neighborhood, 2nd last home on a private lane, completely fenced.

Please describe the security measures that will be used to protect your dried marihuana against loss or theft:
• a safe locked in upstairs master bedroom, also locked.

Address where the marihuana will be stored:

Address: 13909 102 AVENUE Apartment Number: 24

City: SURREY Province: BC Postal Code: V3T 5X8

IMPORTANT: Please note that if the marihuana is not stored at the production site, it must be stored at the ordinary place of residence of the designated person or the applicant.

D7 Authority to Communicate to Canadian Police

To reduce the possibility of police intervention when you engage in activities allowed under your licence, Health Canada will communicate limited licence information to Canadian police in response to a request received from Canadian police in the context of an investigation under the *Controlled Drugs and Substances Act* or the *Marihuana Medical Access Regulations*.

Name: DAVID HEBERT

D8 Part A–Applicant's Declaration and Signature

I, the applicant, declare and confirm that the information contained in this form is correct and complete.

Tanya Beemish — APPLICANT'S SIGNATURE

oct 20 2012 — DATE

Tanya Beemish — PRINT NAME

D8 Part B–Designated Person's Declaration and Signature

I, the designated person, declare that:

i. Within the ten (10) year period preceding the date of this application, I have not been convicted as an adult of a designated drug offence committed in Canada and that I have attached a document from a Canadian police force in support of this declaration. **(Note: Please consult the Applicant Guide for explanation of "designated drug offence.")**

ii. I declare that, within ten (10) years preceding the date of this application, I have not been convicted, as an adult, of an offence committed outside of Canada that, if committed in Canada, would have constituted a designated drug offence.

iii. If I've indicated on this application that I plan to produce marihuana outdoors, I declare and confirm that the production site does not share a border or common point of contact with a school, public playground, day-care facility or other public place frequented mainly by persons under 18 years of age.

iv. I declare and confirm that the dried marihuana will be stored indoors.

v. I declare and confirm that the information contained in this form is correct and complete.

DESIGNATED PERSON'S SIGNATURE

October 20, 2012 — DATE

David Hebert — PRINT NAME

IMPORTANT:

1. **Please ensure that D8 Part A has been signed and dated by the applicant, and D8 Part B has been signed and dated by the designated person.**
2. **It is important to understand that all mandatory information requested must be provided to avoid unnecessary delays.**
3. **We cannot process the application until *ALL* appropriate forms are received.**
4. **Please retain a photocopy of this form for your files.**
5. **Remember to include the document from a Canadian police force also known as a criminal record check for the designated person.**

If you have questions regarding this form, please contact Health Canada toll-free at 1-866-337-7705.

Health Canada Santé Canada

Form E2

Application to Obtain Marihuana Seeds

This form is to be completed by applicants who wish to obtain marihuana seeds only from Health Canada who either:

☐ hold or have applied for an *Authorization to Possess* marihuana and a license to Produce marihuana under the *Marihuana Medical Access Regulations;*

OR

☐ hold an Exemption for the possession and production of marihuana for medical purposes under Section 56 of the *Controlled Drugs and Substances Act.*

Important

1. It is important to understand that all information requested must be provided to avoid unnecessary delays.
2. We cannot process the application until *all* appropriate forms are received.
3. Please retain a photocopy of this form for your files.

If you have any questions regarding this form, please contact Health Canada toll-free at 1-866-337-7705.

Please forward all completed applications to:

Marihuana Medical Access Division
Drug Strategy and Controlled Substances Programme
Health Canada
Address Locator: 3503B
Ottawa, ON K1A 1B9

Note: If purchasing both dried marihuana and marihuana seeds, the dried marihuana will be shipped for a period of up to four months only.

Canada

E2-1 Applicant's Information

☐ Mrs. ☐ Miss ☐ Ms. ☑ Mr.

Applicant's full name: HEBERT / DAVID / WESLEY

Date of Birth: 26 / JULY / 1981

Address: 13909 102 AVENUE Apartment Number: 34

City: SURREY Province: BC Postal Code: V3T 6X8

Telephone: (778) 808-2858

Fax: ( )

E-mail: dhebert81@gmail.com

E2-2 Cost

Marihuana seeds will be provided at a cost of $20.00 per package of 30 seeds. The quantity provided will be calculated based on the maximum number of plants you or your designated person are permitted, by licence or exemption, to produce or cultivate (an amount that is based on your daily approved amount). Representatives of Health Canada will contact you to both determine the quantity of seeds that are required and complete the order.

Typical costs are:

One package:	$20*
Two packages:	$40*
Three packages:	$60*

*(plus applicable taxes)

Note: Before moving on to Section E2-3, please ensure that you are aware of the cost.

E2-3 Delivery Instructions

☑ I would like the seeds delivered to the address provided in Section E2-1 of this application form.

IMPORTANT: To obtain seeds to grow marihuana, you must also have a valid *Personal-Use Production Licence*, or fill out *Form C: Application for Licence to Produce Marihuana by Applicant*.

OR

(continued on next page)

(E2-3 continued)

☐ I would like the seeds delivered to my designated person:

☐ Mrs. ☐ Miss ☐ Ms. ☐ Mr.

Designated person's full name:

Address: Apartment Number:

City: Province: Postal Code:

Telephone: ( )

Fax: ( )

E-mail:

IMPORTANT: To obtain seeds for someone to grow marihuana for you, you must also fill out *Form D: Application for Licence to Produce Marihuana by a Designated Person.*

Note: Before moving on to Section E2-4, please ensure that:

1. You have indicated where you would like the marihuana seeds delivered.
2. You have a *Personal-Use Production Licence*, or have completed *Form C: Application for Licence to Produce Marihuana by Applicant* if you want to grow the marihuana plants yourself OR *Form D: Application for Licence to Produce Marihuana by a Designated Person.*

E2-4 Notice to Applicants, Declaration and Signature

Please read carefully before using this product.

It is important for you to be aware of the following risks and recommendations about the product:

- Health Canada has not approved this marihuana product, or marihuana generally, as a drug under the *Food and Drugs Act*.
- The provision of marihuana for medical purposes does not constitute an opinion from Health Canada on the safety, effectiveness or quality of marihuana within the meaning given to those words under the *Food and Drugs Act* and the *Food and Drug Regulations*.
- The provision of marihuana does not constitute an opinion from Health Canada as to the justification for using marihuana for medical purposes, in general.
- The use of marihuana carries with it a number of potential health risks, including impaired immune system, interaction with other drugs, dysphoria, depleted energy, impaired short term memory, drug dependence and lung damage (particularly if consumed in the smoked form). If marihuana is to be used for medical purposes, it is recommended that it not be smoked. If you do use the product in smoked form, you accept the additional smoking-related risks.
- You should discuss with your medical practitioner the risks that may be associated with the use of this product, and marihuana generally.
- You should obtain directions for use of this product from your medical practitioner.
- Health Canada strongly recommends regular follow-up visits with your medical practitioner to verify that the benefits associated with the use of marihuana continue to outweigh the risks.
- It is possible that not all potential health risks associated with marihuana use, nor the extent of those risks, have been identified. This product therefore is being provided with the understanding that you acknowledge these facts, and that you voluntarily accept and assume the risks and dangers associated with the use of this product.

(continued on next page)

Name: DAVID HEBERT

(E2-4 continued)

- The use of marihuana may have an effect on motor skills. Consequently, if you are consuming marihuana for medical purposes, you are advised not to operate a motor vehicle, handle machinery, or perform other risky activities while under the effects of marihuana. Health Canada recommends seeking the advice of your medical practitioner on this matter. Be advised that the use of marihuana while involved in such activities may constitute a number of offences under the *Criminal Code*, including dangerous operation of a motor vehicle, operating a motor vehicle while impaired, criminal negligence, and others.
- Health Canada strongly recommends that if you are pregnant, planning to get pregnant, or nursing, you should not consume marihuana.
- Given the nature of marihuana and the fact that the provision of marihuana is for your personal treatment needs, Health Canada recommends not consuming this controlled substance in a public place. Please take note that persons in charge of public or private establishments (e.g., bars and restaurants) can request that you not smoke marihuana on their premises, even if you have authority to possess marihuana for medical purposes. There may also be municipal bylaws that prevent smoking. In addition, others should not be exposed to second-hand marihuana smoke.

i. I have read Section E2-4 of this document titled "Notice to Applicants, Declaration and Signature" and acknowledge that the benefits and risks associated with the use of the product are not fully understood. I understand that the use of the product may involve risks to health that are not known. Further, I understand that Health Canada is not giving any assurances, warranties or approvals with regard to the dried marihuana being provided.

ii. I also understand that it is incumbent upon me to ensure that I do not, at any time, have more dried marihuana in my possession than I have been authorized to possess by Health Canada.

iii. I attest that the information on this form is correct and complete.

APPLICANT'S SIGNATURE — DATE: October 20, 2012

PRINT NAME: Dawn Hebert

IMPORTANT:

1. **Please ensure that you have read the Notice to Applicants and have signed the declaration.**
2. **It is important to understand that all mandatory information requested must be provided to avoid unnecessary delays.**
3. **We cannot process the application until ALL appropriate forms are received.**
4. **Please retain a photocopy of this form for your files.**

If you have questions regarding this form, please contact Health Canada toll-free at 1-866-337-7705.

GALLERY 7
Photography

175 - 13450 - 102 Ave.
(Central City Mall)
Surrey, BC V3T 5X3
Tel: 604-582-5582
Gallery7@inbox.com

NOV 16 2012

I certify this to be a
true likeness of

Tanya Beernink

Guarantor's Signature

GALLERY 7
Photography

175 - 13450 - 102 Ave.
(Central City Mall)
Surrey, BC V3T 5X3
Tel; 604-582-5582
Gallery7@inbox.com

NOV 16 2012

I certify this to be a
true likeness of

David Hebert

Guarantor's Signature

Tanya Bennett

Canadian Police Certificate
For Employment, Visa Applicants, Foreign Travel / Work Permits

Certificat de la police Canadienne
pour l'emploi, les requérants de visas, voyages/permis de travail à l' étranger.

Name - Nom	SEX (E)	DOB/DDN Y/A	M	D/J
HEBERT David Wesley	M	81	07	26

Address - Adresse: **34 -13909 102 AVE**
SURREY, BC
CANADA V3T 5X8

Signature of applicant - Signature du requérant

"Based solely on the name(s) and date of birth provided, a search of the National Criminal Records repository maintained by the RCMP did not identify any records for a person with the name(s) and date of birth of the applicant. **Positive identification that a criminal record may or may not exist at the National Criminal Records repository can only be confirmed by fingerprint comparison.** Not all offences are reported to the National Criminal Records repository. A local indices check may or may not reveal criminal record convictions that have not been reported to the National Criminal Records repository."

La recherche dans le dépôt national des casiers judiciaires tenu par la GRC **à partir des seuls nom(s) et date de naissance fournis** n'a produit aucun résultat concernant une personne dont les nom(s) et date de naissance correspondent à ceux du demandeur. **Seule la comparaison des empreintes digitales permet de confirmer l'existence ou l'inexistence d'un casier judiciaire dans le dépôt national des casiers judiciaires.** Toutes les infractions ne paraissent pas nécessairement au casier judiciaire. Une recherche dans les fichiers locaux peut révéler des condamnations criminelles qui n'ont pas été versées au dépôt national des casiers judiciaires.

Issued by -Délivré par:
Chief of Police
Charlottetown Police Department
10 Kirkwood Drive
Charlottetown, P.E.I. C1A 2T3

Name and Rank - Nom et grade:
A.P. Smith, Chief ☐ R.J. Collins, Dep/Chief ☑ G.A. McGuigan, Dep/Chief ☐

Signature: *[signature]*

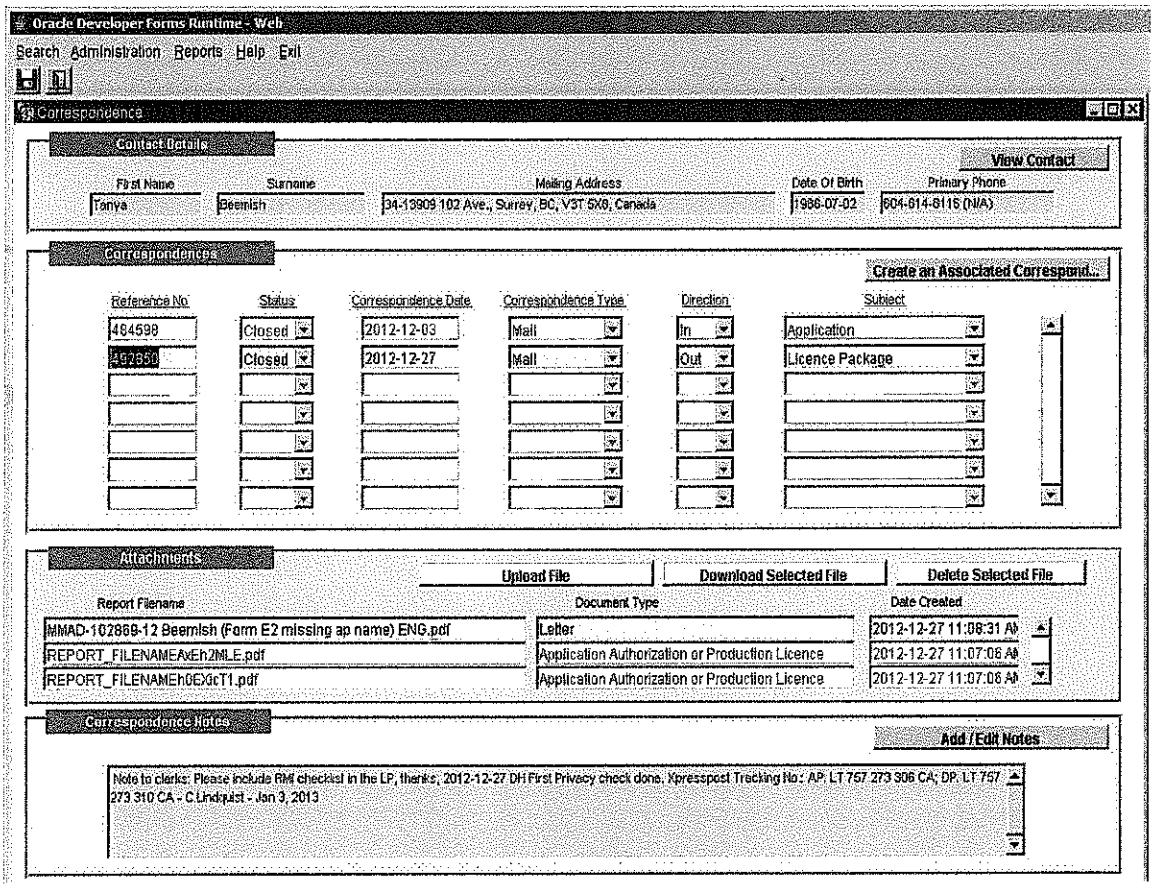
Date: *Nov 16 2012*

39307

NOTE: This certificate does not apply to any individual who works with or is seeking a paid or volunteer position which deals with one or more children or vulnerable persons as defined by Sections 6.3 and 6.4 of the Criminal Records Act, R.S.C. 1985 and the Bill C-7 as amended.

Tanya Beemish

Reference #492850



"Note to clerks: Please include RMI checklist in the LP, thanks, 2012-12-27 DH First Privacy check done. Xpresspost Tracking No.: AP: LT 757 273 306 CA; DP: LT 757 273 310 CA - C.Lindquist - Jan 3, 2013"

This is **Exhibit "F"** referred to in the
Affidavit of **JEANNINE RITCHOT**
Affirmed before me at the City of Ottawa,
in the Province of Ontario,
this 15th day of January 2015.

A Commissioner for Taking Affidavits

Delsys
A Visual Thinking Consultancy

Final Report

Cost-Benefit Analysis of Regulatory Changes for Access to Marihuana for Medical Purposes

November 6, 2012

Prepared by: David Stambrook
Senior Economist, Delsys Research Group Inc.

Derek Ireland, Ph.D.
Senior Economist, Delsys Research Group Inc.

Wei Xie
Senior Policy Analyst, Delsys Research Inc.

Table of Contents

Executive Summary

The Government of Canada requires a Cost-Benefit Analysis to be undertaken as part of the Regulatory Impact Assessment process involved in publication of certain proposed Regulations in the Canada Gazette – Part 1. This requirement was applicable for the development of the proposed new *Marihuana for Medical Purposes Regulations* (MMPR), which will replace the existing *Marihuana Medical Access Regulations* (MMAR).

The Cost-Benefit Analysis is divided into six sections:

1) An overview of the existing (status quo) regulatory regime and the proposed regulatory changes (policy);
2) A summary of stakeholders;
3) A summary of the relevant literature reviewed and used;
4) A description of the methodology employed in deriving monetized valuations of costs and benefits for the status quo and policy scenarios and the net present value measure of the difference between these;
5) A summary of the cost benefit analysis results for the reference scenario and sensitivity analysis of the quantified benefits as well as a discussion on qualitative effects; and
6) A series of conclusions of the overall study.

Each of these sections is summarized below.

1. Overview – Access to Marihuana for Medical Purposes

The Marihuana Medical Access Program (MMAP) is governed under the *Marihuana Medical Access Regulations* pursuant to the *Controlled Drugs and Substances Act* (CDSA). Unlike medical therapies and drugs that are authorized by Health Canada – after scientific review of clinical studies which have demonstrated clinical efficacy and safety– dried marihuana for medical purposes has not been authorized as a legitimate medical therapy. This has created challenges for the government in establishing a coherent and consistent policy for marihuana for medical purposes. The current regulations came into effect in 2001 after Canadian courts ruled that individuals demonstrating a medical need for marihuana have a *Charter* right to possess marihuana and to have *reasonable access* to a legal source of supply. The MMAR provide a process for Canadians to legally obtain access to marihuana for medical purposes by applying to Health Canada for an authorization to possess (ATP) and, if applicable a license to produce.

A legal authorization to possess dried marihuana for medical purposes requires application by an individual to Health Canada. The individual must obtain physician support for their application to access the legal supply of marihuana.

Persons authorized by Health Canada to possess may obtain legal access to dried marihuana via three supply methods:

1. *Government supply*: purchase of dried marihuana directly from Health Canada (HC) through a contracted government supplier;

2. *Personal-use production*: under a Personal Use Production License (PUPL) to produce for their own use; or

3. *Designated-person production*: under a Designated Person Production License (DPPL) where another individual produces for a person authorized to possess the product.

The user price for accessing the government supply is $5/gram and is well below the actual supply price of about $11-$12/gram – an effective subsidy to the user of more than 50% of the product cost (including shipping charge). Estimates suggest that the supply price for personal use production could be in the range of $1-$2/gram. The supply price for designated person production is not known as the commercial (or other) basis for the transaction between the producer and the user is not observed or regulated.

About 60% of current persons with an ATP access marihuana through PUPL. 20% access through DPPL, 10% access through the Government supply and 10% appear to access marihuana from unknown supply sources. As of August 13, 2012 there were 21,986 ATP persons under MMAP.

The MMAP has grown at an exponential rate since its inception and has generated a number of public policy concerns, including:

- Escalating cost to Health Canada under the contract with the government supplier;

- Increasing administrative burden on Health Canada in managing the program;

- Negative safety and security impacts on communities and law enforcement where personal and designated production occurs, especially the potential misuse of such licenses for the criminal purpose of supplying the illegal market; and

- Concerns from members of the medical community that it lacks sufficient information about marihuana for medical purposes to allow its members to appropriately discuss risks and benefits with patients.

In 2009, following the expression of significant stakeholder concerns with the current program, the Minister of Health instructed HC officials to conduct a review of the MMAP. In 2011, the Government of Canada proposed changes to the regulatory framework based on the concerns that had been expressed. There was a public and targeted stakeholder consultation on these proposed regulatory reforms, which will lead to the publication of draft regulations in Canada Gazette-Part I, for which this CBA is being drafted.

Proposed Regulatory Changes

The objective of the proposed regulations is to reduce the risks to public health, security and safety of Canadians, while significantly improving the way in which individuals access marihuana for medical purposes.

To reduce the risks to public health, security and safety of Canadians, a new supply and distribution system for dried marihuana would be established that relies on commercial

production of marihuana for medical purposes. Security requirements would be in place for the production site and key personnel of the licensed producer. Standards for packaging, transportation and record-keeping would contribute to achieving security objectives.

The process for individuals seeking to access marihuana for medical purposes would no longer require application to Health Canada. Individuals would obtain marihuana, of any strain commercially available, by obtaining the support of a health care practitioner (a physician or, potentially, a nurse practitioner), and subsequently purchasing marihuana from commercial producers that are licensed by Health Canada under the proposed regulations. Quality and sanitation standards appropriate for a product for medical use will be in place. In line with other controlled substances, personal and designated production of marihuana for medical purposes would be phased-out. This would reduce the health and safety risks to individuals and to the public, while allowing for a quality-controlled and more secure product for medical use.

The proposed regulatory changes are intended to treat marihuana, as much as possible, like a regulated pharmaceutical product that contains a controlled substance. As such, the new regulations will eliminate personal-use and designated-person production and replace these sources and the contracted government supply with a commercial market of producers who will be licensed by Health Canada as Licensed Producers (LPs).

The policy anticipates the commercial viability of LP market entrants and a high degree of competition in the marihuana for medical purposes market that should lead to efficient production and prices which are sufficiently competitive so as to lead to continued growth in volumes demanded by dried marihuana users for medical purposes.

The purpose of the CBA is to assess and quantify the social benefits and costs that are likely to arise from the regulatory proposal by inducing behavioural change that alters the level of social net benefits.

A CBA requires that the costs and benefits anticipated under the proposed regulation (the "Policy scenario") be compared with the costs and benefits that would be anticipated if the existing regime were to continue (the "Status Quo" scenario). Under both the "Policy scenario" and the "Status Quo scenario", changes will occur.

2. Stakeholder Profile

There are three primary categories of stakeholder who will be affected by the change in the current marihuana for medical purposes program: Consumers and Households; Industry; and Government.

The first category is Consumers and Households – those people who currently, or who will in the future, use marihuana for medical purposes. In the Status Quo scenario, persons engaged with the Marihuana Medical Access Program (MMAP) numbered 21,986 as of August 13, 2012. This number has increased exponentially over the past ten years and, under both the Status Quo and Policy scenarios, this exponential growth will continue over time.

Among current MMAP participants, there are four categories of supply: those who are licensed to grow their own marihuana for medical purposes (PUPL); those who have designated another individual to grow marihuana for them (DPPL); those who purchase marihuana directly from the Government of Canada; and persons for whom there is an unknown source. Under the

proposed Policy scenario, these distinctions will be eliminated – all categories will be replaced with one unified pool of consumers who are authorized to purchase marihuana for medical purposes from Licensed Producers (see below).

In addition to the consumer base, this analysis also considers the impact of the regulations on the Canadian economy and society as a whole, in terms of understanding of regulations, safety and security, and other indirect impacts of the regulation of marihuana.

The second category of stakeholders is the Industry. In this case, the industry *per se* does not yet exist. However, it is anticipated that Prairie Plant Systems Inc., the company with whom the Government of Canada has contracted for the supply of dried marihuana for medical purposes under the MMAP since 2000, will form part of the industry.

The key stakeholder in this group is the Licensed Producers (LPs). Under the new regime, LPs will be licensed by the Government of Canada to produce dried marihuana for medical purposes. Potential users will receive an indication of support via a medical document from a doctor or eligible nurse practitioner, which must then be sent to the LP, along with an application, and used to purchase marihuana in quantities indicated in the medical document. LPs will be privately owned and operated businesses and will determine what, and how many, strains of marihuana they produce, as well as pricing and other business decisions. They will, however, be subject to stringent security and production requirements that will be a prerequisite to being licensed, and to continuing to operate, as an LP. Competition among LPs, and the benefits that come from a market-oriented regulatory regime that ensures reasonable access to marihuana for medical purposes, without government subsidy, is a foundational principle for the proposed policy option.

The third major stakeholder affected is Government. The Federal government currently manages the MMAP and determines whether individuals can be authorized, under the existing regulations, to access and use marihuana for medical purposes. If the requirements of the regulations are satisfied, the government issues limited-term authorizations to possess (ATPs), well as licenses for personal or designed-person production accordingly. Additionally, for those who do not wish to produce their marihuana themselves or have somebody produce it for them, marihuana can currently be bought from the government directly at a subsidized rate of $5/gram.

Provincial governments have a role in the marihuana for medical purposes regime, primarily due to their relationships regulating health care professionals who are responsible for diagnosing patients and supporting access to marihuana for medical purposes, if they so choose.

Both municipal and provincial governments are implicated in the response to the consequences of potential misuse of marihuana for medical purposes, through law enforcement and public safety activities, focussing primarily on the consequences of abuse and other societal risks arising from the current regime.

3. Literature Review

A literature review and related analysis on performance measurement, indicators, sources and interpretation was conducted to support the work on regulatory design, compliance and performance.

In order to properly frame and collect the data sources cited in this research, the Literature Review was divided into four main categories: marihuana medical impact studies; literature relevant to the crime and public safety impacts of the regulations; studies of ongoing compliance and enforcement of the proposed regulatory regime; and resources relevant to System Dynamics and Systems Thinking, used to generate a model of the new marihuana market proposed by these regulations.

While examinations of the literature regarding security and public safety, regulatory compliance, and System Dynamics theory proved to be reliable and insightful, the key challenge was the marihuana industry itself. The best resources available came from the experiences of the Netherlands and California, whose governments have implemented marihuana production and consumption programs. These resources provide some insight into how a regulated industry might function. Even then, the correlation is not exact, as the proposed new Canadian system differs substantially from anything currently in operation in the world. This proposal is entirely novel, and the Literature Review bore that presumption out.

4. Methodology

Both quantitative and qualitative analytical methods were applied in the cost benefit analysis. The study developed and applied a consistent approach to modelling the Status Quo scenario (existing policy and regulations) and the Policy scenario (proposed policy and regulations). There were four basic components of the quantitative (i.e., quantified and monetized) model for each of the two cases:

- *User benefits and costs*: Costs associated with the production and consumption of marihuana for medical purposes through authorized methods;

- *Program administration costs*: Costs borne by Health Canada in the exercise of authorization, licensing and inspection powers under the regulations;

- *Safety costs*: Costs associated with health and safety consequences of residential marihuana cultivation, which focus on the risk of residential fires from production licenses, especially in cases of misuse and supply of the illegal market; and

- *Security costs*: Costs associated with violence and home invasions directed at residential marihuana cultivation misuse and supply of the illegal market.

The quantitative analysis focused on a "Reference case" which represents the most likely outcome of the regulatory change. Sensitivity analysis of the results was undertaken by identifying key parameters associated with uncertainty/risk, and modelling a likely range and distribution of these parameters whose impact on the results was explored probabilistically using a Monte Carlo method.

The study focused on the consumption of marihuana for medical purposes obtained from a legal source of supply. The broader issue of illicit market supply and use was considered to be outside the scope of the study. The only aspect of criminal activity that is included is the misuse of residential production licenses under the Status Quo scenario and its likely decline in the Policy scenario.

Potential & Likely Numbers of Users

The number of persons using marihuana for medical purposes was modelled dynamically over time based on a word-of-mouth process that was calibrated to the known growth path over the historical period, and then projected over the ten-year forecast period in relation to an upper bound value. In the Status Quo scenario, the program participants are distributed across the legal supply methods using fixed shares derived from historical patterns of use.

For the Policy scenario, a transition was modeled, based on an assumed full implementation date for the new regulations of April 2014. Under this transition scenario, individuals would choose to transition to the new legal supply market at a higher price or to opt-out of the legal market and produce or access illegal supply. This transition process takes into account the continued desire by some persons to continue to supply the illegal market, but with a higher probability of police detection and action as a result of the removal of the legal cover of a production license. An economic model of criminal activity was developed with parameters derived from Canadian experience and a crime prevention behavioural relation was derived from the relevant literature for the US. The resulting elasticity of criminal behaviour relative to the probability of conviction was relatively inelastic. The transition model established new fixed proportions for sub-categories of users of marihuana for medical purposes, proportions that were then applied to the future potential users anticipated under the Policy scenario.

Users who access the LP market under the new regime will face higher prices, which will lead to a reduction in the quantity of legal marihuana consumed and the pricing out of some users. This outcome is based on the price elasticity of demand, which is developed from Canadian experience related to pharmaceutical drug demand and US/international experience related to illegal drug demand. The resulting elasticity of demand relative to price is highly inelastic.

User Benefits and Costs

Marihuana for medical purposes is not an approved therapeutic product. The scientific studies of the safety and efficacy of marihuana for medical (therapeutic) purposes are not conclusive, and have not been assessed by Health Canada for the purposes of authorizing marihuana for therapeutic use under the *Food and Drugs Act and Regulations*. Therefore, this CBA does not make any attempt to measure health benefits in terms of quality-of-life or length-of-life changes. Instead, the study relies on a *consumer-surplus* measure of welfare that can be applied to any product consumed subject to a legal market transaction.

Consumer surplus is a measure of the user benefit that is not captured in the value of the market transaction. As the demand curve represents the marginal willingness-to-pay for consumption, consumer surplus is the integral of marginal willingness-to-pay above the transacted value. This is, for an unsubsidized market, the area under the demand curve and above the price line at the market equilibrium quantity.

For the Status Quo scenario, the cost benefit analysis separately estimated consumer surplus for the government supply, personal use production and designated person production *legal* supply markets. For the Policy scenario, there is a single *legal* commercial supply market. The study did not estimate consumer surplus for any consumption derived from *illegal* supply sources.

To simplify the analysis, this CBA assumed *linear* demand and supply curves. Relevant areas under demand and supply curves are triangles that can be estimated from formulae to estimate the area of associated rectangles. This geometric approach is well established in cost benefit practice.

To derive demand curve parameters (i.e., *intercept* and *slope*) the study used: a) knowledge of a single point (price, quantity) associated with an estimated market transaction; and b) an estimate of the *price elasticity of demand.* With a linear demand curve, an inelastic demand means that the estimated market transaction is closer to the x-axis than to the mid-point of the demand curve. The price intercept point for the demand curve and the slope of the demand curve were then estimated from these two parameters.

Producer surplus is a corresponding measure of the supplier benefit which exceeds that reflected in the value of the market transaction. An upward sloping supply curve means that marginal cost is increasing with production volume and a contribution to fixed costs is available. No producer surplus is derived in the Status Quo scenario, as there is constant marginal cost for the two production license markets (i.e., horizontal supply curves) and the government supply market is effectively subsidized so that the marginal cost is above the user price. Producer surplus is obtained in the unsubsidized commercial market in the Policy scenario.

The government supply market in the Status Quo scenario and the commercial market for the Policy scenario have very flat, but upward-sloping, supply curves. The intercept and slope parameters were estimated for the Status Quo based on observed relationships from contracted prices and were estimated in the Policy scenario using heuristic reasoning.

The presence of an effective subsidy in the government supply market for the Status Quo scenario and the presence of HST in the Policy scenario commercial market suggested that the study also required a consideration of the *deadweight loss.* Deadweight loss measures the welfare loss associated with the misallocation of resources from distortion from the true market equilibrium outcome.

Safety Costs

This study's analysis of safety impacts focused on the risk and consequence of residential fires resulting from faulty electrical wiring, overloading of electrical circuits, tampering with electrical usage monitoring, and other electrical system malfunction arising from indoor marihuana cultivation. The cost benefit analysis assumed that an elevated fire risk was primarily associated with misuse of production licenses to supply the illegal market. The study applied a form of the '80:20' rule-of-thumb. This rule assumes that 80% of the negative consequences of misuse are attributable to 20% of the misuse cases, referred to as "*major* misuse". This rule-of-thumb is observed in some of the literature on the social cost of crime.

This analysis used information from Canadian law enforcement authorities on misuse of production licenses, presence of electrical hazards, and known residential fires as the basis to estimate fire risk. This is embedded in Canadian fire data related to mean property damage, fire injury rates and fire death rates, and estimates of the social cost of (i.e., willingness-to-pay to avoid) injuries and death. Under the Status Quo scenario, safety costs rise in a fixed proportion to the overall numbers of persons authorized to cultivate marihuana under the MMAR, as it is postulated that there are fixed share parameters over time for the proportion of activity that is comprised of production licenses and that involves misuse.

The Policy scenario did not allow for legal residential production, which would be illegal under the new regulations. However, the analysis did not assume that there would be full compliance, as the literature on attribution of crime prevention benefits requires the allowance of crime displacement effects and non-compliance. The analysis estimated a reduction in potential misuse arising from a crime prevention behavioural relationship that relates the elasticity of drug trafficking, possession and production to the probability of conviction. Law enforcement authorities have indicated that, in some cases, the existence of production licenses provides legal cover for criminal activity. They argue that this makes police action less likely, because the reasonable and probable grounds required to obtain a warrant to search a residence would likely not be satisfied by the mere presence of a marihuana grow operation in a residence as some operations are authorized by law under a production license. The new program would address this problem by removing ambiguity regarding the legality of residential marihuana production as there would be no legal grow operation in any place other than a licensed producer's premises. Law enforcement would therefore have increased clarity because the legal status of these operations will not be in doubt in the new program.

Security Costs

This study's analysis of security impacts focused on the risks and consequences of home invasion and violence that are targeted on residential production, and the subsequent potential misuse and criminal activity related to marihuana distribution on the illegal market. Law enforcement authorities refer to this type of robbery and violence as a *grow-rip*.

Information from Canadian law enforcement authorities on misuse of production licenses, home invasions and shootings was used as the basis to estimate the risk of violence. This is embedded in international data related to the social cost of (i.e., willingness-to-pay to avoid) robbery, violence to person and violent death.

As with safety costs, the Status Quo scenario's security costs rose in a fixed proportion to the overall numbers of persons authorized to cultivate marihuana under the MMAR,, as the study postulated fixed share parameters over time for the proportion of activity comprised of production licenses and that involves misuse. The Policy scenario has lower security costs due to the reduction in misuse activity resulting from the deterrence effect.

Program Administration Costs

Health Canada program administration costs include salary, employee benefits and accommodation costs associated with staff levels, operations and maintenance costs associated with travel, training and supplies and corporate overhead and shared service functions which are assigned to program activity. The program activities include licensing, inspections, compliance monitoring and promotion, information and client services/education campaigns aimed at increasing regulated parties' understanding of the regulations.

For the Status Quo scenario, these costs have been documented for several years in relation to the known activity volumes. Empirical relationships were estimated to determine fixed and variable components of these costs so that future projections could be made over the forecast period.

For the Policy scenario, an estimate of certain costs was provided for the initial year of operations at an assumed level of activity. The analysis specified an assumed relationship between fixed and variable components of these costs, ensuring that all of the costs embedded in the status quo were also covered (e.g., corporate cost), so that comparable future projections could be made over the forecast period.

Net Present Value

The net present value is the discounted sum over time of the difference streams of benefits and costs in the policy scenario and benefits and costs in the status quo scenario. Net present value provides one mode of assessment value to weigh the Policy Scenario against the Status Quo.

To explain, the "present value" of the flow of costs or benefits represents the amount of money that, if invested now, would generate that flow over the relevant time period. It is the same as asking, "What amount of money would I need to invest to earn $1M over the next 10 years if the interest rate is 8%?" Or, conversely, "How much would I have to borrow to generate total interest payments of $1M over the next 10 years, if the interest rate is 8%?"

Then, the "net present value" for each scenario is calculated by subtracting the present value of the costs from the present value of the benefits. If the net present value of a scenario is positive (i.e., benefits exceed the costs), the scenario is expected to generate an increase in welfare for society (subject to any qualitative impacts). If the net present value of a scenario is negative (i.e., costs exceed benefits) the scenario is expected to diminish welfare for society, again subject to any qualitative impacts).

Non-Quantified Costs and Benefits

A qualitative assessment was made of various costs and benefits that are not quantified and monetized in the net present value measure, which forms the focus of the CBA.

There are costs associated with physician time needed to fill out supporting documentation for individuals to access marihuana for medical purposes under the MMAR. These are not estimated and are not felt to be significant in relation to consumer surplus. Other safety costs are anticipated from potential exposure to mould, chemicals and poorly ventilated residences where marihuana is cultivated. Other security costs are associated with the presence of children who might be influenced adversely by exposure to criminal activity associated with misuse of production licenses. These costs were not quantified as there was insufficient evidence on which to base such estimates and they were felt to be smaller in magnitude than the costs and benefits that were estimated. The qualitative assessment is provided in section 5.5.

5. Results of Quantitative Estimation

The Reference case, representing the most likely outcome of the cost benefit model, was the focus of the quantified results for the net present value over a ten year forecast period from

FY2014-15 to FY 2023-24. The net present value was calculated to be -$109.7 Million with an annualized value of -$16.35 Million.

BENEFITS

Reduction in Residential Fire Risks

The focus on safety impacts was on the risk and consequences of residential fires resulting from faulty electrical wiring, overloading of electrical circuits, tampering with electrical usage monitoring and other electrical system malfunction arising from indoor marihuana cultivation. The analysis assumed that under the proposed policy, the risks of property damage, personal injury or death resulting from marihuana production-related fires would be significantly reduced but not completely eliminated. Over the period from 2014-24, the social costs of adverse safety events related to marihuana for medical purposes production was estimated to be reduced by about 40% under the proposed regulations, at a present value of $64.32 Million. This represents annualized savings (avoided costs of property damage, injury and death from residential fires) of approximately $9.58 Million per year for 10 years.

Reduction in Risk of Break-Ins/ Home Invasion

The focus of the security impacts was on the risk and consequences of home invasion, violence targeting residential production involved in misuse, and criminal activity related to marihuana distribution on the illegal market. Information from Canadian law enforcement authorities on misuse of production licences, home invasions and shootings was used as the basis to estimate the risk of violence. Overall, the analysis valued the projected reduction in the risks of break-ins/home invasions due to the proposed policy at $0.38 Million in 2014, rising to $26.48 Million in 2024. The present value of security cost savings under the proposed policy was estimated at approximately $89.03 Million over the policy impact period, with an average annualized value of $13.27 Million. The proposed policy would have lower security costs (over 40% lower than under the status quo) due to the reduction in misuse activity that results from the expectation that eliminating personal and designated production in favour of a commercial licensing scheme would deter individuals interested in exploiting the Program.

Program Administration Costs Savings

Under the current Program, Government administration costs have increased significantly as the number of Program participants has grown. In the absence of the proposed regulatory changes, the analysis assumed a continuation of the growth in Program applications and corresponding substantial increases in the cost to Health Canada to authorize legal possession and license production of marihuana for medical purposes. The CBA estimated that the administration cost of the current Program would increase from $20.63 Million in 2014 to over $120M in 2024 in the absence of any changes. These costs include salary, employee benefits and accommodation costs associated with dedicated staff, operations and maintenance costs, training, supplies and other corporate overhead costs.

Under the proposed Policy scenario, Health Canada would eliminate the role it plays in determining eligibility of persons to access a legal supply of marihuana for medical purposes, and return to its traditional role as a regulator of industry. This results in significant administrative cost savings over the policy impact period. Under the Policy scenario assumed for the new regulated market, the regulatory proposal was estimated to lead to more than a 90% reduction in Health Canada's administrative expenditures. The present value of administration

costs savings over 10 years was estimated at $478 Million. On average, the proposed regulations would generate administrative cost savings of approximately $71.24 Million per year over this period.

Producer Surplus Gains

The proposed regulations would establish a regulated commercial market for the production and sale of marihuana for medical purposes. Private industry participation in the proposed regime is expected to yield benefits to society. Under the status quo, marihuana is either produced through private arrangements or at a cost to the tax-payer. There are no benefits to society at large beyond the benefits to the individuals involved. Under the proposed regulations, there would be beneficial impacts for the industry, over and above the benefits to the individuals involved in the market. The analysis measured this change in welfare by estimating a change in producer surplus gains under the proposed policy. No producer surplus is derived in the status quo. The CBA found that the new regulated market would generate an overall producer surplus of $2.64 Million in the first year of implementation 2014, rising to about $110 Million in 2024 as the market expanded. The present value of producer surplus gains over the policy horizon (2014-2023) was estimated at $339.85 Million or about $50.65 Million (annualized average) per year for 10 years.

Reduction in Deadweight Loss

The CBA estimated the deadweight loss under the current marihuana access regime from the effective subsidy to supply that resulted in excess demand relative to what a market equilibrium quantity would be. The value of this economic efficiency loss was relatively small as the Government supply component in the CBA model was comparatively small. Under the proposed regulations, the analysis assumes the imposition and payment of the regular consumption tax (HST) by consumers of marihuana under the proposed framework. Both the presence of an effective subsidy in the government supply market for the status quo and the assumed, potential imposition of tax on purchases in the commercial market were projected to cause welfare losses to society by distorting market signals and causing sub-optimal allocation of scarce resources.

The economic efficiency loss under the status quo was estimated to be reduced by about $1.51 Million during the first year of implementation (2014), rising to about $7.70 Million in 2024. This represents an average annualized reduction of about $5.03 Million or a total present value of approximately $33.74 Million over 10 years. Overall, the reduction in deadweight loss is small and not a significant benefit of the regulatory change.

In total, the *present value of benefits* of the proposed regulations was estimated to be $1.005 Billion from 2014-2024. On average, this represents an annualized savings of approximately $149.77 Million each year for 10 years.

COSTS

The CBA projected the negative impacts of the proposed policy on social welfare on the basis of a change in the welfare of the individuals most directly affected by the regulatory change. Because the available scientific evidence does not conclusively support use of dried marihuana for therapeutic purposes, the causal relationships between the use of the substance and purported medical benefits are inconclusive. Thus, the analysis chose to measure the change in individual welfare under the policy directly by estimating the change in users' consumer surplus.

Economic theory does not require the existence of scientifically proven medical benefit in order to measure the welfare implications of a public policy change. The observation that some in society are willing to pay to obtain marihuana for medical reasons was deemed as a sufficient basis for measuring a change in consumer welfare.

Loss of Consumer Surplus

Consumer surplus was estimated as the area under the demand curve and above the price consumers would potentially pay for marihuana under the proposed MMPR. Under the proposed policy, the analysis projected a reduction in the number of legal marihuana users vis-à-vis the Status Quo, and a reduction in the quantity consumed due to a potential increase in the price of marihuana in the regulated market. Under this scenario, the CBA predicted a significant loss of consumer surplus from this policy change. The analysis assumes a price change from about $7.60 per gram to about $8.80 per gram over the 10 year period. This assumption reflects the potentially higher cost of producing marihuana in the new commercial market, compared to personal or designated production under the current MMAP. The higher price also reflects the potentially higher product quality due to quality control measures to limit contaminants and toxic substances and to ensure a product of consistent quality over time. The analysis assumes that this projected price change would lead to a decrease in the relative number of legal users by about 30% over the next 10 years compared to the Status Quo scenario. The total quantity of marihuana consumed was also estimated to decrease. On average, the loss in consumer surplus (representing the total social costs of the proposed regulations) was estimated to be about -$166 Million per year. The present value over 10 years was estimated to be about $1.115 Billion. (The study did not estimate consumer surplus for any consumption derived from illicit supply sources).

Business Compliance Costs

Business compliance costs were estimated as 10% of overall supply cost. On this basis, business compliance costs were estimated to be about double under the proposed Policy scenario. As business compliance costs are incorporated in the supply cost for both the Status Quo and Policy scenarios, they do not form part of the CBA. The business compliance costs mostly fall on medium and large business (as opposed to smaller businesses), as the scale of licensed producer activity (in terms of employees and sales revenue) is expected to grow beyond that of a small business after two years.

NET BENEFITS

The scenario representing the most likely outcome of the cost benefit model was the focus of the quantified results for estimating the present value of the net benefits of the regulatory proposal. The estimated Net Present Value (NPV) was -$109.7 Million with an annualized value of -$16.35 Million. This represents an overall net loss to society due solely to a reduction in consumer surplus.

This loss in consumer surplus results from reduced relative growth in consumption and a higher supply price, due mostly to the shift from less-costly home production to a commercial market with appropriate regulatory controls and oversight.

The Status Quo scenario was modeled on the assumption that Government resources required to administer the current Program would continue to grow over time to fully accommodate the

required Program uptake, in terms of numbers of persons wanting to access a legal source of marihuana for medical purposes. The Program administration cost was projected to increase from $13.8 Million (FY2013-14) to over $120 Million (FY2023-24). In reality, it is highly unlikely that such additional resources would be available to accommodate the forecast increase in Program participation in an era of fiscal restraint.

Results by Stakeholder

Government, especially the federal government, is the main beneficiary of regulatory change, through the reduction in Health Canada program administration costs.

Industry, especially medium-sized business, is also a beneficiary in terms of producer surplus benefits and the expansion of a legal marihuana supply industry that could grow to more than $1.3 Billion per year in annual sales by the end of the forecast period. It is important to note that producer surplus is not related to profitability and should not be taken as such an indicator.

Households, especially users of legal marihuana, are the stakeholder that is most impacted by the reduction in consumer surplus. The general public, in contrast, benefits slightly in terms of reduced deadweight loss and the reduced safety costs, which would be borne through residential insurance. The general public would be a major beneficiary if the government benefits were attributed to them as ultimate taxpayers.

Results by Region

Several regions have negative overall impacts, as these are dominated by the consumer surplus reduction, which is allocated based on MMAP participation. The two regions with disproportionate shares of MMAP participation (relative to population) are British Columbia and Atlantic (primarily Nova Scotia). Some regions are shown to have positive overall impacts as the locus of government activity is in Ontario (where there are savings from lower administrative costs) and the locus of the existing marihuana production activity is in the Prairie region.

Sensitivity Analysis

A full assessment of the sensitivity of the net present value result to all key parameters was undertaken using Monte Carlo probabilistic methods. The results showed that there was substantial variability in the estimate (a range of -$26 Billion to +10 Billion, with a mean of -$1,688 Million).

The sensitivity analysis highlighted an inherent uncertainty regarding various impacts of the proposed regulatory change. These uncertainties reflect regulatory risk and arise due to:

1) the rapid growth in the number of persons wishing to access legal marihuana for medical purposes;
2) the fundamental change that elimination of individual production licenses will bring about;
3) the complex dynamic behaviour that arises from: a) price elasticity effects (for non-trivial effective price change); b) deterrence effects related to criminal misuse of production licenses; and c) the market entry and price-setting mechanics and dynamics involved in the establishment of a totally new industry and market; and

4) the inherently unknown outcome for the end state in FY2023-24.

There are plausible parameter values that would give rise to a very large negative net present value as well as those that would give rise to a very large positive value. The parameters with the biggest impact on the quantitative result influence the valuation of the consumer surplus (the supply costs for personal use and designated person supply and the price elasticity of demand in the status quo). The other parameters with large impacts are an affordability parameter relative to mean annual income which limits the quantity of legal marihuana consumed in the policy scenario with higher supply price; and parameters which estimate the volume of marihuana consumed in the status quo.

Qualitative Discussion

The qualitative discussion uses the major findings from the Literature Review, Stakeholder Consultations and other sources to describe some of the additional benefits, costs and risks of the regulatory change that may be important over the longer term, but cannot be quantified and monetized at this time because of data constraints and the unique attributes of the policy scenario.

Major attention is given to:

(i) additional safety and security issues, impacts and possible benefits;

(ii) reductions in information, administration and other transaction costs for users, the medical community and other stakeholders;

(iii) the possible longer-term benefits from the full establishment of a large, competitive and innovative industry for users of marihuana for medical purposes, the economy and Canadian society; and

(iv) the longer term possibility that a fully functioning and reasonably competitive, efficient and innovative legal market will promote the process of "reverse diversion", whereby the legal market expands at the expense of the illicit drug market.

These qualitative benefits could be substantial over the longer term, but they are highly contingent on a number of economic, social and regulatory factors and would likely become measurable and substantive only near the end of, or after, the ten-year projection period for the quantified CBA.

Another important qualifier to the quantitative results relates to the ability of Health Canada's ability, under the Status Quo scenario, to facilitate the expansion of the MMAP to the level forecasted over the ten-year horizon. This study modelled the Status Quo scenario 'as if' Health Canada has the necessary resources to permit the MMAP to expand and fully accommodate the required program uptake in terms of numbers of persons wanting to access a legal source of marihuana for medical purposes. However, the Government of Canada is facing fiscal restraint and it is highly unlikely that such additional resources would be available (over time) to accommodate the forecast increase in the MMAP in the Status Quo scenario.

Therefore, the achievement of the Status Quo scenario benefits, in terms of consumer surplus, is at considerable risk of not being realized. Rather than imposing a specific government resource constraint, this study shows the status quo being realized in terms of ATP growth and growing program administration costs (and contract costs), even though it is acknowledged that such growth might well not be realized in reality due to fiscal restraint.

This qualification to the achievement of the status quo results is very important when the overall NPV result is examined. This study compares a Policy scenario – whose rationale is partially based on the requirement to reduce administrative costs – to a Status Quo scenario in which it is assumed that sufficient resources are made available, even though there is substantial risk that this would not be realized in reality.

6. Conclusions

There is no Pareto efficient result that supports a statement that one option is superior. The Reference case (Policy scenario) results indicates that the sum of benefit and cost changes across all stakeholders is *slightly* negative. It can be characterized as being only slightly negative because the sensitivity analysis of the result shows a wide range of possible outcomes with a central tendency near zero.

One class of stakeholder bears the cost (in terms of a reduction of benefits) from consumer surplus (see below) - namely the users of marihuana for medical purposes. The remaining stakeholders (e.g., the general public, government, commercial producers) are made better off.

These results are qualified in the analysis by highlighting some of the methodological challenges facing the discipline of cost benefit analysis in such a rapidly growing context involving fundamental change and complex dynamic behavioural responses.

Economists measure user benefit in terms of consumer surplus. The available scientific evidence does not support the acceptance of marihuana use for medical therapeutic use. However, Canadian courts have ruled that individuals have a legal right to possess marihuana for medical purposes and that the Government of Canada has a legal duty to provide reasonable access to marihuana for such purposes. The consumer surplus measure is not evidence, in any fashion, of the existence of medical benefits attributed to the consumption of marihuana for medical purposes. Therefore, the significant consumer surplus over the forecast time period that is reduced by the proposed regulatory change (due to lower consumption levels and higher supply price) may arguably be discounted by policy makers.

This analysis has monetized and quantified the benefits to be gained from reducing risks to public health and safety, to the extent possible, and these benefits are significant in number and value. The Reference case does not show these to outweigh the loss in consumer surplus. It may be that the ability of economists to apply a social valuation to these impacts may not adequately reflect a social valuation of the maintenance of public health and safety.

In addition, it is possible that there will be substantial benefits that can only be assessed qualitatively at this time. These include greater reduction in safety and security risks, reduced costs for consumers, and the benefits of establishing a competitive and innovative legal industry of marihuana for medical purposes.

CHAPTER ONE

1. Overview – Access to Marihuana for Medical Purposes

Access to marihuana for medical purposes in Canada is governed under the *Marihuana Medical Access Regulations* (MMAR) pursuant to the *Controlled Drug and Substances Act* (CDSA).

The current MMAR came into effect in 2001. They provide a process for Canadians to legally obtain access to marihuana for medical purposes. Currently, persons with an Authorization to Possess (ATP) may obtain marihuana from one of three legal sources:

1. Under a Personal Use Production License (PUPL) to produce for themselves;
2. Under a Designated Person Production License (DPPL), where another designated individual can produce for them; or
3. Through purchase of dried marihuana directly from Health Canada (HC) through a Government Supplier.

The Marihuana Medical Access Program (MMAP), which administers the MMAR, has grown at an exponential rate from 2003 to 2012. With this growth, a number of concerns have been identified. These include:

- Escalating cost under the contract with the government supplier;
- Increasing administrative burden/cost of managing the MMAP under Health Canada;
- Negative impacts on communities and law enforcement where personal and designated production occurs; and
- Concerns from the medical community that they do not have sufficient information about marihuana for medical purposes to allow them to appropriately discuss risks and benefits with their patients.

A review of the MMAP was undertaken by Health Canada during 2010-11, which gave rise to a significant public consultation process and subsequent proposed regulatory changes.

1.1 Government Objectives

The Minister of Health committed to a review and reform process for the MMAP with four pillars:

1. Protection of public health,
2. Safety and security;
3. Provision of reasonable access to marihuana for medical purposes; and
4. Examination of the overall costs to the Government of Canada.

1.2 Access to Marihuana for Medical Purposes

Authorization to possess marihuana for medical purposes requires application by an individual to Health Canada. The individual must obtain physician support for their access. Unlike medical therapies and drugs that are authorized by Health Canada – after scientific review of clinical studies which have demonstrated clinical efficacy and safety– dried marihuana for medical purposes has not been authorized as a legitimate medical therapy. This has complicated government policy, especially after Canadian courts ruled that the Government of Canada has a responsibility to ensure reasonable access to a legal source of marihuana for individual use for medical purposes.

In response to Canadian court rulings, the MMAR provide a structure that allows Canadians to access a legal supply of marihuana for medical purposes. Two categories of patient symptoms are recognized:

> Category 1: individuals who suffer various symptoms (related to Multiple Sclerosis, severe arthritis, cancer, epilepsy, HIV/AIDS, spinal cord injury/disease or for compassionate (end-of-life) care).
>
> Category 1 individuals must have a physician signature in support of the application for Authorization to Possess; and
>
> Category 2: individuals who suffer any other symptoms for which conventional treatments have been deemed inappropriate.
>
> Category 2 individuals must have a physician signature in support of the application for Authorization to possess and an assessment by a specialist in an area relevant to the treatment of the individual's medical condition (unless the physician is such a specialist).

Once an individual has applied and been approved for an Authorization to Possess, they can:

1. Apply to access the Government Supply of dried marihuana. This is provided through a firm contracted by the government, Prairie Plant Systems (PPS), with deliveries made directly to a residence using regular courier service;

2. Apply for a 'Personal-Use Production License' (PUPL), with seeds for cultivation that are available from PPS; or

3. Designate someone else to produce on their behalf under a 'Designated-Person Production License' (DPPL) with seeds for cultivation available from PPS.

Historically, persons with an Authorization to Possess dried marihuana under the MMAR have been comprised of:

- 60% who access a legal supply through personal production;

- 20% who access a legal supply through designated production;

- 10% who purchase dried marihuana from Health Canada; and
- 10% for whom there is an unaccounted supply.

1.3 Government Supply Contract

Since 2000, the Government of Canada has contracted for the supply of marihuana for medical purposes with Prairie Plant Systems Inc. (PPS). Initially, this arrangement was established to support research on the risks and benefits associated with the use of marihuana for medical purposes.

Persons who rely on the Government Supply pay a flat fee of $5.00 per gram, with no additional shipping cost. The supply cost for the Government Supply is around $11.00 to $12.00 per gram. As a result, there is an effective subsidy to the user of more than 50% of the product cost (including shipping charge). This price structure was introduced in 2003 and was based on an estimated number of 300 individuals participating per year. About 2,300 persons are expected to rely on the Government Supply during FY2012-13.

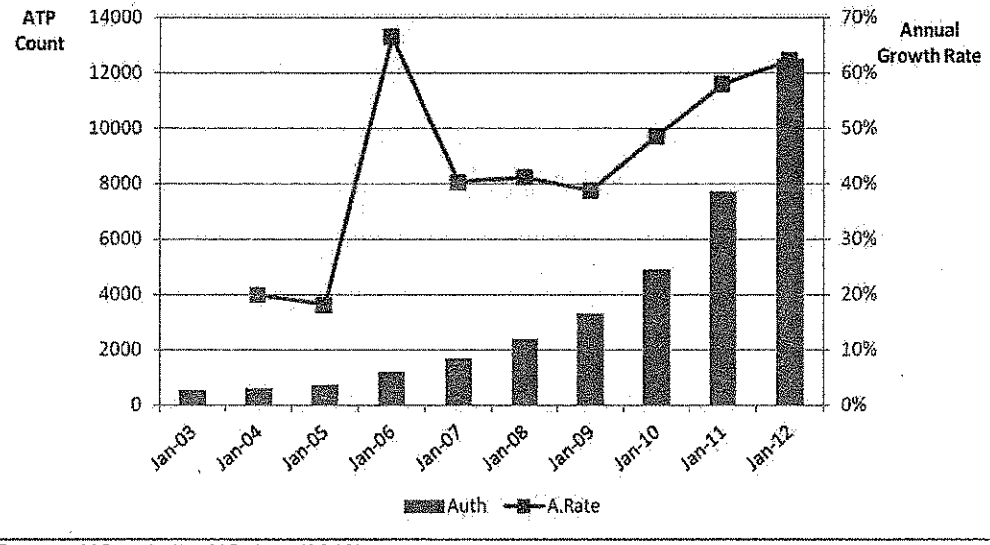
In 2003, the Government Supply contract was expanded to meet Court-imposed requirements, under the Canadian Constitution, to provide reasonable access to a legal source of marihuana for medical purposes to approved users. The existing contract was amended to cover the period to October 2008. The contract was then re-awarded to cover the period to October 2011. A competitive RFP process was undertaken during 2009-10 in which PPS was the successful bidder to provide the government marihuana supply through to March 2014 (including an option year).

The current (2010) contract involved an estimated contract price (over 3 fiscal years) of $16.8M with an option to extend to the 2013-14 fiscal year.

1.4 MMAP Activity Volumes

As of August 13, 2012, there were 21,986 persons with Authorizations to Possess. The exponential growth of MMAP over time is shown in Figure 1.1, which documents a nine year cumulative growth rate of 43%.

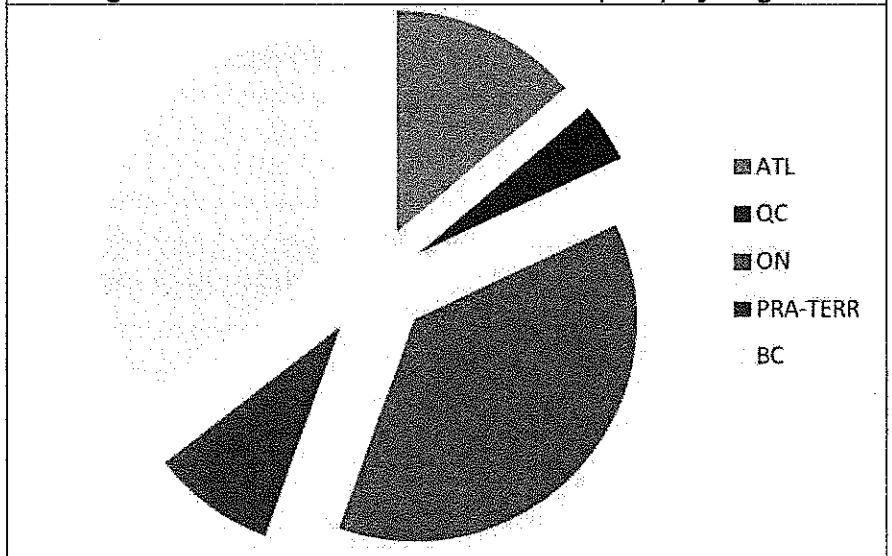
Figure 1.1 – Growth of MMAP (Persons with AP)



Source: HC website, HC data (2012)

Figure 1.2 shows Authorizations to Possess by region. Certain provinces have shares of MMAP participation that exceed their population shares, most notably British Columbia and Nova Scotia. The share of MMAP participation for Quebec is disproportionately lower than its population share.

Figure 1.2 – Authorizations to Possess (ATP) By Region



Source: HC Special Tabulations (2012)

In 85% of recent ATP applications, there was a single reported disease condition, while in 15% of cases there were two or more disease conditions reported.

The majority (72%) of ATP applications involved Category 1 medical conditions (i.e., severe arthritis, spinal cord injury, spinal cord disease, multiple sclerosis, cancer, AIDS/HIV, epilepsy or

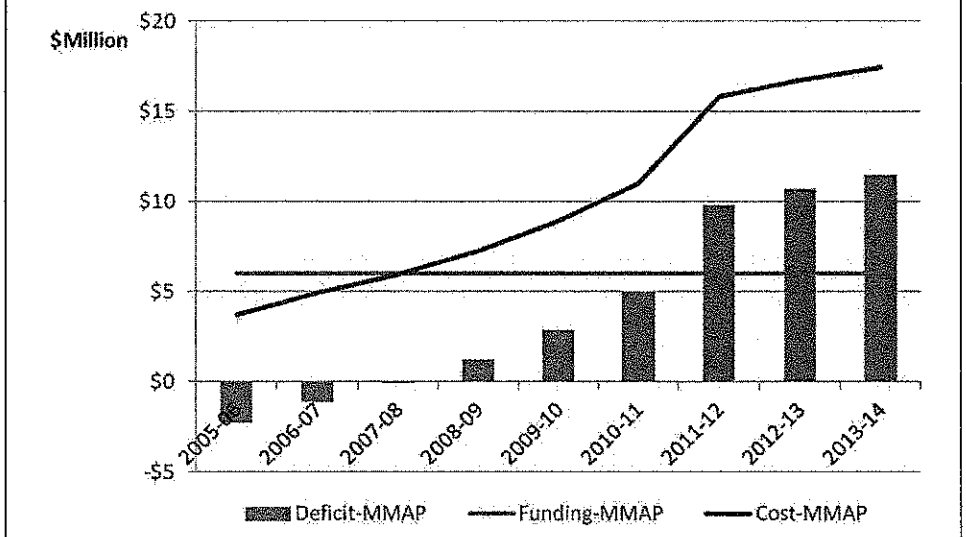
others) while a minority (28%) involved Category 2 diseases for which a specialist (in addition to a General Practitioner) had to support the application. The Category 2 medical conditions included: chronic pain, Crohn's Disease and Hepatitis B and C.

1.5 MMAP Program Costs

Since FY2005-06, the MMAP has been resourced at an 'A-base' funding level of $6.0M per year. Against this, program costs (comprised of HC salary, O&M and corporate costs for program administration and the contract costs for the government suppler) have risen sharply in response to the exponential increase in the number of ATP-persons. This is shown in Figure 1.3, which shows program costs of $8.9M (FY2009-10) with forecast growth to $17.5M (FY2013-14). Roughly half of MMAP program costs relate to HC program administration; the other half relate to the contract costs of the legal marihuana supply.

The expected program deficit would increase from $2.9M (FY2009-10) to $11.5M (FY2013-14) and continue to grow over time. In the current fiscal restraint environment this is a major challenge.

Figure 1.3 – Forecast Growth of MMAP Costs ($Million)



Source: HC Supplemental Funding Request (2010)

1.6 Concerns with MMAP

Residential marihuana cultivation, which is legal under PUPL and DPPL production licenses, is the primary concern related to safety and security.

Canadian law enforcement authorities have documented alleged cases of misuse of marihuana production licenses relating to diversion of product to the illicit market. Some 190 cases of alleged criminal misuse were reviewed over the period from 2003 to 2010. Some of these involved the presence of a weapon (8% of misuse cases), violent attacks and home invasion (8%) and shootings (1%). About half of the misuse incidents involved persons holding production licenses who had previous criminal records.

It may be more onerous for law enforcement to obtain an entry warrant at a residence that is a licenced production site (PUPL or DPPL) where it is believed that marihuana is being diverted to the illegal market, as the existence of this legal operation cannot likely on its own constitute reasonable and probable grounds that an offence has been committed. This means that evidence over and above the mere existence of a residential grow operation must be obtained through investigation, intelligence gathering, tips received, the presence of unusually high electrical consumption, etc., in order for police to have the requisite reasonable and probably grounds on which to obtain a search warrant for a MMAP grow operation. This need for evidence beyond the existence of a residential grow operation is referred to in this analysis as the need for additional evidence. As stated earlier, it follows that law enforcement, under the new program, may be able to obtain search warrants with only evidence of a residential grow operation, as all residential grow operations will be illegal.

Law enforcement authorities believe that current production levels can generate much higher yields per marihuana plant than what is estimated by Health Canada for the purpose of determining the 'maximum number of plants' permitted to be grown to generate a reasonable legal supply for medical use. Their concern is that persons have the opportunity to grow well in excess of their authorized daily amount for medical use and also supply to the illicit market from their excess supply (even if they are within the approved limit of marihuana plants).

Health Canada has limited inspection resources to ensure compliance with the conditions of production licenses in residences and cannot enter a residence without the homeowner's consent in the absence of a warrant. In 2010, Health Canada carried out special inspection of 75 MMAP production license sites. Of the 27 sites for which a person answered the door, only 55% allowed inspection of the residence and 45% refused the inspection.

Residential marihuana cultivation (usually indoor hydroponic) gives rise to various safety concerns. There is an increased risk of fire associated with 'jerry-rigged' modifications to home electrical systems by unqualified individuals. It is recognized that marihuana grow-ops have a much higher risk of residential fire than a normal residence. The review based on Canadian law enforcement information of MMAP misuse identified an electrical hazard in 12% of cases and there were 2 cases (1%) where residential fires had occurred.

In addition to fire risk, the presence of high humidity (from poor ventilation of indoor cultivation) can lead to mould build-up that is associated with an increased prevalence of asthma-related symptoms such as chronic wheezing, irritation symptoms, and non-specific symptoms. There is also potential exposure to chemical contamination from pesticides and fertilizers.

There is also broader social concern with the exposure of children to marihuana through home-based marihuana cultivation. The presence of marihuana at home increases potential drug access, exposure to potential illegal activities, criminal association and possible home invasion. The police noted that children were present in 15 of the alleged misuse cases (8% exposure rate).

These concerns are addressed, where possible (given available empirical literature and empirical data), in the methodology section of this report.

1.7 Regulatory Proposal

Under the proposed regulatory changes:

- Physicians and nurse practitioners will provide the patient with a medical document which will then authorize the patient to order marihuana from a Licensed Producer (LP). The patient will then register to become a client of the LP and the LP will verify the information provided by the patient. Health Canada will play no direct role in this process;

- Residential marihuana cultivation will no longer be legal;

- Legal marihuana supply will be restricted to producers who apply to be licensed for this purpose by Health Canada as a LP;

- Patients will register and order marihuana directly from an LP by phone, fax, mail or on-line and be required to provide proof of physician/health care provider documentation in support of their registration;

- The LP will determine whether: a) the physician/nurse practitioner documentation is genuine; b) the physician/nurse practitioner documentation has not been tampered with; and c) the physician/nurse practitioner is in good standing with an appropriate professional licensing authority;

- The LP will ship marihuana directly to their registered client, or to a physician/nurse practitioner, pharmacist or hospital;

- The LP 'product label' will act as necessary legal proof of authorization of possession of marihuana for medical purposes;

- Health Canada will manage the licensing, auditing and inspecting of LPs;

- The LP is the commercial entity that will supply dried marihuana to meet the authorized demand for the use of marihuana for medical purposes, subject to commercial viability; and

- The commercial market will determine the price of supply/demand of marihuana for medical purposes in an unregulated manner.

The proposed changes anticipate the commercial viability of LP entrants and a high degree of competition in the legal marihuana market, which should lead to efficient production and prices that are sufficiently competitive so as to lead to continued growth in volumes demanded by legal marihuana users for medical purposes.

1.8 Potential Benefits of the Regulatory Proposal

Under the proposed changes, the regulations will no longer specify the disease conditions for which marihuana may be authorized by physicians or other authorized health care providers. In addition, Health Canada will no longer be involved in:

- subsidizing marihuana for medical purposes; and

- managing the authorization process to access a legal marihuana supply and having access to confidential personal medical information.

Law enforcement will no longer be unsure about:

- whether marihuana cultivation is permitted in a residence (as all such production will be illegal).

Fire/emergency services and municipal authorities will no longer be unsure about:

- whether a residence may pose a safety threat as a result of legal marihuana cultivation with potential fire/electrical hazard, toxic chemical hazard and mould hazard.

The purpose of the subsequent sections in this report is to present the results of the cost benefit analysis conducted to assess and quantify the social benefits and costs that are likely to arise from the regulatory proposal, by inducing behavioural change that alters the level of net social benefits.

CHAPTER TWO

2. Stakeholder Summary

Stakeholder Profiles

This section presents a portrait of various agents and actors in society who are likely to be affected by the proposed regulatory changes governing access to marihuana for medical purposes. In general, stakeholders affected by the public policy change fall into three broad categories: a) households or consumers; b) businesses or industry; and c) governments. The proposed marihuana medical access regulatory reform is expected to impact individuals and institutions in all three categories.

A. CONSUMERS & HOUSEHOLDS

1. Current and Future Users of Marihuana for Medical Purposes

The first category of consumer stakeholder includes those persons currently engaged with the Marihuana Medical Access Program (MMAP). These are individual Canadians who have successfully applied to legally use marihuana in response to a particular medical condition. There were 21,986 such persons as of August 13, 2012. It is important to note, however, that the number of participants in the MMAP has grown exponentially over the past ten years, with 40% year-on-year growth from 2003 to 2010, and then 60% from 2010 to 2011. This dramatic growth is crucial to understanding the needs of both the Status Quo and the Policy scenarios, as this is a consumer base that is rapidly expanding.

Of the current MMAP participants, there are four categories of supply source:

a) those who are licensed to grow their own marihuana for medical purposes (Personal Use Production License or PUPL);

b) those who have designated another individual to grow marihuana for them (Designated Person Production License, or DPPL);

c) those who purchase marihuana directly from the Government of Canada supply; and

d) those whose source of supply is unknown.

Individuals in these four categories constitute the foundation of the legal demand for marihuana for medical purposes in Canada. This is distinct from the overall demand for marihuana, which includes the illegal use of the marihuana for recreational purposes, as well as unauthorized use of marihuana for medical purposes, both of which are beyond the scope of the regulations and this study.

Under the MMAP, the two provinces with the heaviest usage of marihuana for medical purposes per capita are British Columbia (6.7% of MMAP participants are in BC), and Nova Scotia (5.6%).

The MMAR allow access to marihuana for medical purposes for persons with the following conditions: Multiple Sclerosis; Spinal Cord Injury; Spinal Cord Disease; Cancer; AIDS/HIV Infection; Severe Arthritis; Epilepsy; and End of Life (Category 1). There is also a category for conditions beyond the contemplated scope, where access to marihuana for medical purposes requires support from a medical specialist (Category 2).

Under the proposed regulations (Policy scenario), the current MMAP participants will become the core customer base for the new LPs. They will drive most of the demand for the LPs' products.

The proposed regulations would eliminate the PUPL and DPPL designations. As a result, all Canadians who legally use marihuana for medical purposes would be required to obtain their marihuana from LPs (and, possibly from pharmacists, physicians or nurse practitioners who could also be authorized to stock and sell it). The new regime would eliminate the specification of medical condition categories that are eligible for access to marihuana for medical purposes, which could potentially expand the number of legal users.

A successful policy regime would have the capacity to reach new users who are price- and risk-sensitive, and who might be involved in the illegal marihuana market as they seek relief for their symptoms. These persons might have found the current MMAR program to be difficult to deal with.

New program participants might be attracted away from the illegal market to the new regime through a combination of:

a) prices that are lower than those prevailing in the illegal market;

b) a product of higher quality;

c) a product with higher assurance of availability from LPs under legal and normal business conditions;

d) removal of legal threats and/or social stigma related to marihuana use; and

e) belief that marihuana could be used by patients with a wider variety of symptoms.

It is estimated currently that there are roughly 450,000 marihuana users in Canada who report using marihuana for medical purposes. These persons could potentially make a strong market base for LPs[1].

2. General Canadian Population

A change to the MMAR will also have an impact on the general population of Canada – i.e., persons who do not use or purchase marihuana for medical purposes. Despite not being active participants (or consumers) of marihuana for medical purposes, the general population is nevertheless affected by marihuana production and consumption in two important respects.

Firstly, there is extensive evidence (elaborated further in the Literature Review and other sections of this report) that residential production of marihuana raises public safety concerns. These include increased risk of fire, exposure to toxic chemicals and mould, and potential

[1] The Canadian Alcohol and Drug Use Monitoring Survey (CADUMS) for 2011, administered by Statistics Canada for Health Canada, identified that 1.6% of Canadian adults (aged over 15 years and over) reported using marihuana in the past year for medical purposes. This study uses an upper ceiling of 450,000 users.

ground water contamination from improper waste disposal. Secondly, residential production of a controlled substance tends to produce adverse public security issues – increased risk of burglary, home invasion, criminals convening in areas where they believe marihuana is being grown, and potential violence against individuals who are carrying marihuana.

The MMAR impact on the general Canadian population, largely due to the misuse of PUPLs and DPPLs as *de facto* "grow ops" under the legal cover of a MMAR production license. In the Policy scenario, all non-LP production of marihuana becomes illegal by definition, making any non-LP "grow ops" illegal and, therefore, no longer an unintentional by-product of the MMAR.

B. INDUSTRY, BUSINESS & MEDICAL SERVICES

3. Physicians/Medical Community

There are 69,700 licensed physicians in Canada (2011 Census), which is a ratio of 203 physicians per 100,000 Canadians. This number is divided between 35,350 family medicine practitioners, and 34,350 specialist physicians. Under both the existing MMAR and the proposed Policy scenarios, physicians play a key role in supporting an individual's access to marihuana for medical purposes. As with the treatment of all symptoms and conditions, they are responsible for assessing and evaluating their patients' medical needs to determine the most appropriate and effective treatment.

Under the MMAR, the paperwork required to support the patient's application for authorization to access marihuana for medical purposes has been characterized by physicians as onerous. If the patient's medical condition is not covered under the nine recognized conditions listed (i.e., Category 1), the MMAR require patients to seek advice from a specialist to support the patient's application as appropriate in light of their symptoms and overall treatment plan.

Physician willingness to support the use of marihuana for medical purposes varies considerably from province to province, with British Columbia and Nova Scotia having the highest rate of support. Under the MMAR, physicians bear a time cost to support program administration in filling out the necessary paperwork to support patient authorization for the use of marihuana for medical purposes.

Under the proposed Policy scenario, the need to recommend a specialist will be eliminated, as there is no category of allowable conditions. Furthermore, the document required to be completed by physicians is anticipated to be much less complex and time-consuming to complete.

In addition to physicians, it is anticipated that other health care practitioners (e.g., nurse practitioners) will also be able to support the access to marihuana for medical purposes, if authorized by their provincial regulatory authorities.

Health Canada will no longer play a role in authorizing user access to the regime, although it will continue to support health care providers through the support and review of scientific investigation of the health effects of using marihuana for medical purposes.

the approved production volume associated with a specific facility). However, they will not be able to operate "storefront" sales locations, and their marketing and promotional activities will be limited as a result of marihuana's status as a controlled substance. All marihuana will be distributed in dried form. All LPs must provide standardized packaging and labelling for their product, and ensure its safe and secure distribution (with signatures required at all transition points during delivery).

LP start-up costs will be significant in the short term, as they are required to obtain a license, to establish a secure indoor growing area, to provide sufficient manpower and infrastructure to grow crops, to prepare operations for mandatory inspections by Government of Canada and to provide regular reporting to the Health Canada's Office of Controlled Substances (OCS). LPs will pay for their supply of seeds, production supplies (e.g., water, electricity, equipment, packaging materials, etc.) and provision of a secure delivery system.

LPs will benefit from the opportunity to participate in the new industry of providing legal marihuana for medical purposes directly to eligible consumers. They will be free to compete within the bounds of the regulations and grow their client base. Projecting the size, number, productive capacity and viability of LP is the crux of the Policy case and is a matter of particular focus in the analysis.

C. GOVERNMENTS

6. Municipal Governments

There are 5,600 municipalities in Canada of varying sizes and socio-demographic composition. These municipal governments will be impacted by the proposed regulations in two key respects. First, they currently shoulder the burden of the majority of the public safety and security costs identified above (e.g., fires, burglary) as the responsible agencies (e.g. fire department, police service) are generally funded municipally. Under the current MMAR, municipal governments have consistently highlighted the dangers of residential production of marihuana.

Second, municipal governments would potentially be involved in the business regulation of LPs, through land-use zoning, business permitting and by-law inspection of LP facilities. Municipalities will generally require that LPs be registered as a business entity and pay for municipal services like any other business. It is possible that LP production facilities and places of business may require a greater response from municipal agencies and first responders if they become the undue target of crime. Commercial indoor marihuana production by LPs may also impact on municipal land-use or environmental bylaws where applicable.

Municipal governments are also responsible for the fire departments that must respond to the increased risk of fire from residential indoor marihuana cultivation. While all forms of residential marihuana cultivation likely involves a higher fire risk than the baseline (i.e., for all family residences), the evidence from fire services data is that the risk of fire resulting from electrical wiring/equipment and risks related to faulty installation or construction are likely to be much higher when the legal scale of approved marihuana cultivation is exceeded and the MMAR production activity is misused as a *de facto* marihuana 'grow-op'.

7. Law Enforcement Agencies

First, it has engaged a Government Supplier under contract – Prairie Plant Systems (PPS) – to provide legal marihuana to authorized users. This contract was the result of an open competition in 2000, followed by subsequent amendments. PPS produces a contracted amount of dried marihuana, which is distributed to individuals at a price of $5.00 per gram. The size of the MMAP has grown exponentially over the past ten years resulting in amendments to the contract with PPS to provide an adequate legal supply.

Second, Health Canada is responsible for administration of the MMAP. Individual Canadians fill out forms and apply for an authorization to possess and use marihuana for medical purposes (ATP). In addition, the Government of Canada bears the administrative costs of processing applications for PUPLs and DPPLs. As of August 13, 2012 there were 21,986 ATP persons under MMAP, and this number is expected to continue to rise to 40,000 ATPs by 2014. Processing and monitoring active ATPs requires system and human resource support.

Third, the Government of Canada is subject to ongoing litigation with respect to the MMAR.

The contract with PPS will expire at the end of March 31st, 2014 with no intention to extend it. This will generate cost savings related to the effective subsidy (i.e., the difference between the actual supply cost and the price paid by users). Program administration costs will diminish, as rather than processing and licensing individual applicants, the Government of Canada will only deal with the licensing and inspection related to a small number of LPs. These LPs will be subject to regulatory oversight, including security and quality inspections, as well as regular reporting and business license extensions. LPs would also be subject to corporate income tax.

Under the MMAP, the licensing and administration of ATPs is handled by a dedicated team within Health Canada, along with the management of the contract with the Government Supplier. In the Policy scenario, licensing and administration related to LPs will be incorporated into the operations of the Office of Controlled Substances.

3.1 Cannabis/Marihuana Usage and Trafficking

A series of reports from consultations with multiple stakeholders, conducted by Health Canada in regards to the MMAP, was analyzed. This included feedback from doctors, government officials, law enforcement, compassion clubs and individual Canadians, often with personal stories of their use of marihuana for medical purposes and experience with the existing regulatory regime. This review provided a framework to understand the current regime and its challenges, and to identify further resources to pursue.

Existing personal-use growers, designated growers and participants in the current MMAP were largely opposed to the new regulatory proposals. A minority of participants, largely those who were not growing or who had found a designate, had mixed response to the new regime. However, the comments of some participants and other stakeholders, when combined with inferences from the literature, suggest that these groups could benefit from the proposed regulations via: (i) easier access to marihuana for medical purposes, which would lead to lower information and other transaction costs, as well as shorter delays; and (ii) greater product choice and "freedom of choice" from a regulated industry that, in time, would be producing a product of higher and more predictable and reliable quality.

A review of studies [Dandurand et al (2002), Easton (2004), Jaworski (2009), Lucas (2009), Patton-Bodnarchuk (2004), Plecas et al (2005), Tjepkema (2004)] identified key trends in Canadian marihuana use and trafficking.

A review of studies [Ben Amar (2006), Hazekamp (2006), Health Canada (2010b), Seamon (2007) Williams-Skeel (2006)] of the medical perspective on the use of cannabis for medical purposes was also assessed. Generally, while there have been studies reporting some (anecdotal) positive effects of cannabis for the treatment of certain medical conditions these have not been replicated with sufficient rigour and/or without contradictory evidence from other studies.

Health Canada (2010b) concludes that there is insufficient evidence to scientifically conclude that the benefits of cannabis treatment for certain medical conditions outweigh its risks to health. In particular:

- Precise dosages for cannabis have not been established (i.e., the complex pharmacology of cannabinoids, inter-individual differences in cannabinoid bioavailability, prior exposure to and experience with cannabis, the variable potency of the plant material, and different dosing regimens used in different research studies all contribute to the difficulty in reporting precise doses or establishing uniform dosing schedules);

- While there are many anecdotal reports of the therapeutic value of smoked marihuana, scientific studies supporting the safety and efficacy of marihuana for therapeutic claims are generally inconclusive; and

- The risk/benefit ratio of marihuana should be carefully evaluated in patients with the following medical conditions (because of individual variation in response and tolerance to its effects, as well as the difficulty in dosing):

    a) patients with cardiac disorders (i.e., concerns re: hypotension, possible hypertension, syncope or tachycardia);

b) patients with respiratory insufficiency such as asthma or chronic obstructive pulmonary disease (concern re: smoked marihuana);

c) patients with a history of substance abuse including alcohol abuse (concerns re: risk to abuse marihuana);

d) patients with mania, depression, or schizophrenia who should be under careful psychiatric monitoring (concern re: exacerbation of such illnesses);

e) patients receiving concomitant therapy with sedatives, hypnotics or other psychoactive drugs (concern re: additive or synergistic CNS effects);

f) patients should be advised of the negative effects on memory and to report any mental or behavioural changes that occur after using marihuana; and

g) patients with ongoing chronic hepatitis-C should be strongly advised to abstain from daily cannabis use (concern re: marihuana use as a predictor of steatosis severity in these individuals).

Seamon (2007) notes that marihuana may alleviate symptoms associated with certain neurologic disorders (e.g., muscle spasticity in patients with multiple sclerosis and spinal cord injuries; lower urinary tract symptoms in patients with MS; analgesia, muscle relaxation, bronchodilation, saliva reduction, appetite stimulation and sleep induction for patients with amyotrophic lateral sclerosis) and in the treatment of a variety of pain disorders (e.g. prophylactic and symptomatic treatment of migraine headache and phantom limb pain; treatment of acute pain associated with sickle cell disease). However, he concludes that the overall evaluation of the efficacy of marijuana is difficult to ascertain. The available studies are generally characterized by a lack of control groups, small numbers of patients, short duration, and imprecise outcome measures.

This medical assessment and overall concern regarding marihuana's use as a 'treatment' was supported by the feedback from the Canadian medical community during the Health Canada consultations [CMA (2011)] and the "needs assessment" conducted with family doctors at the College of Family Physicians of Canada (CFPC) Family Medicine Forum in Montréal in November 2011. Key concerns cited by medical professionals and practitioners were:

(i) Lack of scientific evidence, information and guidance available to the ordinary physician on the risks and benefits of marihuana for medical purposes;

(ii) Lack of established/regulated standards and clinical practice guidelines on prescribing practices for marihuana for medical purposes;

(iii) Too much similarity with traditional prescribing practices under the new regime (which is seen as a negative feature by the medical community and a positive feature by many other stakeholders);

(iv) Lack of guidance on 'prescribed dosage' and 'period of treatment time', and the potential impact on medical legal liability;

(v) The risk of "over-prescribing" marihuana, particularly given the absence of clinical practice guidelines for its usage. This risk creates additional costs and burdens for physicians because they need to conduct additional oversight and monitoring;

(vi) Pressure on physicians who are the sole practitioners in their communities to support the use of marihuana for medical purposes despite their discomfort on medical and/or ethical grounds; and

(vii) Lack of research and/or a clinical trial component in the reform proposal.

A wide body of literature on the economic considerations of marihuana use and trafficking has been considered in the context of the broader policy of marihuana legalization. Much of these economic considerations are also valid within the context of this more focused assessment of the regulatory change and the use of marihuana for medical purposes. This CBA does not address the larger policy issue related to marihuana legalization. Key studies [Becker et al (2006), Bretteville-Jensen-Line (2006), Godfrey et al (2002), Kilmer et al (2010), Kilmer-Pacula (2009), McDonald et al (2005), Pacula et al (2003), Rhodes et al (2000), Single (1998)] suggest that economic regulation, rather than prohibition, of access to marihuana for medical purposes would generate economic benefits that far outweighed the costs associated with pursuing and prosecuting low-level crime like marihuana dealing.

Key considerations for potential LPs, which are relevant for assessing the impact of the proposed regulation, include:

(i) The cost of applying for and receiving a license and approvals from local governments;

(ii) The full cost of investment, including: financing costs; information and transactions costs (which can be significant for a new industry); costs of establishing the distribution system and relationships with suppliers; costs of attracting, hiring and training the work force; and the costs of meeting the safety, security, quality, record-keeping and other regulatory costs (many of which are 'sunk costs' that may be difficult to recover in the event of company, industry and/or regulatory failure);

(iii) The cost of operation, including: costs of labour and intermediate inputs (goods and services) from suppliers' on-the job training; ongoing regulatory compliance; and providing reliable information on their products to doctors, Health Canada and other stakeholders;

(iv) The cost of adapting to and complying with new regulatory requirements after start-up; and

(v) Any regulatory constraints on advertising and marketing.

3.2 Crime Prevention and Public Safety

Crime prevention studies [Bowles (2010), Cohen (1998, 2010), Cohen et al (2004), Dhiri-Brand (1999), Reppetto (1976), Roman (2010)] have shown that any attribution of benefits to government law enforcement must take into account the 'displacement effect' of crime reduction on shifting (rather than diminishing) criminal activity. This literature has also developed willingness-to-pay or economic costs of criminal activities.

An economically-rational deterrence effect on illicit drug activity was developed [Chang et al (2008)] using a calibrated general equilibrium model result for the United States (US) to determine optimal drug policy for a low-income neighbourhood. This model analyzed the consequence of both demand-side and supply-side drug policies and compared welfare gains through calibrated simulation analysis in a manner similar to a general-equilibrium tax incidence model.

Effectively, drug trafficking was treated as an occupational choice with employment and drug transactions modelled in a search-theoretic manner. The drug market equilibrium was established through supply/demand interaction and the entry of drug dealers continued until expected (risk-adjusted) pure profit was eliminated. The extent to which community members opted for a career in the drug market determined the supply of drugs by the community.

This model and its results were considered relevant to this study as it was the only empirical model in the literature that provided a behavioural response of drug trafficking to changes in the probability of conviction. The calibrated simulation results indicated that a 10% increase the probability of criminal conviction for drug trafficking or production would decrease the number of active dealers by 0.26%.

Additionally, a consortium of twenty (20) law enforcement agencies [RCMP (2010)] (representing services to perhaps more than 75% of the Canadian population) reviewed 190 cases over a six to seven year period in which police made an investigation of a residence for which a person held a valid MMAR production license (PUPL, DPPL)[2].

A review of alleged 'misuse' cases (Figure 4.7 below) showed that the number of such alleged misuse cases as a proportion of MMAR authorizations to possess varied from 1.5-3.0% over 2005-2010. However, there is a low estimated rate of police detection for marihuana cultivation (i.e. grow operation). One British Columbia (BC) study estimated this rate at 5% [Dandurand et al (2002)] while another study estimated the rate for Quebec at 2.5% [Bouchard (2007)]. If a higher (10%) rate of detection is assumed, this implies that the estimated rate of MMAP 'misuse' could be in the range of 15-30%. The lower rate of 5% detection would imply an estimated rate of MMAP 'misuse' in the range of 30-60%.

Health Canada regulatory analysis dealing with cigarette ignition propensity [Health Canada (2005)] used fire statistics from the Canadian Association of Fire Chiefs *Annual Report – Fire Losses in Canada* for various years to estimate probabilities of fires. The analysis followed this approach using available average Canadian data for a five year period (1998-2002) that involves the most recent data available.

3.3 Regulatory Compliance Theory

The theory of regulatory compliance was assessed to better understand how the proposed regulations might impact the behaviour of persons already accessing marihuana under the MMAR and persons who always have an option to access marihuana for medical purposes from

[2] RCMP (2010) *An Analysis of National Cases Related to the Marihuana Medical Access Regulations*. The law enforcement agencies including RCMP, OPP, SQ and municipal police in Toronto, Montreal, Vancouver, Ottawa, Calgary, Edmonton etc.

the illegal market. In particular, this study explored what evidence exists to help anticipate the expected regulatory compliance of Canadians under the proposed new regulatory regime. The success or failure of the new LP industry is predicated in the assumption that, as in other regulatory regimes, the new regulations will be enforced such that the requirements are obeyed by persons subject to the regulations.

Key insights were derived for three key issues relevant to the transition between the existing and new regulatory regimes of accessing a legal supply of marihuana for medical purposes:

A. *Monitoring regulatory performance* and the behavioural response of agents following regulatory change;

B. *Impact of regulatory change* on compliance performance and market dynamics; and

C. *Impact of inspection* on compliance motivation and relationship between the regulatory authority and the affected population.

A) Monitoring Regulatory Performance

Existing regulators taking on new and unfamiliar responsibilities typically encounter limitations in their ability to measure and report on performance [Sparrow (2000, 2008)]. Although the proposed regulations are patterned on the existing regulatory regime for controlled substances, the performance management and reporting by Health Canada (HC) will likely be based on the following:

(i) Presumed relationships between inputs, outputs, intermediate outcomes and final policy outcomes from the logic model and "theory of the regulation";

(ii) Qualitative and anecdotal information and complaints from the media, competitors, business customers, civil society groups and other affected and interest groups on the determinants of compliance and other indicators of outcomes and results; and

(iii) Improvements to compliance and other outcomes resulting from projects that mitigate a specific regulatory problem, risk or harm, and which are selected because of their ability (based on the theory and logic model) to contribute to the higher level outcomes and objectives of the regulatory regime.

In the context of the uncertainty of establishing a new and commercially viable LP industry to supply a legal source of marihuana for medical purposes, Health Canada will need to closely monitor the performance of LPs as they ramp up to full production. This may be challenging in terms of access to information (beyond what is required to meet regulatory requirements).

B) Impact of Regulatory Change

The proposed regulations make fundamental changes to the legal marihuana supply industry. Generally, regulatory change results in the expansion or contraction of regulations affecting an existing stakeholder group. However, the proposed regulatory regime for legal marihuana for medical purposes will fundamentally change who is being regulated. As this is an uncommon occurrence, the literature was investigated to determine the likely results of a fundamental shift

in the focus of government regulation, in particular, how Health Canada's focus (away from licensing of individuals and towards licensing commercial producers) will change the incentives and behaviour of individuals.

Changes in regulatory scope and reach (i.e., the affected population and their attitudes) could have either a positive or negative influence on compliance and other intermediate and final outcomes [May-Koski (2004)]. These outcomes will depend on:

- The affected population's experience, resources and interest in complying with the regulation;
- Structural change and (possible) market concentration in the industry, which could either improve compliance (i.e., fewer firms are easier to regulate) or make compliance more problematic (i.e., larger and more powerful firms can increase political lobbying and regulatory capture, and lead to the "too-big-to-fail" erosion of enforcement);
- Changes in political, voter and consumer interest and media attention can change regulatory compliance and performance over time [Sparrow (2000, 2009)];
- Changes in a regulated market's growth and profitability can result in competitive turbulence and greater compliance variation, especially during market downturns when cost cutting pressure can reduce compliance resources; and
- Rapid market growth and entry of new regulated firms can also place pressure on the regulatory authority's inspection and enforcement during times when investment and market pressures are focused on increased production, perhaps to the point where the firms may cut corners in complying with regulations.

C) Impact of Inspection

The establishment of a new LP market under the proposed regulations requires a series of inspections, particularly at the start-up phase of the new businesses. Regulatory compliance theory [May-Koski (2004)] highlights the importance of the relationship between inspectors and regulated industry managers which may create positive and negative motivations and trade-offs between the two. For example, inspectors that are collegial, respectful, less formalistic and provide good information on the requirements of the regulation can increase positive motivations through shared information, learning, "mental models", problem solving and a "social contract" between the regulator and affected population. Such an approach also reduces negative motivations through increasing transparency, demystifying the regulation and its enforcement and compliance programs, and reducing the fear, risk and uncertainty that promote negative motivations towards compliance.

3.4 System Dynamics

Marihuana use and results from a complex set of relationships and interactions between markets and stakeholders (e.g., governments, users, doctors, law enforcement authorities, suppliers). A System Dynamics approach [Sterman (2000), Morecroft (2007)] captures the inter-

relationships between these system elements and enables the analysis of causal loops that affect the behaviour of the overall system.

System Dynamics (as opposed to Systems Thinking) requires "causally-closed" models [Richardson (1991)], as the causes of the behaviour exhibited by the system must be found endogenously – within the structure of the system model itself. While there will be external inputs and outputs which have an impact on the magnitude of the system's operations, the causal relationships which create that behaviour must be entrenched within the system itself.

The Cost-Benefit Analysis benefited from a System Dynamics model of individual and firm behaviour over time for the legal marihuana for medical purposes supply industry. This model involved: LPs, production capacity, strategic resources, market processes, production processes, pricing impacts, projected growth, projected users etc.

The System Dynamics model was based heavily on various studies related to modeling and the conceptualization process [Forrester (1961), Randers (1980), Vennix et al (1992), Hodgson (1992), Saeed (1992), Richardson et al (1992), Winch (1993)] which include examples of the process and structure of developing an industry model, including how consumers gain awareness of products, the development of supply, marketing, distribution, and consumer usage patterns.

Specific studies that were relevant to *regulatory compliance* and *legal/illegal market dynamics* included:

- Homer (1993, 1997), which developed a 'War on Drugs' model to understand cocaine prevalence trends and policy impacts. The model captured the cocaine market mechanism including supply, demand, price, and market actors as well as how the criminal justice system interacts with the illicit market;

- Lyneis (1999, 2000), which developed a detailed, calibrated model to support the development of business strategies. It focused on market share and resource allocation between competing companies and assessed cost-benefit tradeoffs of business strategies. Lyneis (2000) also explained the causes for market behaviours and illustrated that System Dynamics models can "provide more reliable forecasts than statistical (non-structural) models);

- Cavana-Clifford (2006), which tested the causality between tobacco import behaviour and government policy options in New Zealand;

- Dudley (2004), which examined the inter-relationships between demand, price and forecast stock and log availability, log harvesting capacity, log exports and the impact of an export ban on Papua New Guinea;

- Delsys Research Group (2012), which developed a qualitative system dynamics model depicting the "theory of the business" for the new consumer product safety regulatory regime at Health Canada; and

- Tawileh et al (2009), which developed a model of alcohol misuse, which touched on many of the same issues as marihuana use for medical purposes, including law enforcement and doctor/patient relations.

Specific studies that were relevant to *business and user dynamics* included:

- Sterman (2000), which modeled commodity cycles and examined how price functions to balance supply and demand, and examined the business supply chain mechanism and how business adjusts capacity to meet orders and demand; and

- Delsys Research Group (2004), which developed a strategic 'business flight simulator' for First Nations Statistical Institute. This business-planning tool modeled inter-relationships between market demand for statistical services, production, human resources and financing.

Specific studies that were relevant to *licensing, compliance and law enforcement issues* included:

- Delsys Research Group (2008), which mapped broadcasting and telecom licensing processes and tracked information flows into and through the process. The model included unavoidable re-work cycles and tested how to sustain organizational capacity to meet performance requirements;

- Morecroft (2007), which focused on drug-related crimes and modeled inter-connections between drug users, street market, police and the community; and

- Delsys Research Group (2005), which developed simulation models to support strategies for combating mass-marketing fraud, including: entry, exit, marketing activity investment, ROI, and sales success rates (i.e., victim responsiveness). The models tested different compliance strategies, including law enforcement activities and related deterrent effects.

Other literature that was specific to identification of variables and parameters required in the CBA model is cited in the Methodology section.

CHAPTER FOUR

4. Cost Benefit Analysis - Methodology

This section describes in detail the methodology used in the Cost Benefit Model to estimate the Status Quo and Policy scenarios over the forecast period and the Net Present Value difference between them for monetized benefits and costs.

This section is divided into sub-sections that describe the following components:

1. Persons Accessing Legal Marihuana for Medical Purposes;
2. Status Quo – Program Administration Costs;
3. Status Quo – User Benefits & Costs;
4. Status Quo – Safety Costs;
5. Status Quo – Security Costs;
6. Status Quo – Summary of Benefits & Costs;
7. Policy – Transition Model (April 2014);
8. Policy – Demand Curve;
9. Policy – Supply Curve;
10. Policy – LP Market Equilibrium;
11. Policy – User Benefits & Costs;
12. Policy – Safety Costs;
13. Policy – Security Costs;
14. Policy – Program Administration Costs;
15. Policy – Summary of Benefits & Costs; and
16. Net Present Value (Policy vs. Status Quo)

The methodology description will address each of these components separately.

It is important to note that the Cost-Benefit Analysis (CBA) focuses on the consumption of marihuana obtained from legal sources of supply for medical purposes. The broader issue of illicit market supply and use (and their possible legalization) is outside the context of the study. The only aspect of criminal activity that is included in the scope of the CBA is the potential misuse of residential production licenses under the MMAR and, in the Policy scenario, the likely continuation of such activity that, counterfactually, would have occurred under the MMAR. will be tracked.

4.1 Persons Accessing Legal Marihuana for Medical Purposes

The CBA study estimates a pool of potential persons who, over time, would be interested in accessing legal marihuana for medical purposes. This was used to estimate the time path of legal marihuana users in the Status Quo scenario. Following the development of a Transition Model, this pool of potentially eligible marihuana users was also used to estimate the path of legal users in the Policy scenario.

4.1.1 Future Growth & Likely Upper Bound

Health Canada data on persons with Authorization-to-Possess (ATP) status were available for the month of January values from 2003 to 2012 (Figure 1.1 above). This data showed exponential program growth of over 40% per year since 2006.

It is difficult to confidently assume that such exponential growth can continue for another ten years, as there is good reason to believe that there is a natural ceiling towards which the level would approach (or a steady- state growth path that is much lower than 40% per year).

Assuming that exponential growth of 40% per year continues for the 12-year forecast horizon from 2012 to 2024, this would effectively project an ATP level of about 690,000 persons in 2024.

The Canadian Alcohol and Drug Use Monitoring Survey (CADUMS) for 2011, administered by Statistics Canada for Health Canada, identified that 1.6% of Canadian adults (aged 15 years and over) reported using marihuana in the past year for medical purposes. This would suggest that there were 460,000 persons in 2011 who claimed to use marihuana for medical purposes. Of these persons, about half reported that their medical reason for cannabis use was related to a chronic pain condition, while the other half reported use related to insomnia, depression and anxiety.

For the purpose of modelling the future growth of the MMAP (in the Status Quo scenario) over the forecast period from 2014-15 to 2023-24, the analysis used an upper bound (or ceiling) of 450,000 Canadians who might become participants in the MMAP as the Reference case. In order to provide a sensitivity analysis, the range of upper limit was assessed from 250,000 to 650,000 persons participating in the MMAP.

A System Dynamics model[3] of program uptake was developed to track the growth of the program (to 2012) and to forecast program uptake to 2025. This continuous simulation model used differential equations to calculate variable changes over time. Figure 4.1 shows a simplified model structure in which potential ATP persons move through a process to become aware of, and apply for, access to the existing MMAP regime.

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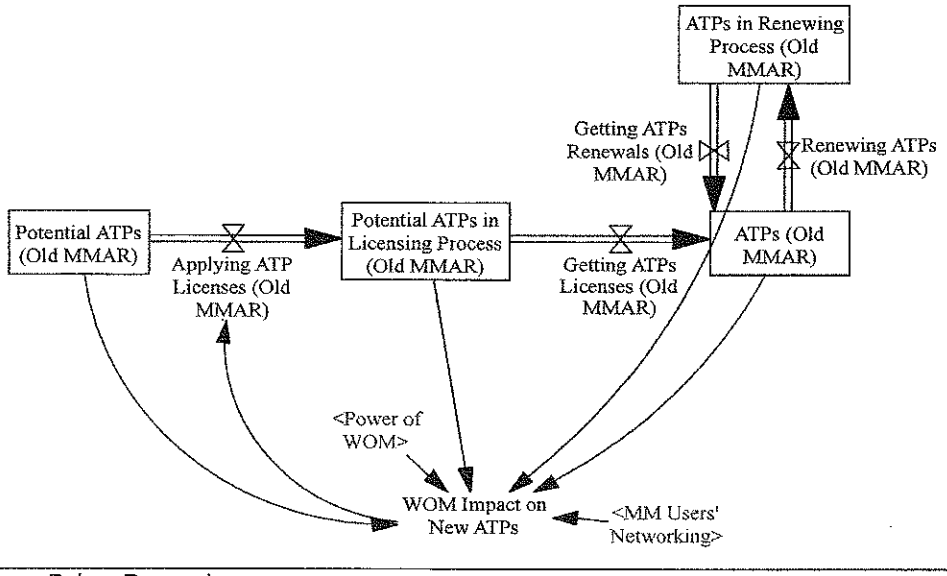
[3] System Dynamics simulation models map the causal relationships that determine the behaviour of complex systems and use differential equations to account for dynamic changes in stocks (accumulations) and flow processes over time. These models can be calibrated to replicate known data and can be used to rigorously assess how complex interaction and feedback processes in economic, environmental and social systems influence behaviour over time. They can help identify potential unanticipated consequences of policy proposals in both public and private sector contexts. Systems Dynamic models were used to inform the CBA with respect to the growth of MMAP usage both with and without resource constraints under the Status Quo scenario, as well as the transition process between the Status Quo and Policy scenarios. These models also informed other aspects of the regulatory change process.

Figure 4.1 – Status Quo – System Dynamics Model
ATP Awareness, Application, Approval Process



Source: Delsys Research

The ATP process models the movement of potential ATP persons through the license application and renewal activities. The full model captures the complex dynamics of how Health Canada issues and renews ATPs, DPPLs and PUPLs, and provides access to the Government supply of marihuana for medical purposes.

The upper bound (ceiling) is represented by the sum of four stocks: 1) potential ATP persons; 2) persons applying for an ATP in the licensing process; 3) persons with an ATP; and 4) ATP persons involved in the renewal of their ATP, where:

Ceiling Value = Potential ATP + ATP Applications + Existing ATP + ATP Renewals

For the Reference case (i.e. deterministic case), the study assumed there are 450,000 persons who might be in need of marihuana for medical purposes (for simplicity, it is assumed that this is constant over the forecast period to 2025). As there were 4,884 ATP persons in January 2010, the majority of persons were in a 'potential pool' of persons who might want to access the MMAP regime. As the number of persons with ATP grows over time, the size of the potential pool drops.

There is no Health Canada marketing or promotion of the MMAP, even though historical growth has been about 40% per year over several years. Peer influence (i.e. 'word-of-mouth' - WOM) is assumed to be the dominant process that continues to drive MMAP growth. Such a process is often modeled in System Dynamics.

ATP Applications = Existing ATP * WOM Factor * [Potential ATP / Ceiling Value]

The resulting path of ATP persons over time is an 's'-shaped logistics curve. This curve initially tracks and continues the historical exponential path of growth before slowing and approaching the ceiling value asymptotically.

Over time, with infirmity of a growing and aging Canadian population, the effective ceiling could rise. However, it is likely that the effective ceiling on the number of ATPs would be reached before 2024 and would involve a slowing of the rate of growth to some value less than 40% per year.

The System Dynamics model produced outputs for January values which allowed calculation of monthly compound growth rates. These allowed a monthly time series to be generated so that fiscal year annual average values could be determined.

The System Dynamics growth path is expressed in terms of the percentage movement towards the asymptotic upper limit (ceiling). In order to allow for a different value for the upper limit, the CBA model used the shape-path of the percentages and adjusted these to reflect that the starting value (i.e. the value for FY2013-14) was a different percentage of the different ceiling value. This can be seen in Figure 4.2, which shows several paths for the percentage movement towards the asymptotic upper limit (for ceiling values of 250,000, 450,000 and 650,000). The shape of the paths is similar to a logistics ('s'-shaped) curve.

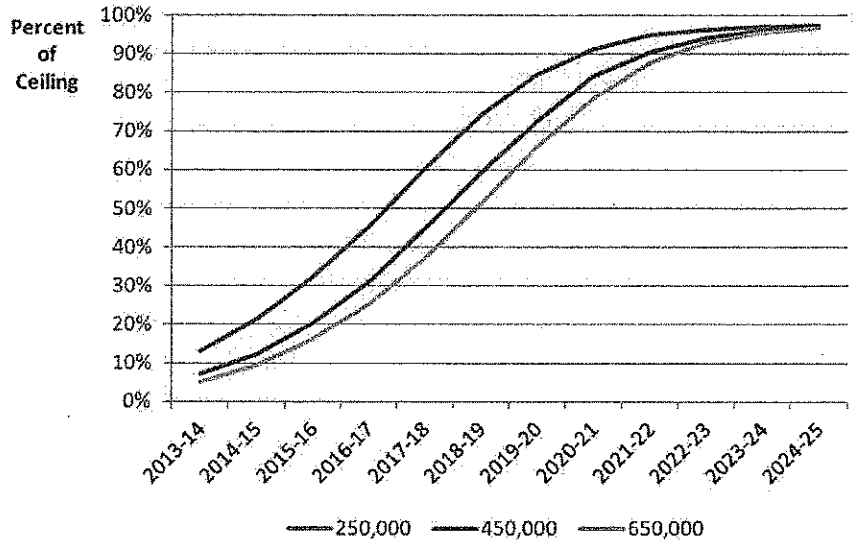
The CBA model for ATP in the Status Quo scenario is of the form[4]:

(01) ATP(t) = Upper Limit Value * % of Ceiling(t)

where the percent of ceiling at time (t) is based on the System Dynamics growth path (for a ceiling of 450,000) and adjusted for the difference in starting value. This path is determined for the aggregate number of ATP persons[5].

[4] Numbered equations focus on calculations that are embedded in the CBA Model.
[5] Effectively, the percentage increment was estimated as a polynomial of degree two relative to the lagged value of the ceiling. This produced a good fit for the System Dynamics growth path.

Figure 4.2 – Status Quo – ATP Forecast Growth Path As % of Ceiling Value Showing Upper Limit Values



Source: Delsys Research

4.1.2 Status Quo – Composition by Supply Method

Under the MMAR, there are various supply methods that an ATP person can use to access legally produced marihuana for medical purposes:

- Access the Government Supply (these are referred to as ATP-G);
- Grow their own supply under a Personal Use Production License (PUPL) (referred to as ATP-P); or
- Arrange for their supply to be grown by a designated person under a Designated Person Production License (DPPL) (referred to as ATP-D).

For the purpose of the CBA, it is important to forecast the composition of these different types of MMAP participants. In addition to these streams of ATP users, it also turns out that a substantial proportion of persons with an ATP-G to access the Government Supply do not in fact ever place an order through Health Canada to access this supply. Therefore, as this study needed to estimate the actual usage of the Government Supply, the stream of ATP-G persons was subdivided into two types:

- Persons who do, in fact, access the Government Supply (referred to as ATP-GS); and
- Persons who do not access the Government Supply (referred to as ATP-O).

While there has been variation of time in the relative proportions of these ATP supply types, there is guidance from Health Canada that the current proportions are roughly:

- 10% ATP-GS: who access the Government Supply;

- 10% ATP-O: who access unknown supply;
- 60% ATP-P: who grow their own supply under a PUPL; and
- 20% ATP-D: who arrange for their supply to be grown under a DPPL.

The model for ATP-P in the Status Quo scenario is of the form:

(02) ATP-P(t) = ATP(t) * %share-P

where the percent share of ATP who hold PUPL is fixed over the forecast period.

The model for ATP-D in the Status Quo scenario is of the form:

(03) ATP-D(t) = ATP(t) * %share-D

where the percent share of ATP who hold DPPL is fixed over the forecast period.

The model for ATP-G in the Status Quo scenario is of the form:

(04) ATP-G(t) = ATP(t) * (1 - %share-P - %share-D)

and is calculated as a residual to be consistent with the above forecasts for ATP (total) and ATP-P and ATP-D.

The model for ATP-GS in the Status Quo scenario is of the form:

(05) ATP-GS(t) = ATP-G(t) * %share-GS

where the percent share of ATP-G who actually access the Government Supply is fixed over the forecast period.

The model for ATP-O in the Status Quo scenario is of the form:

(06) ATP-O(t) = ATP-G(t) * (1 - %share-GS)

and is calculated as a residual to be consistent with the above forecasts for ATP-G and ATP-GS.

These share parameters were assumed to be fixed over the forecast period. In order to provide sensitivity analysis, the percentage shares for ATP-P and ATP-D was varied over a range and the share of the residual ATP-G was divided between ATP-GS and ATP-O based on a percentage that also varied over a range.

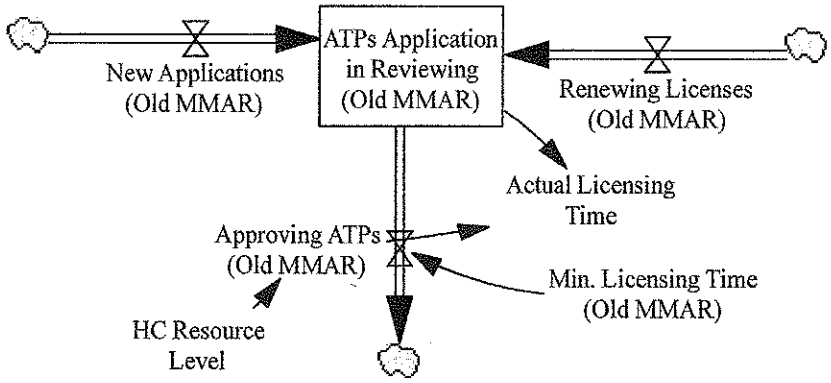
4.1.3 Future Growth and Upper Bound Under Resource Constraint Scenario

Since the MMAR were introduced, Health Canada has been faced with escalating program costs due to the increasing numbers of ATPs - over 40% in the past 7 years. MMAP costs increased from $3.7 million in 2005 to $16.7 million in 2012. A scenario in which program costs must scale resources to meet an exponential growth in demand is unsustainable for any

regulator. However, this analysis adopted a Status Quo scenario that nevertheless assumed that resources would scale as necessary to meet the demand. The reason this approach was adopted was two-fold: 1) There was no basis on which to base an assumption about what proportion of required resources the government would be willing to allocate; and 2) a scenario in which resources were not scaled would have implied the government would tolerate significant delays in issuing ATPs to users.

With a limited budget, it is inevitable that the number of ATPs will experience slower growth compared with an unlimited budget Status Quo scenario. An alternate to the Status Quo scenario was analyzed using a System Dynamics model that illustrated how a budget limitation impacts on program performance. Figure 4.3 shows the model for the MMAP licensing process, including new applications and renewal applications.

Figure 4.3 – Resource Constraint – System Dynamics Model
ATP Applications & Backlog Process



Source: Delsys Research

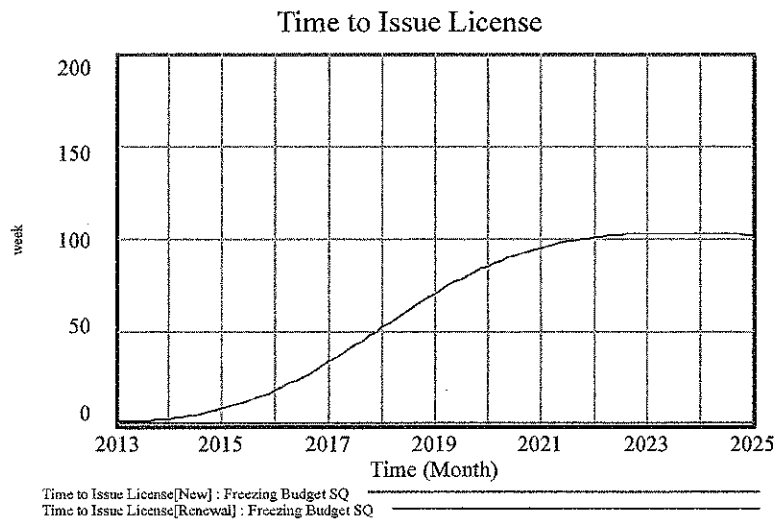
The constrained-budget scenario assumed that MMAP administration was frozen at current levels effective April 1, 2013 (estimated at $4.87 million per year). With this resource level, Health Canada forecasts that there would be 27,847 individuals authorized to possess marihuana for medical purposes by April 1, 2013[6]. In other words, this resource level would allow the MMAP to process 10,767 new applications and renew 17,080 existing licenses per year.

Figure 4.4 shows MMAP service performance relating to the time required to issue and renew ATP licenses. In the constrained-budget scenario, the average time to renew a license remained the same – approximately 0.54 weeks in the study period. This level of performance was achieved by giving greater priority to licensing *renewals* as opposed to issuing *new* licenses, a management decision designed to minimize the service gap for existing ATPs. The consequence, however, of the assumed budget freeze, coupled with the priority on renewals, was that the time to issue new licenses increased from 1 week to 102 weeks by 2025. This

[6] Health Canada forecast. As of August 13, 2012, there were 21,986 ATPs. This number is in line with the projected amount of 20,452.

result occurred because increasing program capacity was dedicated to ever-increasing license-renewal activities, and fewer resources were available for new applications.

Figure 4.4 – Resource Constraint – System Dynamics Model
ATP Application Backlog (Weeks) Over Time



Source: Delsys Research

In this scenario, the System Dynamics model projected that the total number of ATPs would increase at a much slower rate compared to the unlimited resource status quo scenario, as shown in Figure 4.5, below.

- 10% ATP-O: who access unknown supply;
- 60% ATP-P: who grow their own supply under a PUPL; and
- 20% ATP-D: who arrange for their supply to be grown under a DPPL.

The model for ATP-P in the Status Quo scenario is of the form:

(02) ATP-P(t) = ATP(t) * %share-P

where the percent share of ATP who hold PUPL is fixed over the forecast period.

The model for ATP-D in the Status Quo scenario is of the form:

(03) ATP-D(t) = ATP(t) * %share-D

where the percent share of ATP who hold DPPL is fixed over the forecast period.

The model for ATP-G in the Status Quo scenario is of the form:

(04) ATP-G(t) = ATP(t) * (1 - %share-P - %share-D)

and is calculated as a residual to be consistent with the above forecasts for ATP (total) and ATP-P and ATP-D.

The model for ATP-GS in the Status Quo scenario is of the form:

(05) ATP-GS(t) = ATP-G(t) * %share-GS

where the percent share of ATP-G who actually access the Government Supply is fixed over the forecast period.

The model for ATP-O in the Status Quo scenario is of the form:

(06) ATP-O(t) = ATP-G(t) * (1 - %share-GS)

and is calculated as a residual to be consistent with the above forecasts for ATP-G and ATP-GS.

These share parameters were assumed to be fixed over the forecast period. In order to provide sensitivity analysis, the percentage shares for ATP-P and ATP-D was varied over a range and the share of the residual ATP-G was divided between ATP-GS and ATP-O based on a percentage that also varied over a range.

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Since the MMAR were introduced, Health Canada has been faced with escalating program costs due to the increasing numbers of ATPs - over 40% in the past 7 years. MMAP costs increased from $3.7 million in 2005 to $16.7 million in 2012. A scenario in which program costs must scale resources to meet an exponential growth in demand is unsustainable for any

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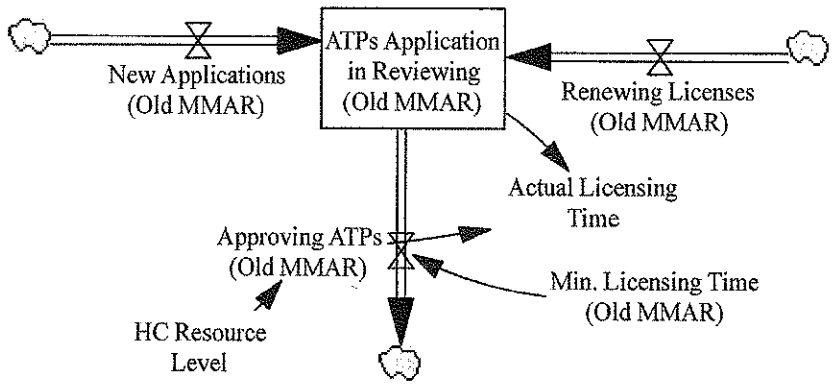

Source: Delsys Research

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[6] Health Canada forecast. As of August 13, 2012, there were 21,986 ATPs. This number is in line with the projected amount of 20,452.

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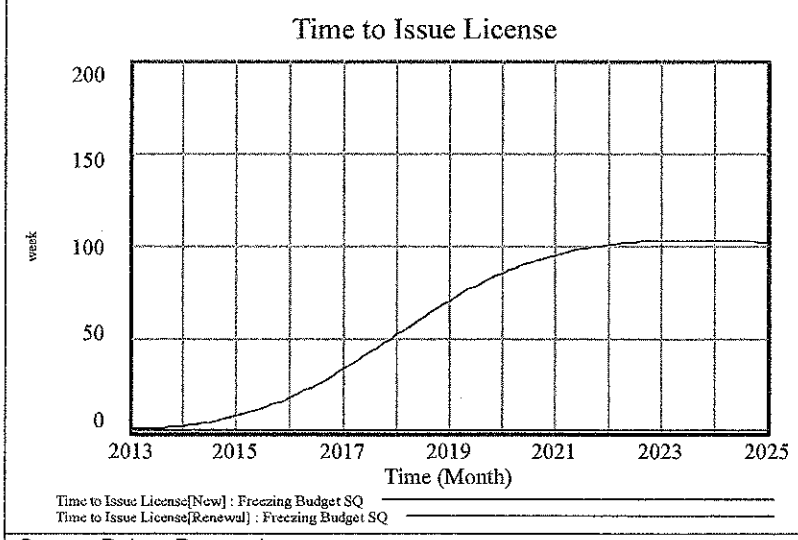
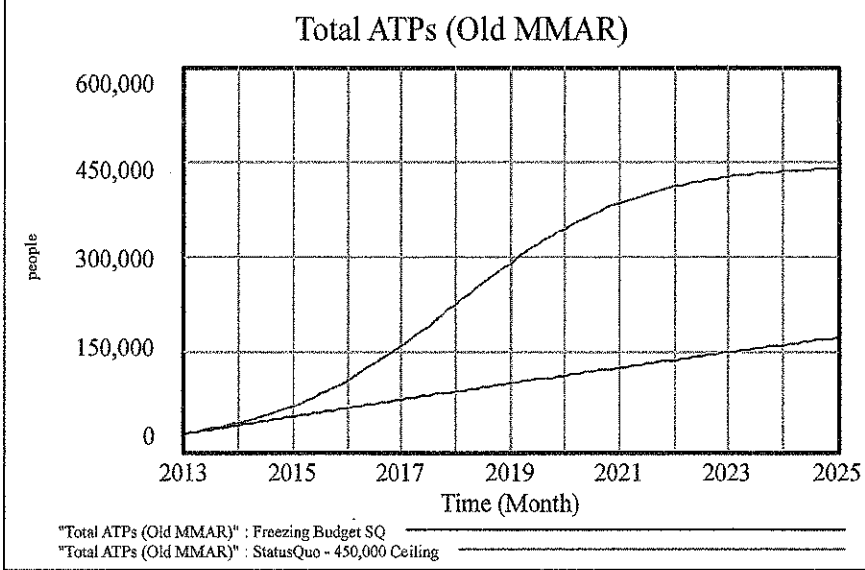


Source: Delsys Research

In this scenario, the System Dynamics model projected that the total number of ATPs would increase at a much slower rate compared to the unlimited resource status quo scenario, as shown in Figure 4.5, below.

Figure 4.5 – Resource Constraint – System Dynamics Model ATP Volume Over Time Showing a) No Resource Constraint and b) Effect of Resource Constraint and Backlog



Source: Delsys Research

Although the constrained-budget scenario is likely to result in practice (if the Status Quo were maintained), it was not used as the Status Quo scenario for a variety of reasons. First, there were a number of critical assumptions (e.g., the duration of the budget freeze, the decision on funding levels, alternate assumptions regarding program resource allocations) that change the results of the scenario for which there was no evidentiary basis. Second, to ensure consistency if budgetary constraint assumptions were applied to the Status Quo scenario they should also apply to the Policy scenario. Again, there was no evidentiary basis for applying specific assumptions. Accordingly, the Status Quo scenario incorporated an assumption that the government would scale resources sufficiently to meet emerging demand.

4.2 Program Administration Costs

Health Canada – Program Administration Costs are comprised of:

- Salary and Human Resources (HR)-related costs such as Employee Benefits Program (EPB) and staff accommodation costs;
- Operations & Maintenance (O&M) costs for travel, training, supplies and professional contracts;
- Corporate Cost to reflect departmental shared services and overhead; and
- Contract Cost for the Contracted Government Supply.

This latter cost is counted as part of Health Canada's MMAP Cost but is not included in the CBA as a Program Administration cost as it is related to the cost of supply for those persons

accessing the Government Supply. Contract costs are taken into account as part of the User Benefits and Costs.

Salary & HR-Related Costs

Health Canada administrative costs (human resource costs, accommodation, O&M costs) were documented for 2005-06 to 2009-10 as part of a Health Canada (2009) Supplemental Funding Request. The majority of the operational requirements under the Status Quo scenario arise from the administration of the ATP eligibility requirements and the administration and order processing related to the contract Government Supply. As there has been a fairly steady proportion (10%) of ATP persons who rely on the Government Supply for their access to marihuana for medical purposes, this analysis was able to model the Health Canada program administrative costs directly in relation to the total number of persons with ATPs.

The number of full-time equivalent persons (FTE) for FY2010-11 was reported as 33 FTEs and allowed the computation of an average salary cost per FTE ($68,060) based on the total salary cost for the fiscal year. It was assumed that salary costs per FTE were subject to a fixed salary escalator factor (e.g., 2% per year). This allowed the estimation of FTE for the same years for which salary costs were known (2005-06 to 2009-10).

As the activity volume is considered to be proportional to the average number of ATP persons in a fiscal year, a productivity measure was calculated as the ratio of ATP persons to estimated FTE. This showed an upward trend over time that was fitted with a logarithmic function in Figure 4.6.

The logarithmic equation allows for a prediction of the future number of FTEs required for Health Canada program administration in relation to the number of ATPs expected over time in the forecast period.

The MMAP ratio of ATP/FTE in the Status Quo is given by:

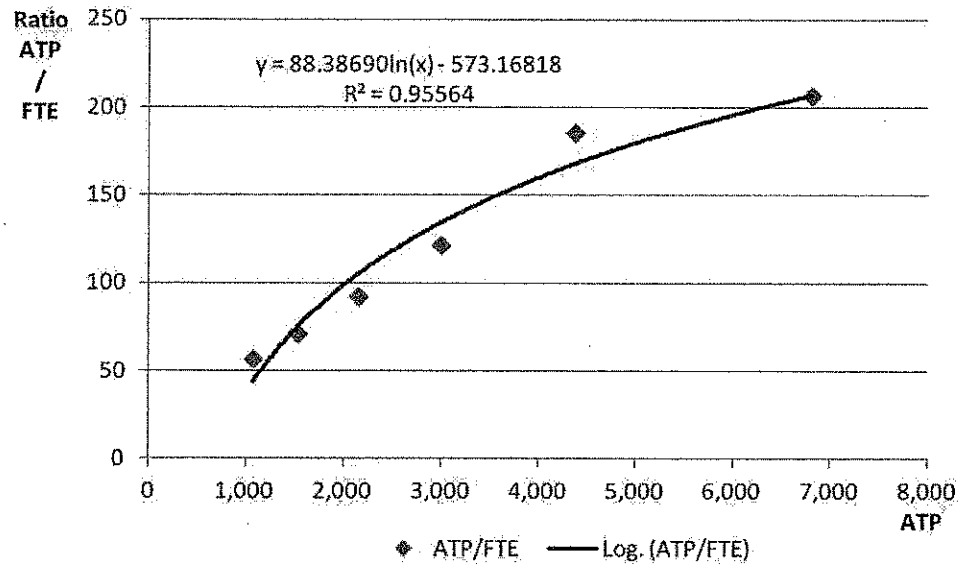
(07) $ATP/FTE(t) = -573 + 88.4 * LN[ATP(t)]$

where:

ATP = the forecast number of persons with ATP in future years

LN[ATP] = the natural logarithm of the above.

Figure 4.6 – Status Quo - Productivity Measure
Ratio of ATP Persons per MMAP-FTE
and Fitted Logarithmic Function



Sources: Delsys Research using HC (2009) data and fitted logarithmic function

The number of required MMAP-FTE over time is then given in the Status Quo scenario by:

(08) FTE(t) = ATP(t) / [ATP/FTE(t)]

The average salary per FTE was benchmarked for $68,060 for 2010-11 and was adjusted annually based on a salary escalation factor, so that the salary per FTE over time is then given in the Status Quo scenario by:

(09) Salary/FTE(t) = Base Year Salary * (1 + Escalation Factor)^(t - base year)

where '^' means raised to the power.

The Salary Cost is then given in the Status Quo scenario by:

(10) Salary Cost(t) = FTE(t) * Salary/FTE(t)

Data in the benchmark period (2010-11) indicate that Employee Benefits Program (EBP) and Accommodation costs are proportional to Salary Cost at a fixed percentage (41%).

The EBP & Accommodation Cost is then given in the Status Quo scenario by:

(11) EBP & Accomm Cost(t) = Salary Cost(t) * 0.41

4.2.1 O&M Costs

Data in the benchmark period (2010-11) indicate that O&M costs are proportional to Total Administration Cost at a fixed percentage (20%). As Total Administration Costs = Salary Cost + EPB & Accommodation Cost + O&M Cost, this allows for the following equation for O&M Costs in the Status Quo scenario:

(12) O&M Cost(t) = [.2 / (1 - .2)] * [Salary Cost(t) + EBP & Accomm Cost(t)]

The Health Canada Administration Cost is then given in the Status Quo scenario by:

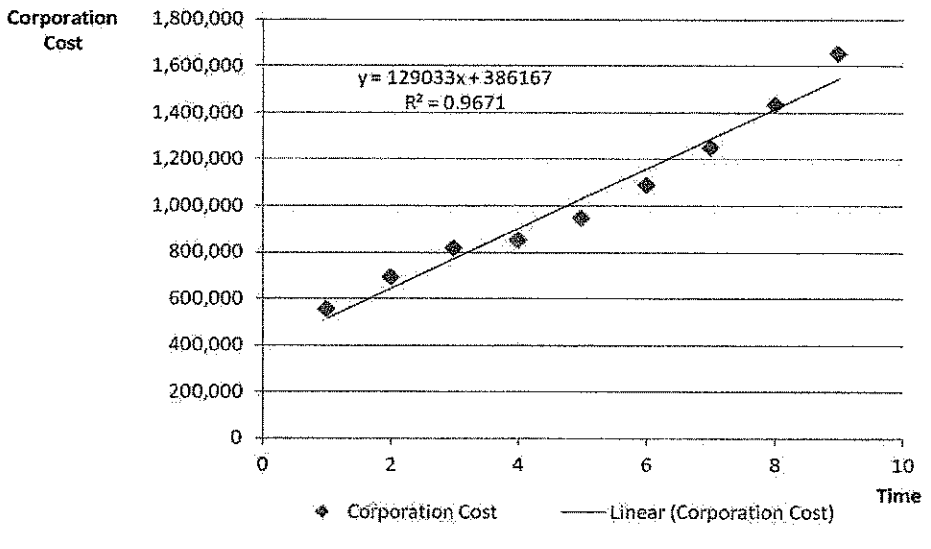
(13) HC-Admin Cost(t) = Salary Cost(t) + EBP & Accomm Cost(t) + O&M Cost(t)

4.2.2 Corporate Cost

Health Canada Corporate Cost includes Human Resources, Finance, Corporate Services and other departmental functional costs that are allocated to program activities such as MMAP.

For FY2005-06 to FY2013-14 (based on HC estimates), the Corporate Cost was a linear function of time as shown in Figure 4.7.

Figure 4.7 – Status Quo – Corporation Cost Linear Time Model



Sources: Delsys Research

The linear equation allows a prediction of the future Corporate Cost over time in the Status Quo scenario as:

(14) Corporate Cost(t) = 386,167 + 129,033 * (t)

where:

t = a time trend which has values of 10 (FY2014-15) to 20 (FY2024-25).

The sum of Health Canada administrative cost (equation 13) and corporate cost (equation 14) equal the total Program Administration Costs for the Status Quo scenario:

(15) Program Administration Cost(t) = HC-Admin Cost(t) + Corporate Cost(t)

4.2.3 Contract Costs – Government Supply

Health Canada, through Public Works and Government Services Canada (PWGSC) has a contract to cultivate and distribute legal marihuana to persons authorized to access the Government Supply under MMAP. The contract terms provide for payment related to a schedule of payments against certain deliverables, the most important of which is the Kilogram (KG) produced to meet the expected MMAP demand.

KG-Demand, Supplied and Produced

The model for KG-Demand for persons eligible to access the Government Supply was estimated based on actual data for KG-Supplied (for FY2005-06 to 2011-12) and an estimate of the Maximum KG-Demand based on the number of ATP persons who are:

- existing ATP-GS at the beginning of the FY (April of the year) who are eligible to access 12 months of Government Supply;
- new ATP-GS during the FY who are eligible (on average) to access 6 months of Government Supply; and
- new ATP-P/D during the FY who are eligible to access 4 months (on average) of 'interim' Government Supply.

From the Fiscal Year forecast of the Total ATP persons, a monthly time series was calculated that allowed, based on parameters for the proportion of Total ATP persons in different supply methods, an estimate of the number of persons in each category as described above.

The mean number of 'Proposed Daily Amount' from the ATP application form for each of the supply categories was obtained, which for 2010-11 showed that the proposed daily amount was significantly higher for DPPL supply (mean=9.0 grams) and PUPL supply (mean=7.6 grams) than for persons accessing the government supply (mean=3.6 grams). The mean across PUPL/DPPL supply was 8.0 grams.

For the years up to FY2009-10, during which ATP persons were able to access the Government Supply *without prepayment*, there was a significant rate of non-payment (around 20%) – and the 'effective utilization' rate[7] was around 17-20%. In other words, the actual KG-Demand was only 17-20% of what was theoretically possible to have been made available to persons eligible (and likely[8]) to access the Government Supply.

For the FYs after 2010-11 and including an estimate for FY2012-13 (based on one quarter's data[9]) the 'effective utilization' rate following the demand for full pre-payment was around 6%.

The Maximum KG-Demand (Government Supply) is given in the Status Quo scenario by:

(16) Max KG-GS(t) = {[Starting ATP-GS(t) * 12 * 30 * PDA-GS]

+ [New ATP-GS(t) * 6 * 30* PDA-GS]

+ [New ATP-P/D(t) * 4 * 30 * PDA-P/D]} / 1,000

where the first term in each of the three expressions on the right-hand side of the equation is the number of relevant ATP persons eligible to access the Government Supply, the first integer is the months of possible orders in the FY, the second integer is the mean days per month and the last term is the mean Proposed Daily Amount (a maximum) for each category of user.

The KG-Demand is given in the Status Quo scenario by:

(17) KG-Demand(t) = Max KG-GS(t) * Utilization Rate-GS(t)

where the effective utilization rate was assumed to be 6% for the beginning of the forecast period and allowed to rise towards the end of the forecast period as the growth of new ATP persons slows and there was expected to be higher utilization from the persons who start the year as ATP-GS.

It was assumed that the KG-Demand equalled the KG-Supply, as this is an actual transacted market with Health Canada as the intermediary between the consumer and the contracted producer.

The ratio of KG-Supply to KG-Produced was estimated to be 85% for FY2008-09. As a result of reduced demand as a result of pre-payment of orders, this ratio might have fallen to around 50% for FY2009-10. Access was only available for planned expenditures in additional FYs and the actual contracted amounts for KG-Produced were unknown. It was assumed, for the

[7] The effective utilization rate is the ratio of the KG actual supplied to persons from the Government Supply to this study's estimate of the Maximum KG-Demand, based on the number of persons eligible to access the Government Supply and the maximum amount they were eligible to obtain based on the application 'Proposed Daily Amount'.

[8] The theoretical maximum does not include the persons eligible for Government Supply who never place an order. It includes the existing and new ATP-GS who are expected to make use of the Government Supply and the new PUPL/DPPL persons who are eligible for interim Government Supply.

[9] There was little predictable seasonality in KG-Supply data by month for 2010 and 2011.

purpose of costing the Government Supply contract, that there was a constant 85% ratio between KG-Supply (and KG-Demand) and KG-Produced.

The KG-Produced is given in the Status Quo scenario by:

(18) KG-Produced(t) = KG-Supply(t) / 0.85

Government Supply - Contract Cost

Health Canada contracted Government Supply costs were documented for 2005-06 to 2009-10 as part of a HC (2009) Supplemental Funding Request. These costs were in addition to Health Canada administration costs.

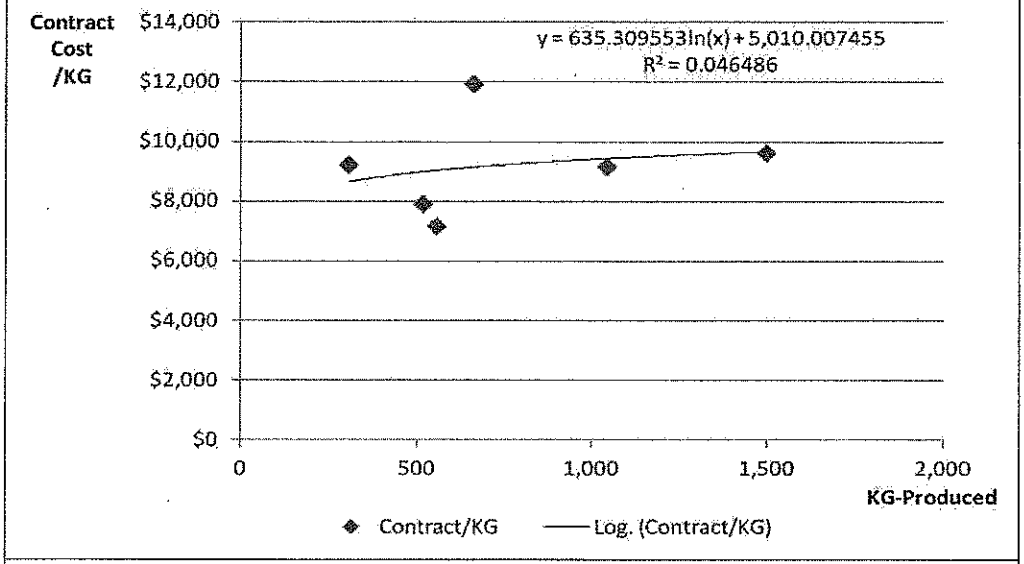
Contract Cost included dried marihuana supply, marihuana seed pouches, various reporting requirements and other miscellaneous work. Payment was made against a schedule of unit costs negotiated in a supply contract between the Government of Canada and the contract Government supplier.

The contracted KG supply costs were known for six fiscal years that spanned the two Supply Contracts signed in 2008 and 2010. There were two prices specified in the Contract: a) a price for 'base quantity' (referred to by Health Canada as 'firm deliverable'); and b) a price for 'optional quantity'. For the purposes of estimating a supply cost, a weighted average was selected, with 90% of the price of the 'base quantity' and 10% of the price for the 'optional quantity'.

These prices were plotted against actual and estimated KG produced for FY2008-09 to 2013-14 in Figure 4.8. There was a poor fit to the data as there was an increase for prices in the 2010 contract over the 2008 contract, but in each of these contracts there was (generally) declining prices over the three fiscal years of the contract. This produced a 'ratcheting' movement over time. Even though the estimated fit of a logarithmic function was poor, this model was used, as it made full use of available data[10].

[10] While the statistical 'fit' of the logarithmic regression is poor it still captures the (generally) upward movement over time (between successive Contracts) but at a declining rate that seems to be reflected by the decrease over time for the years of any particular Contract. Neither the slope not intercept parameter had much impact on the variation of the NPV results.

Figure 4.8 – Status Quo – KG Supply Cost
Relation of KG-Supply Cost and KG-Produced
and Fitted Logarithmic Function



Sources: Delsys Research

The logarithmic equation allowed a prediction of the future KG supply cost over time in the Status Quo scenario as:

(19) KG Supply Cost(t) = 5,010 + 635.3 * LN[KG(t)]

where:

LN[KG(t)] = is the natural logarithm of forecast KG-produced over time.

An estimated KG Cost was then calculated, based solely on the KG Supply Cost and the KG-Produced forecast. This value would not represent the full Contract Cost as it excludes the costs associated with seeds, reporting and miscellaneous work requirements for which the contract supplier is compensated under the contract. It does represent the bulk of the Contract Cost.

Estimated KG Cost over time in the Status Quo scenario is given by:

(20) Estimated KG Cost(t) = KG-Produced(t) * KG Supply Cost(t)

A comparison of the relationship for the observed and estimated period for FY2005-06 to FY2013-14 can be made between the Health Canada reported Contract Cost (for all items) and the Estimated KG Cost. This ratio has fluctuated from 67% to 92% over time. This study assumed that the Estimated KG Cost represented a fixed 90% ratio to Contract Cost over the forecast period.

Estimated Contract Cost over time in the Status Quo scenario is given by:

(21) Contract Cost(t) = Estimated KG Cost(t) / 0.90

4.2.4 Program Cost

The total Health Canada Program Cost for the MMAP is the sum of the Program Administrative Cost and the Contract Cost.

Total Program Cost over time in the Status Quo scenario is given by:

(22) Total Program Cost(t) = Contract Cost(t) + Program Administrative Cost(t)

For the purposes of the CBA it is important to note that the Administrative Cost component was treated as an economic cost of the program administration while the Contract Cost was treated as the supply cost associated with a market transaction in the estimation of Consumer Surplus and Producer Surplus.

4.2.5 Status Quo – Business Compliance Cost

It was assumed that Regulatory Compliance Cost was 10% of the Contract Cost. There was no available evidence to support this assumption but the best available information was that the new regulations governing LP supply security and reporting requirements would be less onerous than those embedded in the Government Supply contract.

Compliance Cost over time in the Status Quo scenario is given by:

(23) Compliance Cost(t) = Contract Cost(t) * 0.10

4.2.6 Status Quo – Government Supply Curve

The Government Supply Curve is the relationship between KG-Demand and Supply Price per KG over time. This differs from the Estimated Contract Cost as it: a) excludes the Compliance Cost component; and b) uses KG-Demand as the denominator (rather than KG-Produced).

Generally, the volume of seeds produced and supplied is a trivial component of the Supply Contract and is omitted from these calculations.

The Supply Price per KG-Demand over time in the Status Quo scenario is given by:

(24) Supply Price/KG-Demand(t) = [Contract Cost(t) * (1 - 0.10)] / KG-Demand(t)

When the Supply Price per KG-Demand and the KG-Demand are plotted over time for the forecast period, an upward sloping Government Supply Curve is obtained.

The linear equation for the Government Supply Curve over time in the Status Quo scenario is given by:

(25) Supply Price/KG-Demand(t) = 11,511 + 0.160595 * KG-Demand(t)

where

S-Intercept-GS = 11,511

S-Slope-GS = 0.160595 (times the quantity supplied in KG)

4.3 Status Quo– User Benefits & Costs

The existence of a market for transacted quantities of legal marihuana for medical purposes allows an inference, from observed and estimated market quantities and prices and parameters related to linear Demand and Supply curves, of measures of welfare in the form of *Consumer Surplus* and *Producer Surplus*. Before formulae for these welfare measures can be derived, intercept and slope parameters for the Supply and Demand curves must be developed. For the Demand curve, the single parameter assumed in this study will be the Price Elasticity of Demand.

4.3.1 Price Elasticity of Demand

Marihuana is a controlled substance and shares many of the demand characteristics of *illegal drugs*. Demand for illegal drugs has been found to be price inelastic, meaning that the percentage change in quantity demanded is less than the (absolute value) of the percentage change in price.

Mathematically, own-price elasticity of demand ε_p is defined in this study as:

$$\varepsilon_p = \%\Delta \text{ in quantity} / \%\Delta \text{ in price} = d(\ln q) / d(\ln p)$$

where d is the differential operator and ln is the natural logarithm function, q is quantity demanded and p is price.

A comprehensive assessment of US marihuana demand [Rhodes et al (2000)] found evidence that ε_p was in the inelastic range of -0.25 to -0.50 for young people and less frequent adult users. Marihuana price elasticity was:

- lower in the short term than the long term [Becker et al (2006) show that habits change slowly for products with physical and/or social addiction];
- lower for frequent versus first-time users than for regular users [Bretteville-Jensen (2006) shows higher price elasticity among heavy users of heroin]; and
- lower for young adults than for older users.

A comparable form of price responsiveness has been found for a 'participation' elasticity which measures the relationship between price changes and the number of users. A participation elasticity for marihuana of about -0.3 is reported [Kilmer et al (2010)].

The demand for *legal marihuana for medical purposes* might differ from the demand for marihuana as an illicit substance and might be closer to that for prescription drugs. It is important to note that marihuana is not an approved therapeutic product in Canada.

Qualification – Marihuana for Medical Purposes is not an Approved Therapeutic Product
Marihuana for medical purposes is not an approved therapeutic product and the scientific studies of the safety and efficacy of marihuana for medical (therapeutic) purposes are generally inconclusive [Health Canada (2010)].
HC (2010) *Marihuana (marijuana, cannabis)* – (Information for Health Care Professionals)

With this qualification, it may still be that the demand for marihuana for medical purposes exhibits similarities (in terms of consumer preferences and price sensitivity) to demand for prescription drugs. At the very least, individual Canadians appear *to perceive* there to be anecdotal therapeutic benefit of marihuana consumption in relation to various disease conditions.

The price elasticity of demand for prescription drugs in Canada has been estimated at ε_p = -0.10 to -0.15 [Contoyannis et al (2005)] or very inelastic.

Prescription drug price elasticity was:

- lowest ($|\varepsilon_p| < 0.20$) for lowest income/lowest usage *and* for moderate income/highest usage;
- highest ($|\varepsilon_p| > 1.0$) for higher income/low-to-moderate usage.

Another study [Kapur-Basu (2005)] found a similar non-linear relationship between drug expenditures and household income with an overall (average) income elasticity for prescription drugs of ε_y approx = 0.

Empirical evidence for Canada does not indicate much price sensitivity (in terms of out-of-pocket costs) for prescription drug demand for changes in price. The low price elasticity of demand for prescription drugs is a result of medical need and the generally low out-of-pocket cost for prescription medicines after insurance (public and private) plan coverage[11].

The combined evidence from both marihuana use (as an illegal substance) and from prescription drug use (as a legal substance) indicate that the price elasticity of demand for marihuana for medical purposes is likely to be low (inelastic) and in the range of ε_p = -0.10 to -0.50 (with a median value of ε_p = -0.25). It was therefore expected that the Marshallian demand curve for marihuana for medical purposes would be downward sloping with a steep slope indicating highly price inelastic.

For the purpose of the CBA study, linear demand and supply curves were assumed. These are the simplest economic specification and facilitate calculation of Consumer Surplus and Producer Surplus measures. They also require the fewest assumptions (e.g., intercept and slope) which must be inferred based on minimal empirical evidence.

[11] At present (2012), expenses to acquire legal marihuana for medical purposes is not eligible for reimbursement under Provincial/Territorial Drug/Health plans. For this reason the Status Quo scenario assumes that 100% of the cost of accessing a legal supply of marihuana for medical purposes is borne by the user.

The price elasticity of demand for a linear demand curve varies at different points along the curve, with high price elasticity at points near the y-axis intercept (i.e. zero demand) and low price elasticity at points near the x-axis (i.e. maximum demand) intercept point. The assumption that the Status Quo scenario supply markets all exhibit inelastic demand (at the observed positions of supply price and actual consumption) means that the observed market position is found towards the lower right-hand arc of the demand curve close to the x-axis.

Annex 1 contains a comprehensive discussion of the concepts of Consumer and Producer Surplus and the challenge of estimating the impacts of a policy change that involves:

- the existence of an effective consumer subsidy in the Status Quo scenario; and

- a Policy scenario that removes the effective subsidy and also allows for more efficient, lower cost supply.

For the case of the portion of the market that involves the Government Supply, this is effectively what occurs between the Status Quo and the Policy scenarios.

Measures of Consumer Surplus and Producer Surplus were estimated for three categories (i.e., separate markets) of persons with ATP:

1. Government Supply Market: persons who access marihuana for medical purposes from the Government Supply through Health Canada;

2. Personal Use Market: persons who supply their own marihuana for medical purposes from self-cultivation; and

3. Designated Person Market: persons who access a supply of marihuana for medical purposes from a designated person who grows it for them.

These categories were treated as separate markets for two main reasons: a) the supply price is estimated to be very different between these markets; and b) the product characteristics of the marihuana may vary considerably between the Government Supply (i.e., a single strain of cannabis) and 'private production' (i.e. which may involve many strains of cannabis). The available literature on cannabis use suggested that certain users have a marked preference for certain strains of cannabis. There was no scientific evidence as to the actual or possible therapeutic properties of different strains of cannabis.

4.3.2 Government Supply Market

A Government Supply curve was estimated in equation 25. This involved a linear relationship between the KG-Demand and the Supply Price per KG-Demand. For the purpose of estimating Consumer Surplus and Producer Surplus, the Government Supply curve Slope was kept constant at the value (0.160595) in equation 25 and the Supply curve Intercept was allowed to vary slightly over time so as maintain the constant slope at the equilibrium values (Supply Price per KG-Demand, KG-Demand) determined from equations 24 and 17 above.

The slope of an upward-sloping line is given by the ratio:

$$\text{Slope} = \text{Rise} / \text{Run} = (\Delta\text{vertical} / \Delta\text{horizontal})$$

The Δvertical up the y-axis (price) is given by the difference between a point on the Supply Curve (i.e. Supply Price per KG-Demand) and the Supply Intercept.

The Δhorizontal along the x-axis (quantity) is given by the difference between KG-Demand and Zero (i.e. the quantity associated with the Supply Intercept).

Therefore:

Slope = (Supply Price per KG-Demand - Supply Intercept) / (KG-Demand - 0)

This equation can be rearranged to solve for the value of the Supply Intercept. The Government Supply curve Intercept over time in the Status Quo is given by:

(26) Intercept-GS(t) = Supply Price per KG-Demand(t) – [KG-Demand(t) * Slope-GS]

The definition of the price elasticity of demand is:

Price Elasticity ε_p = %Δ in quantity / %Δ in price

One point on the Demand curve (for the Government Supply) is known, as this is the point (observed or forecast) that results in quantity KG-Demand at the User Price ($5.00/gram * 1,000 grams = $5,000/KG).

In order to estimate the value of the Demand Intercept, the known point and the Price Elasticity of Demand can be utilized. By definition, the Demand Intercept is the point where the Demand curve intersects the y-axis and the quantity demanded is equal to zero. This corresponds to a -100% change in quantity. Therefore, the associated % change in price can be determined.

%Δ in price = %Δ in quantity / ε_p

The %Δ in price associated with the movement from the point (User Price, KG-Demand at User Price) to the Demand Intercept is given by:

%Δ in price = (Price Intercept – User Price) / User Price

These two equations can be brought together to give the following value of the Demand Intercept. The Demand curve Intercept (for the Government Supply) over time in the Status Quo scenario is given by:

(27) Intercept-D(t) = User Price(t) [1 – (1.0 / ε_p)]

With two points of the Demand curve specified – the y-axis intercept and the observed transaction point (User Price, KG-Demand at User Price) – and the assumption that this curve is linear, it is possible to calculate the Demand curve Slope (which is negative as the curve is downward-sloping).

The Demand curve Slope (for the Government Supply) over time in the Status Quo scenario is given by:

(28) Slope-D(t) = [User Price(t) – Intercept-D(t)] / KG-Demand(t)

One characteristic of a constant Price Elasticity of Demand and a constant Demand Intercept is that the Demand Slope declines (in absolute value) as the scale of the market (i.e., KG-Demand) increases.

As shown in Figure 4.9, the Government Supply users (ATP-GS and those who are new ATP-P/D who access an interim supply) face an (effectively subsidized) User Price ($5,000/KG) when they consume KG-Demand. The actual cost associated with KG-Demand is the higher Supply Cost.

In the absence of an effective subsidy, users would face a price slightly less than the Supply Cost (associated with KG-Demand) and would consume at KG*-Equilibrium. Note that the Supply curve (while somewhat flat) is not horizontal, and has a positive slope.

Because the equations for the Supply and Demand curves are known and the equilibrium is determined by their intersection, it is possible to determine the value of KG*-Equilibrium.

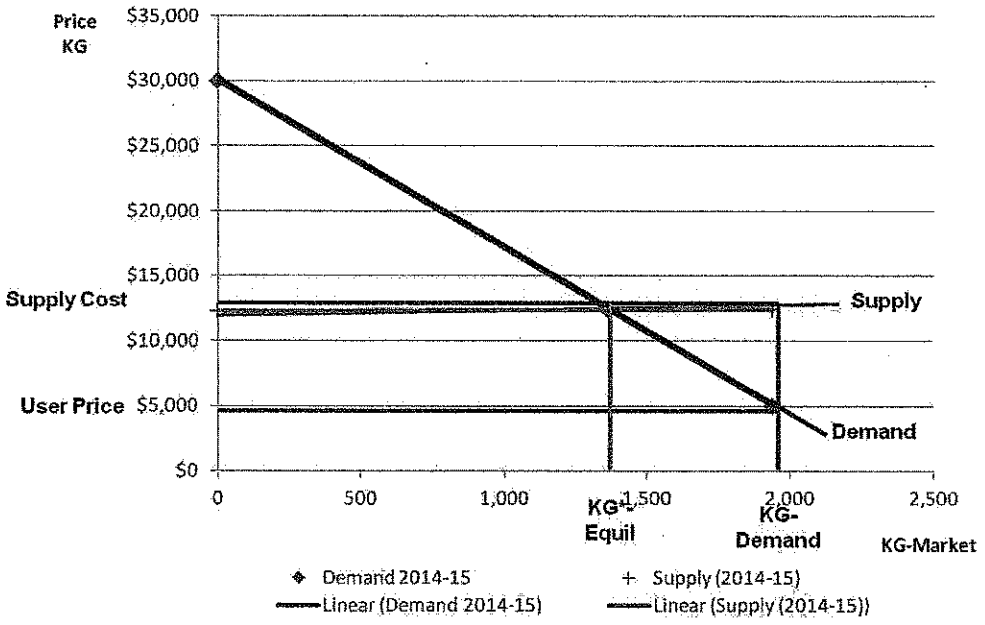
If the Demand and Supply curves are given by:

Supply Curve = Intercept-GS(t) + (Slope-GS * KG)
Demand Curve = Intercept-D - (Slope-D(t) * KG)

then it can be determined that the KG*-Equilibrium over time in the Status Quo scenario is given by:

(29) KG*-Equilibrium(t) = [Intercept-D – Intercept-GS(t)] / [Slope-GS + Slope-D(t)]

Figure 4.9 – Status Quo – Government Supply
Demand & Supply Curves Showing KG*-Equilibrium
and KG-Demand at (Effectively Subsidized) User Price



Sources: Delsys Research

NB: as supply curve is flat-ish it is not possible to show equilibrium price line.

The associated P*-Equilibrium can then be found using the above value for KG*-Equilibrium and either the Supply or Demand equations.

Using the Demand curve equation, P*-Equilibrium over time in the Status Quo scenario is then given by:

(30) P*-Equilibrium(t) = Intercept-D + [Slope-D(t) * KG*-Equilibrium(t)]

Consumer Surplus-GS

Consumer Surplus is a measure of the user benefit not captured in the market transaction. As the Demand curve represents the *marginal willingness-to-pay* for consumption, Consumer Surplus is the integral of marginal willingness-to-pay above the transacted value. This is (for an unsubsidized market) the area under the Demand curve and above the price line at the market equilibrium quantity.

For a situation of a subsidized market, as is the case here, the Consumer Surplus (Government Supply) is the area under the Demand curve and above the Supply Cost associated with the User Price at the KG-Demand[12]. While the Supply curve is very flat, it is not horizontal. In order to correctly estimate the Consumer Surplus, it is necessary to find the KG'-Demand that is associated with the Supply Price per KG.

Using the Demand Curve equation, KG'-Demand over time in the Status Quo scenario can be determined by:

(31) KG'-Demand(t) = [Intercept-D - Supply Price per KG-Demand] / Slope-D(t)

Consumer Surplus can be estimated using a geometric formula which exploits the fact that, with linear Demand and Supply curves, the areas to be measured are triangles whose area is half that of the associated rectangles.

Consumer Surplus (Government Supply) over time in the Status Quo scenario is given by:

(32) CS(Govt Sup)(t) = 0.5 * [Intercept-D - Supply Price per KG-Demand(t)]

* KG'-Demand(t)

Producer Surplus-GS

For reasons explained in Annex 1, there is no Producer Surplus (Government Supply), as the market is subsidized and the marginal cost of production is always above the (effectively) subsidized price.

Deadweight Loss-GS

[12] See Annex 1 for a more detailed explanation of this point.

Deadweight Loss is the cost of producing at a quantity that exceeds KG*-Equilibrium such that the social value (i.e. willingness-to-pay) is less than the marginal cost of production. This occurs in markets where there is a subsidy or tax that creates a 'price wedge' between what users pay and what suppliers receive in a market transaction. The Deadweight Loss (Government Supply) over time in the Status Quo scenario is given by:

(33) DWL(Govt Sup)(t) = {0.5*[P*-Equil(t) - User Price(t)] * [KG-Dem(t) – KG*-Equil(t)]}

+ {0.5*[Supply Price(t) - P*-Equil(t)] * [KG-Dem(t) – KG*-Equil(t)]}

The Deadweight Loss calculation requires the area of two triangles to be calculated.

This completes the discussion of the Government Supply market in the Status Quo scenario.

4.3.3 Personal-Use Supply Market

Equation 2 gives the number of persons with a PUPL who self-supply their marihuana under the MMAR in the Status Quo scenario.

Personal Use – Supply Cost

The estimate for Supply Cost (Personal Use) used in the CBA model was based on an Activity-Based Costing (ABC) model which follows the analysis of a small-scale indoor grow-op [Kilmer et al (2010), Caulkin (2010)]. The model converted from US imperial/dollar units to Canadian metric/dollar units and replaced certain values (e.g. electricity cost per kwh) with Canadian values. In addition, the opportunity cost for residential facility space and own time was included.

The maximum number of allowable plants for the mean Proposed Daily Amount (for ATP-P persons) was calculated using the Health Canada formula. For a mean PDA of 7.6 grams, this corresponded to 37 marihuana plants. The space requirement for this number of plants was based on 15 plants per square metre. The dried marihuana yield was 30 grams per plant per harvest and there was an assumed 3 harvests per year.

Variable labour cost was calculated using an assumption that each harvest (for this quantity of plants) required 60 labour hours and an opportunity cost of $10.00 per hour. Estimates of growing medium/supplies, electricity, space cost (for growing, drying and supplies) and equipment requirements were also used. There was also an estimate of fixed labour (equipment set-up) costs in addition to space usage cost based on a proportion of amortized housing cost.

The resulting Supply Cost (Reference case) was estimated at $1.80/gram (or $1,800/KG). In the CBA analysis, the sensitivity of the results was tested by allowing this parameter to vary over a range of values.

Table 4.1 – Status Quo – Personal-Use Supply Cost		
Cost Summary per m^2 of Grow Area	**Per Harvest**	**Per Year**
Variable Consumables & Power	$222	$667
Variable Labour	$240	$720
Fixed Space & Equipment & Labour	$210	$631
Total Cost	$673	$2,018
Cost Using m^2 of Grow Area	**Per Harvest**	**Per Year**
Variable Consumables & Power	$555	$1,666
Variable Labour	$600	$1,800
Fixed Space & Equipment & Labour	$526	$1,579
Total Cost	$1,682	$5,045
Assumed Personal Use (Grams)		2,774
Cost per Gram of Use		**Per Year**
Variable Consumables & Power		$0.60
Variable Labour		$0.65
Fixed Space & Equipment & Labour		$0.57
Total Cost		**$1.82**
Sources: Delsys Research		

Personal Use – KG-Demand

As with Government Supply users, a Maximum KG-Demand for Personal Use was calculated based on the mean PDA (7.6 grams) for ATP-P persons and the maximum number of days that persons could consume, allowing for persons who were ATP-P at the start of the Fiscal Year to consume for 12 months (at 30 days per month) and new ATP-P persons to consume for 3 months, on average (after they have successfully harvested their first crop, during which they are eligible to access the government supply for 4 months).

The Maximum KG-Demand (Personal Use) is given in the Status Quo scenario by:

$$\text{(34) Max KG-PU}(t) = \{[\text{Starting ATP-P}(t) * 12 * 30 * \text{PDA-P}] + [\text{New ATP-P}(t) * 3 * 30 * \text{PDA-P}] / 1{,}000$$

where the first term in each of the two expressions on the right-hand side of the equation is the number of relevant ATP persons eligible for Personal Use production, the first integer is the months of possible supply in the FY, the second integer is the mean days per month and the last term is the mean Proposed Daily Amount (a maximum) for each category of user.

In terms of actual use, it was assumed that this is less than the amount indicated in the PDA figure. For Personal-Use ATP persons, the PDA figure determines the maximum amount of marihuana plants legally allowed to be grown. This likely overstates actual usage. Data on MMAP users [Lucas (2009)] suggests that about 72% of users rely on inhalation methods of ingestion while 28% of users rely on oral methods of ingestion. Analysis [Kilmer-Pacula (2009)] suggests that heavy marihuana users (presumably smokers) consume about 1.2 grams per day +/- 0.4 grams. If this range is considered to represent a Standard Deviation (SD), then very

heavy smokers might consume 2.0 grams per day (i.e. the mean of 1.2 plus two SD). Assuming that oral ingestion requires five times the amount of marihuana than that required for inhalation, 10.0 grams per day can be estimated as the oral ingestion mean. A weighted average of these would come to about 4.2 grams per day.

The ratio between the estimated mean daily consumption (4.2 grams) and the mean PDA for ATP-P (7.6 grams) provides the effective Utilization Rate (Personal Use), which is equal to 55%.

The KG-Demand (Personal Use) is given in the Status Quo scenario by:

(35) KG-Demand(t) = Max KG-PU(t) * Utilization Rate-PU(t)

Personal Use – Supply Curve

For the Personal-Use market segment it was assumed that the Supply Curve is horizontal at the Supply Cost (i.e., infinitely elastic supply which corresponds to Constant Returns to Scale production, based on the replication of small scale operations).

Personal Use – Demand Curve

Based on the estimate of the equilibrium quantity demand (equation 35) it is possible to infer, using the estimated Price Elasticity of Demand, the parameters of the Demand curve.

The Demand curve intercept (for Personal Use Supply) over time in the Status Quo scenario is given by:

(36) Intercept-D(t) = Supply Price(t) [1 – (1.0 / ε_p)]

As there were two known points of the linear Demand curve – the y-axis intercept and the estimated transaction point (Supply Price, KG-Demand at Supply Price) – it was possible to calculate the Demand curve slope (which is negative as the curve is downward-sloping).

The Demand curve slope (for Personal Use Supply) over time in the Status Quo scenario is given by:

(37) Slope-D(t) = [Supply Price(t) – Intercept-D)] / KG-Demand(t)

One characteristic of having a constant Price Elasticity of Demand and a constant Demand Intercept is that the Demand Slope declines (in absolute value) as the scale of the market (i.e. KG-Demand) increases.

Personal Use users have a lower Demand Intercept than those for the Government Supply market. This is a mathematical result of the assumption that the elasticity of demand is the same in the two markets. It implies that the initial (marginal) users of Personal Supply have a lower willingness-to-pay for the initial quantity units than those in the Government Supply market.

Consumer Surplus-PU

Consumer Surplus (Personal Use) over time in the Status Quo scenario is given by:

(38) CS(PU)(t) = 0.5 * [Intercept-D - Supply Price per KG-Demand(t)]

* KG-Demand(t)

Producer Surplus-PU

As the Personal-Use Supply Curve is horizontal, there is no Producer Surplus.

Deadweight Loss-PU

As there is no effective subsidy, there is no Deadweight Loss.

This completes the discussion of the Personal-Use supply market in the Status Quo scenario. In the next section, dealing with the Designated-Person supply market, this logic is replicated.

4.3.4 Designated Person Supply Market

Equation 3 gives the number of ATP persons associated with a DPPL who arrange for a Designated Person to supply their marihuana under MMAR in the Status Quo scenario.

Designated Person – Supply Cost

As noted above, the Supply Cost (Designated Person) was estimated based on an Activity-Based Costing (ABC) model (see description of Personal Use above). There was no information on the specific arrangements that are typically made between persons holding an ATP (the user) and the person with a DPPL (the supplier). Health Canada has no regulations related to the commercial arrangements between these parties. It is possible that a family member does the cultivation, for which the Supply Cost would be comparable to that for Personal Use production. However, the arrangement could involve a person undertaking marihuana production for up to two persons and expecting a commercial return for their efforts.

For the purpose of calibrating a model, the estimated mean PDA for ATP-D persons specified at a higher level (9.0 grams), which allows for a maximum of 44 marihuana plants. The production for a DPPL cultivating for two ATP-D users was scaled to allow for some economies of scale. With similar parameters (as for Personal Use), the estimated Supply Price was lower ($1.40/gram) when no profit and overhead were allowed. When an allowance was made for an overhead/profit factor of 50% of total cost, the CBA model generated a Supply Price of $2.80/gram. This result was very sensitive to the overhead/profit factor. If that value is higher (65%) the Supply Price becomes $4.00/gram.

As the generally accepted supply price from a compassion club is believed to be between $10.00-$12.00/gram, the estimated Supply Price would be more attractive than reliance on the 'grey market' illicit supply from those organizations.

The resulting Supply Cost (Reference case) is estimated at $2.80/gram (or $2,800/KG). The sensitivity of the results was assessed by allowing this parameter to vary over a range of values.

Table 4.2 – Status Quo – Designated Person Supply Cost

Cost Summary per m^2 of Grow Area	Per Harvest	Per Year
Variable Consumables & Power	$222	$667
Variable Labour	$105	$316
Fixed Space & Equipment & Labour	$203	$610
Total Cost	$531	$1,592

Cost Using m^2 of Grow Area	Per Harvest	Per Year
Variable Consumables & Power	$1,933	$5,799
Variable Labour	$915	$2,745
Fixed Space & Equipment & Labour	$1,770	$5,310
Overhead & Profit	$4,618	$13,854
Total Cost	$9,236	$27,708

Assumed Personal Use (Grams)	9,855

Cost per Gram of Use	Per Year
Variable Consumables & Power	$0.59
Variable Labour	$0.28
Fixed Space & Equipment & Labour	$0.54
Overhead & Profit	$1.41
Total Cost	**$2.81**

Sources: Delsys Research

Designated Person – KG Demand

As with Personal-Use users, an estimate was calculated for Maximum KG-Demand for Designated-Person Use based on the mean PDA (9.0 grams) for ATP-D persons and the maximum number of days that persons could consume. This calculation allowed for persons who were ATP-D at the start of the Fiscal Year to consume for 12 months (at 30 days per month) and new ATP-D persons to consume for 3 months, on average.

The Maximum KG-Demand (Designated Person Use) is given in the Status Quo scenario by:

(39) Max KG-DP(t) = {[Starting ATP-D(t) * 12 * 30 * PDA-D]

+ [New ATP-D(t) * 3 * 30* PDA-D] / 1,000

where the first term in each of the two expressions on the right-hand side of the equation is the number of relevant ATP persons eligible for Designated Person production, the first integer is the months of possible supply in the FY, the second integer is the mean days per month and the last term is the mean Proposed Daily Amount (a maximum) for each category of user.

The analysis assumed the same actual mean daily consumption (4.2 grams) as for Personal Use which, compared to the mean PDA for ATP-D (9.0 grams), provides an effective Utilization Rate (Designated Person) equal to 47%.

The KG-Demand (Designated Person) is given in the Status Quo scenario by:

(40) KG-Demand(t) = Max KG-DP(t) * Utilization Rate-DP(t)

Designated Person – Supply Curve

For the Designated Person market segment it was again assumed that the Supply Curve is horizontal at the Supply Cost (i.e., infinitely elastic supply which corresponds to Constant Returns to Scale production-based on the replication of small scale operations).

Designated Person – Demand Curve

Because the equilibrium quantity demand (equation 40) was already estimated, it was then possible to infer, using the assumed Price Elasticity of Demand, what were the parameters of the Demand curve.

The Demand curve Intercept (for Designated Person Use Supply) over time in the Status Quo is given by:

(41) Intercept-D(t) = Supply Price(t) [1 – (1.0 / ε_p)]

As there were two known points on the linear Demand curve, the y-axis intercept and the estimated transaction point (Supply Price, KG-Demand at Supply Price), it was possible to calculate the Demand curve Slope (which is negative as the curve is downward-sloping).

The Demand curve Slope (for Designated Person Supply) over time in the Status Quo is given by:

(42) Slope-D(t) = [Supply Price(t) – Intercept-D)] / KG-Demand(t)

Designated-Person users have a lower Demand Intercept than those for the Government Supply market. This is a mathematical result of the assumption that the elasticity of demand is the same in the two markets. It implies that the initial (marginal) users of Designated-Person Supply would have a lower willingness-to-pay for the initial quantity units than those in the Government Supply market.

Consumer Surplus-DP

Consumer Surplus (Designated Person) over time in the Status Quo is given by:

(43) CS(DP)(t) = 0.5 * [Intercept-D - Supply Price per KG-Demand(t)]

* KG-Demand(t)

Producer Surplus-DP

As the Supply Curve is horizontal there is no Producer Surplus.

Deadweight Loss-DP

As there is no effective subsidy there is no Deadweight Loss.

4.4 Status Quo – Safety Costs

The policy rationale for the proposed regulatory change involves a number of risks to public health and safety including: a) fire risk due to use of family residence for marihuana cultivation; and b) health risk for family members and public service officials as a result of the possible presence of mould, chemicals and other toxic materials related to the production of marihuana.

For the purposes of this CBA, only the safety costs associated with the risk of fire were quantified, as this is more tangible and has better data availability than the other risks. The broader safety risks are addressed in the qualitative analysis discussion.

4.4.1 Fire Risk Due to Faulty Electric Wiring/Use & Outcomes

One intended consequence of the proposed regulatory change is an improvement to public safety, by removing from residential areas the locus of legal marihuana cultivation under the MMAR (i.e. home cultivation under PUPL/DPPL).

Fire Causes Specific to Residential Marihuana Cultivation

The principal public safety risk relates to house fire caused by faulty electrical wiring, overloading of electrical circuits, tampering with electrical usage monitoring and other electrical system malfunctions.

Evidence has been offered in support of the existence of such fire risks associated with indoor marihuana cultivation (i.e., grow operations) although much of this evidence is not specific to misuse of PUPLs/DPPLs:

- [Ontario Fire Marshal/OPP (2009)] reported for a 6-month period that they had been called to fires involving either a marihuana grow operation or illegal drug lab approximately every 15 days (i.e. 24 times/yr)[13];

- [Plecas et al (2005)] estimated that marihuana grow-ops have a 24x greater risk of residential fire than a regular home and that Surrey, BC (2003) attributed about 9% of house fires to electrical problems in marihuana grow-operations[14]; and

- [RCMP (2010)] reported that among MMAR 'misuse' cases (n=190) there were 23 cases (12%) where electrical hazard was mentioned, and 2 cases (1%) where a fire had occurred.

Health Canada regulatory analysis dealing with cigarette ignition propensity [Health Canada (2005)] used fire statistics from the Canadian Association of Fire Chiefs *Annual Report – Fire Losses in Canada* for various years to estimate probabilities of fires. This analysis followed that approach using available average Canadian data for a five-year period (1998-2002) that involves the most recent data available.

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[13] An unknown proportion of these involved other 'drug labs' and were not specifically marihuana grow-op related.
[14] As Surrey and British Columbia (more generally) are thought to be hotspots for marihuana grow-operations, these rates may not be representative of the average situation across Canada

Fire Outcomes

The overall annual fire numbers (annual average over the five-year period 1998-2002) are shown in Table 4.3. The following information is provided: a) the number of total fires, b) the death rate per fire, c) the injury rate per fire, d) the average property damage per fire and information about the number of fires (by type) for residential occupancy (one- and two-family dwellings) compared to the number of Census (2001) family dwellings of a similar nature[15].

Table 4.3 – Canada Fire Data (Annual Average 1998-2002)	
Total Annual Fires	55,081
Total 1-2 Family Dwellings	8,273,535
Total 1-2 Family Dwelling Fires	11,279
Incidence of 1-2 Family Fire (per 100,000 family dwellings)	136
Rate of death per Fire	0.0062
Rate of injury per Fire	0.0448
Property Damage per Fire	$23,654
Source: CCFMFC *Annual Report – Fire Losses in Canada* for selected years.	

For the CBA analysis, it was necessary to focus on risks associated with faulty wiring in residential homes. Data provided by the Canadian Association of Fire Chiefs data has several breakdowns of relevance to this analysis. The fire loss data provides the statistical breakdown for fires by:

- *Property classification*: which includes residential occupancy and further breakdown for 1- & 2-family dwellings (urban, rural) which is most relevant for MMAR misuse circumstances;

- *Sources of ignition*: which includes three categories relevant for MMAR misuse special electrical circumstances, i.e., 1) appliances and equipment (e.g. dryers, electrical appliances); 2) electrical distribution equipment (e.g. electrical wiring); and 3) other electrical equipment (e.g. lamps, electrical motors); and

- *Act or omission causing fire*: which includes two possible categories relevant for MMAR misuse special circumstances, i.e., 1) mechanical/electrical failure or malfunction (e.g. short circuit, part failure); and 2) construction design/installation deficiency (e.g. over-fusing).

As the death, injury and property damage profiles for all three relevant sources of ignition were similar, the CBA took an aggregate profile of their combination to represent the situation for special ignition sources specific to the marihuana 'grow-op' situation.

The analysis used the death, injury and property damage profiles for the latter act or omission causing fire to represent the situation for special acts/omissions specific to the marihuana

[15] Census (2001) Dwelling count for single-detached, semi-detached, row house, detached duplex apartment and other single-attached house. This is said to correspond to the one- and two-family dwellings from CCFMFC data.

production misuse associated with the MMAR, as it was more deadly and seemed to better relate to the main fire safety concern related to 'jimmy-rigged' electrical systems (e.g., electrical over-loading, poor electrical wiring, breaker-box bypass) involved in 'grow-op' situations.

Table 4.4 shows the fire data specific to these circumstances of interest.

Table 4.4 – Detailed Fire Data (Annual Average 1998-2002) for special circumstances relevant to 'grow-op' situations

	All	FRD	Electrical	Design/Install
Total Annual Fires	55,081	11,279	8,463	2,492
Probabilities	100%	20.5%	15.4%	4.5%
			Compound Factors	
Rate of death per Fire	0.0062	2.0815	0.3765	0.5872
Rate of injury per Fire	0.0448	1.7715	0.8382	0.6704
Property Damage per Fire	$23,654	1.2121	1.2074	1.0949

Source: CCFMFC Annual Report – Fire Losses in Canada for selected years.
FRD – Family residential dwelling
Electrical – all forms of electrical sources of ignition
Design/Install – construction design/installation act or omission

The row for total annual fires shows the annual average for the five-year period for each separate circumstance of interest relevant to the marihuana production misuse situation.

The row for probability shows the ratio of number of fires for a specific circumstance to the total number of fires.

The column for 'All' shows the actual rates (for all fires) for death and injury and the average property damage per fire.

The rows of rates (death and injury and property damage per fire) for the columns for 'Family Residential Dwelling' (FRD), 'Electrical' and 'Design/Install' show a compounding factor which, when applied to the overall rates (of death and injury) or for property damage per fire, yield the appropriate values which can separately by derived from the data directly for those values.

The data was compiled in this way because the CBA model required the assumption that the probabilities and compound factors for the three circumstances of interest are statistically independent. This assumption allows them to be used multiplicatively (without adjusting for correlations which would be required if they were not independent) to develop compound probabilities and compound rates (for death/injury) and compound property damage per fire.

These values for the compound factors suggest that, for example:

- *1 & 2 family residential fires* (FRD): have a higher (208%) death rate (than for all fires), a higher (177%) injury rate and higher (121%) property damage per fire;

- *Electrical source of ignition fires* (Electrical): have a lower (38%) death rate (than for all fires), a lower (84%) injury rate and higher (121%) property damage per fire; and

fire is present in 12% of MMAR 'misuse'. In the section of this report dealing with public security (below), an 80:20 'rule of thumb' was assumed in respect of MMAR 'misuse'. This assumption postulates that *major* misuse (i.e., closest to a grow operation) is 20% of all estimated misuse while 80% involves *minor* misuse (i.e., misuse of a smaller scale of criminality and involving minimal grow-operation conditions, such as distribution of excess marihuana production to friends).

The alleged MMAR misuse data found that there were n=2 cases (1%) where a fire had occurred. As this probability is specific to MMAR misuse, which is a specific focus of concern in the CBA, this probability was used for the risk of fires associated with misuse of marihuana cultivation activities under MMAR production licenses.

How does this MMAR-misuse-related fire risk relate to the fire risk for all residences? Based on data from the Canadian Association of Fire Chiefs, it was estimated that the probability of a house fire among all Canadian residences (one- and two- family dwellings) associated with all causes was 0.14%. If the 1% probability of fire among known MMAR misuse cases is taken as a true measure, it suggests that the probability of fire for a MMAR misuse is about seven (7) times higher than for an average house. This estimate compares to a BC estimate [Plecas et al (2005)] that a marihuana grow-op has a twenty-four (24) times greater risk of residential fire than a regular home. As MMAR misuse involves a family residence compared to most grow-ops which are dedicated to marihuana cultivation, it would be reasonable to expect family members to engage in less risky makeshift electrical setups than is found in an average marihuana grow-op, so the lower risk assumed in the CBA may be more in keeping with this type of less risky and smaller scale operation than a full (average) marihuana grow-op.

The specific fire risk and outcome parameters (Table 4.5) were utilized in the CBA.

4.4.3 Residential Dwellings at Risk

The 78 fires (for simplicity the base period was assumed to be 2002) are related to specific circumstances relevant to marihuana 'grow-op' situations. However, it is known that they arise from all marihuana 'grow-ops' and not just those associated with the misuse of MMAR production licenses (PUPL/DPPL).

In the section (below) on public security risk, it was assumed that 36% of MMAR production licenses (PUPL/DPPL) were involved in some degree of possible 'misuse' but only 20% of that (i.e. 20% of 36%) was of a *major* misuse which would give rise to the type of elevated fire risk addressed in the CBA . Therefore, using probability compounding, the percentage of all MMAR production licenses giving rise to the elevated risk of house fires would be 2.6% (36% * 20%). This is the constant rate that is applied to a base year number of MMAR production licenses (e.g. 2012 value of 12,000) with growth over time in the Status Quo scenario. Therefore, for example, in 2012 there are an estimated 15,000 MMAR production licenses, of which 36% are assumed to be engaged in some degree of alleged misuse (5,400) and only 20% of these are assumed to engage in major misuse (1,080). Of these, 12% are likely to involve the presence of electrical hazards (130) and 1% will experience a house fire (11, rounding from 10.8).

The rate of growth of Census family dwelling has been 1.410% per year (based on the observed Census value for one- and two- family dwellings over the period 2001-05), so there would have been roughly 13,000 house fires in 2012. There were an estimated 13,000 indoor hydroponic marihuana cultivation (grow-op) sites in Quebec in 2000 [Bouchard 2007]. As Quebec

accounted for 46% of Canadian police-reported cases of cannabis cultivation, this would imply that Canadian indoor grow operations were perhaps 28,000 in 2000. The estimated probability of fire for a grow-operation residence is 3.3% [Plecas et al (2005)], so one would expect about 925 house fires associated with grow-operation marihuana cultivation. This compares to an estimate of 11 house fires associated with MMAR misuse of production licenses. Accordingly, the MMAR-related contribution to marihuana grow-op fires would be only 1%.

4.4.4 Misuse-Related Fires – Status Quo

The CBA used the specific fire incidence as a parameter going forward in time as the scale of MMAR production and misuse (quasi 'grow-op') activities was projected to increase.

The benchmark Pr_{fire} is 1%, which was taken to be specific to *major* misuse of MMAR production licenses. This is an increased probability above the baseline risk of fire for a 1 & 2 family residential home (which is estimated to be 0.14% for all of Canada). It was also assumed that there are elevated fire risks for *minor* misuse of MMAR production license (assumed to be 33% of that for *major* misuse) and for no misuse of MMAR production license (assumed to be 10% of that for *major* misuse). The rationale for these categories having some risk of residential fires (above the benchmark) is that, while there is a lesser (or no) level of misuse, there are inherent fire risks from the nature of indoor marihuana cultivation.

For purposes of the analysis it was not possible to lump ATP-P (PUPL) and ATP-D (DPPL) persons together, as there could be multiple DPPLs held by a single producer. In the case of DPPL production, the fire risk (from marihuana cultivation) is not borne by the person holding the ATP-D but the person engaged in marihuana cultivation under the DPPL. The analysis assumed, for production costs, that an average of 1.5 production licenses was held by the average DPPL producer which, in terms of fire risk, means that there is a lower fire risk for each ATP-D user than for each ATP-P user.

PUPL Licenses – Fire Events

The number of fires in the Status Quo scenario associated with MMAR-PUPL production is:

$$\text{(44) House Fire-PU}(t) = \{ATP(t) * \%PUPL * \%Misuse * \%Major * Pr_{fire}\}$$
$$+ \{ATP(t) * \%PUPL * \%Misuse * (1 - \%Major) * Pr_{fire} * 0.33\}$$
$$+ \{ATP(t) * \%PUPL * (1 - \%Misuse) * Pr_{fire} * 0.10\}$$

Where:

ATP-P(t) is the total number of ATP persons in time t

%PUPL (60%) is the proportion of ATPs with PUPL

%Misuse (36%) is the probability of misuse of PUPLs/DPPLs

%Major (20%) is the proportion of misuse that was assumed to be *major* misuse

Pr_{fire} (1%) is the probability of house fire (related to marihuana cultivation) given MMAR *major* misuse.

Pr_{fire} * 0.33 is the probability of house fire given MMAR *minor* misuse.

Pr_{fire} * 0.10 is the probability of house fire given normal MMAR use.

The number of fires is rounded to the nearest integer value.

DPPLs– Fire Events

The number of fires in the Status Quo associated with MMAR-DPPL production licenses is:

(45) House Fire-DP(t) = {[ATP(t) * %DPPL / Scale Factor] * %Misuse * %Major * Pr_{fire}}

+ {[ATP(t) * %DPPL / Scale Factor] * %Misuse * (1 - %Major) * Pr_{fire} * 0.33}

+ {[ATP(t) * %DPPL / Scale Factor] * (1 - %Misuse) * Pr_{fire} * 0.10}

where

%DPPL (20%) is the proportion of ATPs with DPPL

Scale Factor (1.5) is the assumed number of DPPL per Designated Person producer (or is otherwise a scaling factor for possible lower risk for DPPL producers versus PUPL producers).

4.4.5 Fire Outcome Social Cost – Status Quo

Three consequences of fire were assessed quantitatively:

A. *Risk of Death from Fire*

B. *Risk of Injury from Fire*

C. *Property Damage from Fire*

For 'risk of death from fire', the analysis used an estimate specific to fires that involved: a residential home, an electrical source of ignition, and faulty construction design or installation. This was estimated to be 0.28% (2000 data) [CCFMFC *Annual Report – Fire Losses in Canada* data]. The analysis used a Value of Statistical Life of $5.8M [Health Canada (2005)] in the event of a death being realized.

For 'risk of injury from fire', the analysis used an estimate specific to fires that involve: a residential home, an electrical source of ignition, and faulty construction design or installation. This was estimated to be 2.52% (2000 data) [CCFMFC *Annual Report – Fire Losses in Canada* data]. A willingness-to-pay (WTP) to avoid injury was estimated to be $13,300, based on healthcare costs associated with different forms of injury [as reported in Health Canada (2005)] with a scalar adjustment of 2.5 to adjust this health care cost to a WTP measure based on a rule-of-thumb used in some of the literature.

For 'property damage from fire', the analysis used an estimate specific to fires that involved: a residential home, an electrical source of ignition, and faulty construction design or installation. This was estimated to be $37,900 (2000 data) [CCFMFC *Annual Report – Fire Losses in Canada* data].

4.4.6 Status Quo - Fire Costs

For each of the fire events associated with PUPLs and DPPLs, the social costs associated with fires related to marihuana cultivation are given, in the Status Quo scenario over time, by:

$$(46)\ \text{Fire Costs}(t) = [\text{House Fire}(t) * WTP_{damage}] + [\text{House Fire}(t) * Pr_{injury} * WTP_{injury}] + [\text{House Fire}(t) * Pr_{death} * WTP_{death}]$$

where:

WTP_{damage} = $37,903 i.e. the mean property damage per such fire

Pr_{injury} = 4.46%

WTP_{injury} = $13,300

Pr_{death} = 0.28%

WTP_{death} = $5.8M

The total fire costs for the Status Quo scenario are the sum of the Fire Cost for each of PUPL and DPPL.

The number of injuries and deaths for any year is rounded to the nearest integer value. A slight adjustment is made to the Pr_{injury} to reflect the non-integer part of the Pr_{death} so that, effectively, a 'partial death' is treated as an additional injury in the rounding related to the number of injuries.

4.5 Status Quo – Security Costs

The policy rationale for the proposed regulatory change involves a number of risks to public security, including: a) the threat of home invasion and violence to family members (including shooting) as a result of criminal 'grow-rip' from *de facto* grow-op activity under MMAR production license misuse; and b) the exposure to young children in the family to possible criminal activity which may have a lasting impact on such children.

For the purposes of the CBA, only the security costs associated with the risk of home invasion and violence to family members were quantified, as this is more tangible and has better data availability than the other risks. The broader security risks are addressed in the qualitative analysis section of this CBA (below).

4.5.1 Criminal Misuse of MMAR Production Licenses

One intended consequence of the proposed policy is to improve public security by removing from residential areas the locus of legal marihuana cultivation under MMAR (i.e., home cultivation under PUPL/DPPL). It is thought that some portion of PUPL/DPPL production licenses may be used as a 'cover' by persons who divert marihuana into the illicit market. This could take the form of:

a) growing an excess amount above what is legally permitted under the terms of the production license from Health Canada, which is subsequently sold or distributed illicitly; and/or

b) diverting some unconsumed amount of the marihuana grown within the permitted amount under the production license from Health Canada which is subsequently sold or distributed illicitly.

Health Canada Inspections

In 2010, Health Canada carried out special inspections of PUPL/DPPL premises. Of 75 production sites identified: 27 persons answered the door (36%) and of these 15 allowed inspection (55%), while 12 did not allow inspection (45%). Therefore, based on this small sample (n=75), there were 16% of all residences that did not allow inspection and 45% of those residences for which a person was present at the time of the inspection.

Law Enforcement Review of Criminal Misuse

A consortium of 20 law enforcement agencies [RCMP (2010)], providing services to perhaps more than 75% of the Canadian population, reviewed 190 cases over a six- to seven-year period in which police carried out an investigation of a residence for which a person held a valid MMAR production license (PUPL, DPPL)[16].

A review of the suspected 'misuse' cases (Figure 4.10) shows the number of cases reviewed by police. This is compared to the total number of PUPLs/DPPLs to show the 'observed' rate of MMAR misuse which varied from 1.5-3.0% over 2005-2010.

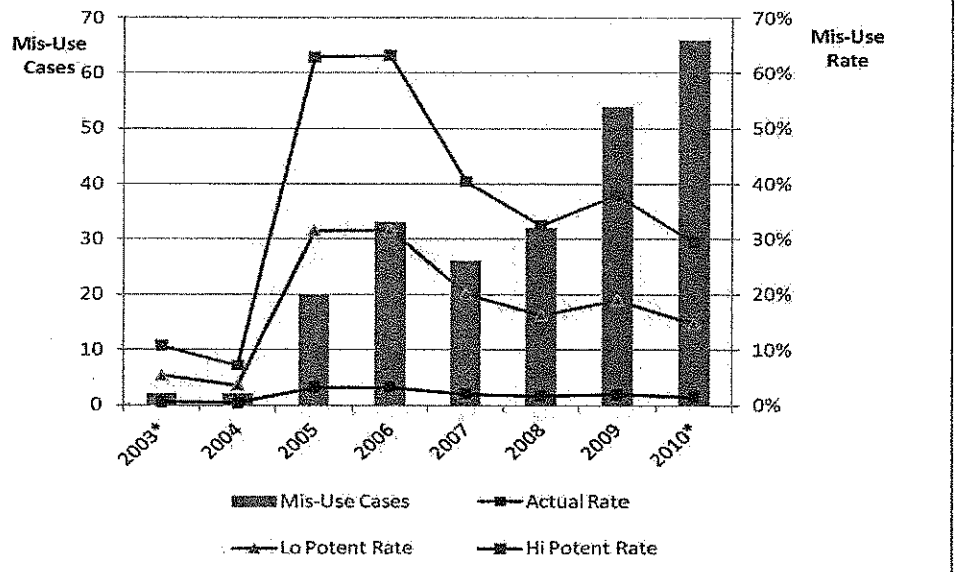
There is a low estimated rate of police detection for marihuana cultivation (i.e. grow operation). One BC study estimated this rate at 5% [Dandurand et al (2002)], while another study estimated the rate for Quebec at 2.5% [Bouchard (2007)]. If a higher (10%) rate of detection is assumed, this implies that the estimated rate of MMAR 'misuse' could be in the range of 15-30%. The lower rate of 5% detection would imply an estimated rate of MMAR 'misuse' in the range of 30-60%. When we use the average-per-year number of alleged misuse cases (29) and the average number of MMAR production licenses per year (1,653) for the 2003-2010 period and assume that there is a 5% probability of detection, it is estimated that about 36% of MMAR production licenses are 'likely' to be involved in misuse. The 36% 'misuse' rate reflects an average observed rate of 1.8% per year and an estimated 5% probability of detection. For purposes of sensitivity analysis, a misuse probability range from 25% to 45% was examined.

[16] The law enforcement agencies include: RCMP, OPP, SQ and municipal police in Toronto, Montreal, Vancouver, Ottawa, Calgary, Edmonton, etc.

It was estimated [RCMP (2010)] that about 13% of Canadian adults have a criminal record. A police review of alleged MMAR misuse cases indicated that in about 50% of MMAR licenses involved in 'misuse' the person had a criminal record (n=67 of 134, with 1 ATP, 9 DPPL and 54 PUPL).

Some alleged MMAR misuse incidents involved the presence of weapons (n=16; 8%) or involved attacks and home invasion (n=16; 8%). There were 2 incidents (1%) where individuals were shot during a home invasion.

Figure 4.10 – MMAR Misuse – Incidents Investigated By Police (2003-10)



Sources: RCMP (2010) and HC (website).
Data are adjusted for full year for 2003 and 2010.

The public security risks arising from 'misuse' under the MMAR relate to:

- Diversion of marihuana produced under PUPL/DPPL to the illicit market;
- Increased resources for law enforcement to address potential misuse – i.e., the need for additional evidence to support reasonable and probable grounds over and above the existence of a residential grow operation, since some operators are authorized and licensed to produce marihuana under the MMAR;
- The corrupting influence of illegal activity occurring in the residence on children residing there; and
- Threat of violence to family members from the potential targeting of the residence for armed robbery by other criminals who want to seize the drugs, profits or materials of crime.

With respect to the presence of children, the police reported that about 8% of MMAR 'misuse' involved the presence of children.

With respect to the threat of violence, the police reported that:

a) weapons were present in 8% of 'misuse' cases;

b) an attack or home invasion had occurred in 8% of 'misuse' cases; and

c) a person was shot during a home invasion in 1% of 'misuse' cases. It is not known whether these cases were all related (i.e., the weapons were necessarily related to the attack/home invasions).

Other data [Dandurand et al (2002)] found that a firearm was involved in about 3% of marihuana trafficking cases.

4.5.2 Social Costs Associated with Crime

Costs of Crime & Willingness-to-Pay to Avoid Crime

CBA techniques have been increasingly applied to crime reduction policy and evaluation of programs. The social cost of crime, or value per crime averted, is comprised of [Bowles (2010)]:

1) *Victim costs*: in terms of damage/replacement of property, health/care cost, loss of earnings, intangible quality-of-life aspects (i.e., WTP to avert pain and suffering);

2) *Fear of crime costs*: willingness to pay to avert possible crime in anticipation of future crimes (which may or may not be informed and rational); and

3) *Criminal justice system costs*: direct costs for police, courts, corrections etc.

Evidence from the United Kingdom (UK) suggests that (for all crime) the relative contribution of these three components is: 70% (victim costs), 5% (fear of crime) and 25% criminal justice system costs [UK-Home Office (2011)]. These components differ by type of specific crime.

There are various national level estimates of the overall 'cost of crime' that range from US$450-1,700B for the US (late 1990s), $40B for Canada (1993 estimate) and AU$35B for Australia (2005 data).

These estimates have been refined to the level of cost of crime by type of criminal offence. They generally rely on one of two types of methodologies:

a) 'Bottom-up' accounting of detailed cost (e.g., activity-based costing); or

b) 'Top-down' measures of individual (or social) willingness-to-pay be avert or avoid crime (or accept the harm caused by crime).

As in most fields where WTP approaches have been applied, the top-down estimates are often two (2) times higher (or more) than the bottom-up accounting estimates [Cohen (2010)].

Macro-econometric analysis [DiTella-MacCulloch (2008)] for the United States (US) found that an increase in the violent crime rate (from 242 to 388 assaults per 100,000 population) was equivalent to a 3.5% decrease in GDP per capita. This result, calibrated for US values for 2011, implied a WTP of US$1.15M to eliminate one violent crime.

Crime Prevention Costs - General

Out-of-pocket costs for the Canadian criminal justice system (1993) have been estimated at about $10 Billion [Federation of Canadian Municipalities (2000)] including the costs of police services, the courts, legal aid and corrections. Evidence from the US and UK suggest that such costs represent perhaps 25% of the entire cost of crime when victim impacts and fear of crime are taken into account [National Crime Prevention Council (1996)].

Crime Prevention Benefits - General

Various United States studies have used stated preference methods to estimate the willingness to pay (WTP) to avoid crimes with estimates by specific types of crime. One study [Cohen et al (2004)] asked individuals to report their willingness to pay to reduce crime in their specific neighbourhood that implied marginal WTP to prevent crimes of about: US$25,000 per burglary, US$70,000 per serious assault, US$232,000 per armed robbery, US$237,000 per rape and sexual assault, and US$9.7 million per murder. As can be seen, these WTP measures have been estimated for serious crimes with clear victim impact.

Most drug crimes (especially drug possession and drug trafficking) are considered to have lesser victim impact. Drugs play into broader criminal activity when considering the criminal acts undertaken by certain drug addicts to meet their drug habit. One US estimate of the annual cost of crime attributable to each drug abuser is approximately US$60,000 [Miller et al (2006)]. Other US evidence [Cohen-Piquiero (2009)] indicates that the WTP to reduce *drug-related crime* among young adults is much lower (US$30,000 per crime) than for other types of crime such as aggravated assault (US$335,000 per crime), armed robbery (US$210,000 per crime) and murder (US$855,000 per crime) (2007 data).

The UK government produces standardized cost-of-crime estimates [UK-Home Office (2011)] for different types of crime. These vary from: GBP1.8 million per murder, GBP37,000 per sexual offence, GBP8,800 per robbery-personal, GBP3,900 per burglary in a dwelling to GBP1,750 for common assault.

Crime Costs - Drugs

One UK study [Dubourg-Pritchard (2007)] estimated that the social cost of illicit drug use was GBP15.4B (in 2003). The bulk (90%) of these costs was related to crime versus health costs (4%) and drug-related death (6%). The primary components of drug related crime costs were robbery/burglary (43%), fraud (32%) and shoplifting (12%). Drug arrests (in and of themselves) accounted for only 3.5% of all drug use costs (GBP540M). The UK analysis suggested a ratio of social costs of illicit drug use to street value of drug consumption of 3:1.

4.5.3 Security Cost Associated with Residential Cultivation Misuse

For the Status Quo scenario, two forms of MMAR 'misuse' were modeled:

- 20% was assumed to involve 'major' misuse in which production licensees grow more than the authorized amount and divert the excess to the illicit market; and

- 80% was assumed to involve 'minor' misuse in which operators act as retail traffickers for a small part of their marihuana cultivation.

This assumption was based on the 80:20 *rule-of-thumb* (i.e., 20% of inappropriate activity creates 80% of the social problem) and allowed the analysis to concentrate on the major misuse, which, most importantly, is the activity that is assumed to increase the risk of home invasion and violence.

Four effects were examined that generate social welfare gains in the form of social willingness-to-pay to avoid the harm associated with crime related to the misuse of MMAR production licenses and the expected behavioural changes under the proposed Policy scenario.

a) *Avoidance of Residential Misuse*

b) *Avoidance of Home Invasion*

c) *Avoidance of Non-Fatal Shooting*

d) *Avoidance of Fatal Shooting*

In the analysis, event a) was applied to all 'major' and 'minor' misuse of MMAP production licenses. It was assumed that events b), c) and d) would apply only to the activity considered to be 'major' misuse of MMAR production licenses.

Data on social willingness to pay (WTP) (i.e., a 'top-down' measure) to avoid crimes has been estimated for the US [Cohen et al (2004)]. Similar data based on social costs (i.e. a 'bottom-up' measure) to avert crimes has been estimated for the UK [UK-Home Office (2011)]. To "convert" the social cost estimate to a WTP estimate[17] the analysis took an average of comparable estimates from the US and UK after adjusting for exchange rates[18]. Generally, in all cases the US and UK estimates were in the same order of magnitude.

a) Risk & Consequence of Residential Misuse

All MMAR misuse is considered to be residential misuse. There is no evidence in the literature as to a social WTP to avoid drug trafficking or to avoid marihuana cultivation in a residential area. Accordingly, the analysis did not include a value for this WTP in the absence of an estimate available in the literature.

b) Risk & Consequence of Home Invasion

Over the seven years of the police review of alleged MMAR misuse cases, there were 16 alleged cases of home invasion reported in relation to 190 police cases of alleged MMAR misuse. During those years, there was an average of about 1,650 MMAR production licenses and, based on the 36% misuse rate, about 595 estimated cases of misuse. On an annual basis, in terms of the probability of home invasion occurrence, this worked out to 0.38% per year per MMAR misuse. As all home invasion events were attributed in the CBA to *major* misuse, this worked out to a probability of 1.92% per major case of MMAR misuse.

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[17] The analysis employed a rule of thumb adjustment factor of 2.0 so that the UK social cost estimates were multiplied by 2.0 to reflect WTP estimates.

[18] US$1.00 = CA$1.00 ; GBP1.00 = CA$1.30 (as of June 4, 2012).

For 'home invasion', the analysis used adjusted WTP estimates from the UK for 'robbery-personal' and the US for 'burglary' which averaged to $23,900 (US estimate of CA$25,000, UK adjusted estimate of CA$22,900).

c) Risk & Consequence of Non-Fatal Shooting

There were two (2) cases of shootings associated with home invasion reported in relation to the 190 police cases of alleged MMAR misuse. Represented as an annual probability, this is 0.048% per year per MMAR misuse. Since all shooting events were attributed in the analysis to *major* misuse, this worked out to a probability of 0.24% per year per major case of MMAR misuse. Data [Kleck (1991)] suggest that the probability of a fatality (given shooting) is 15%, so the probability of a non-fatal shooting would be 85% (given shooting).

For 'non-fatal shooting' the analysis used adjusted WTP estimates from the UK for 'serious wounding' and the US for 'serious assault', which averaged to $68,500 (US estimate of CA$70,000, UK adjusted estimate of CA$67,000).

d) Risk & Consequence of Fatal Shooting

For 'fatal shooting', the CBA used adjusted WTP estimates from the UK and US for 'murder' which averaged to $7.2M (US estimate of CA$9.7M, UK adjusted estimate of CA$4.7M). These WTP estimates for tragic, violent loss of life were much higher than the Canadian Statistical Value of Life, which is a WTP measure of death in normal circumstances.

Social Cost Associated with Residential Misuse – Status Quo

The social loss associated with residential misuse is given in the Status Quo scenario by:

$$(47)\quad \text{Social Loss}_{misuse}(t) = \text{ATP-P/D}(t) * Pr_{misuse} * WTP_{misuse}$$

where:

ATP-P/D(t) = number of persons ATP-P and number of persons with ATP-D divided by a scale factor to allow for multiple DPPL.

Pr_{misuse} = 36%

WTP_{misuse} = $0

Social Cost Associated with Home Invasion – Status Quo

The social loss associated with home invasion is given in the Status Quo scenario by:

$$(48)\quad \text{Social Loss}_{invasion}(t) = \text{ATP-P/D}(t) * Pr_{misuse} * Pr_{major} * Pr_{invasion} * WTP_{invasion}$$

where:

ATP-P/D(t) = number of persons ATP-P and number of persons with ATP-D

divided by a scale factor to allow for multiple DPPLs.

Pr_{misuse} = 36%

Pr_{major} = 20% (conditional probability given misuse)

$Pr_{invasion}$ = 1.921% (conditional probability given *major* misuse)

$WTP_{invasion}$ = $23,900

Social Cost Associated with Non-Fatal Shooting – Status Quo

The social loss associated with non-fatal shooting is given in the Status Quo scenario by:

(49) $\text{Social Loss}_{non\text{-}fatal}(t) = \text{ATP-P/D}(t) * Pr_{misuse} * Pr_{major} * Pr_{shoot} * (1-Pr_{fatal}) * WTP_{non\text{-}fatal}$

where:

ATP-P/D(t) = number of persons ATP-P and number of persons with ATP-D divided by a scale factor to allow for multiple DPPLs.

Pr_{misuse} = 36%

Pr_{major} = 20% (conditional probability given misuse)

Pr_{shoot} = 0.240% (conditional probability given *major* misuse)

Pr_{fatal} = 15% (conditional probability given shooting)

$WTP_{non\text{-}fatal}$ = $68,000

Social Cost Associated with Fatal Shooting – Status Quo

The social loss associated with fatal shooting is given in the Status Quo scenario by:

(50) $\text{Social Loss}_{fatal}(t) = \text{ATP-P/D}(t) * Pr_{misuse} * Pr_{major} * Pr_{shoot} * Pr_{fatal} * WTP_{fatal}$

where:

ATP-P/D(t) = number of persons ATP-P and number of persons with ATP-D divided by a scale factor to allow for multiple DPPLs.

Pr_{misuse} = 36%

Pr_{major} = 20% (conditional probability given misuse)

Pr_{shoot} = 0.240% (conditional probability given *major* misuse)

Pr_{fatal} = 15% (conditional probability given shooting)

WTP_{fatal} = $7,190,000

Status Quo – Security Cost

For each of the security events associated with PUPL/DPPLs, the social costs associated with residential misuse, home invasions and non-fatal/fatal shootings are given in the Status Quo scenario over time, by:

(51) $\text{Security Cost}(t) = \text{Social Loss}_{misuse}(t) + \text{Social Loss}_{invasion}(t) + \text{Social Loss}_{non\text{-}fatal}(t) + \text{Social Loss}_{fatal}(t)$

4.6 Status Quo – Summary of Benefits & Costs

Status Quo – Program Administration Costs

Health Canada – Program Administration Costs are from equation 22.

Compliance cost is given from equation 23.

Status Quo – User Benefits

User benefit is the sum of the Consumer Surplus measures for each of Government Supply (equation 32), Personal Use (equation 38) and Designated Person (equation 43) supply markets.

The Deadweight Loss (from the effective subsidy for the Government Supply) is given from equation 33.

There is no Producer Surplus in the Status Quo scenario.

Status Quo – Safety Costs

Safety cost is the sum of the Fire Costs (equation 46) for each of the PUPL and scaled DPPL supply.

Status Quo – Security Costs

Security cost is given from equation 51.

This concludes the discussion of the Status Quo scenario and measures to be calculated for the CBA. The next section addresses the Policy scenario that embodies the proposed Regulatory changes.

4.7 Policy – Transition Model (April 2014)

It is contemplated that, as of April 1, 2014, there will be a migration from the existing MMAP (Status Quo scenario) to the new (Policy scenario) regime for access to marihuana for medical purposes. This migration (transition) may take place in a number of ways.

The CBA model did not attempt to capture the complexity of the transition dynamics. Generally, the CBA focused on the 'steady state' of this transition process and the number of persons who will 'remain' in the legal marihuana access regime and the number of persons who will choose an illegal supply source.

The reasons that persons who have been participating in the MMAP (prior to April 1, 2014) may choose to obtain marihuana from an illegal supply source are various and include:

- the supply cost of legal marihuana from LP may be too high;
- persons may prefer the control and quality of their own production; and
- persons may want to engage in illicit marihuana cultivation and distribution.

It has already been noted that some proportion (36%) of PUPL/DPPLs may involve misuse. Some 80% of ATP persons are associated with PUPL and DPPL production activities. The cost of legal supply through LPs will likely be higher than the supply cost for PUPL/DPPL production.

The CBA assessed the likely migration of persons from each of ATP-GS, ATP-O, ATP-P and ATP-D status to the new regime.

4.7.1 Policy Transition – Government Supply

In April 2014, the Status Quo scenario was forecast to have 1,823 KG-Demand for the Government Supply with an estimated 387 grams per year per full-time user[19]. One of the reasons for the relatively low usage rate for the Government Supply was the perceived quality of the cannabis strain used [Lucas (2009)]. In the Policy scenario, LP suppliers would be able to offer a variety of cannabis strains. It is therefore probable that, subject to affordability, the amount per person purchased could be different from this amount per year. The analysis, therefore, made an adjustment to the KG-demand that would be purchased at $5.00/gram (the Status Quo user price) before applying a model based on the operation of demand price elasticity.

Analysis [Kilmer-Pacula (2009)] suggests that heavy marihuana users consume about 1.2 grams per day +/- 0.4 grams. The analysis took 1.6 grams per day as the *desired* mean daily amount that a person would want to consume of marihuana. This would imply an annual

[19] This average is based on 1,823KG and 4,712 ATP-GS users. For this calculation, no consumption was attributed to persons on interim supply with new PUPL/DPPL production licenses.

consumption of 560 grams which, at $5.00/g, would cost $2,800 per year. This was felt to be affordable for the mean MMAP ATP person with a mean annual income of $30,000[20].

The base annual quantity of marihuana (in KG) that would be consumed in the Policy scenario, for the initial number of persons with ATP-GS in April 2014 and at the Status Quo user price of $5.00 per gram, is given by:

(52) Base KG-GS(User Price) = ATP-GS(April 2014) * 560 grams / 1,000

For the establishment of the benchmark transition to the Policy scenario, it was assumed that the LP market price of marihuana would be $7.50/g[21]. This represents a 50% increase in price (over the Status Quo user price per gram). With an assumed price elasticity ε_p of -0.25, the quantity demanded would be expected to fall by 12.5%.

$$\%\Delta\text{Quantity} = \varepsilon_p * \%\Delta\text{Price}$$

Therefore, the base annual quantity of marihuana (in KG) that would be consumed in the Policy scenario, for the initial number of persons with ATP-GS in April 2014 and at the higher LP market price of $7.50 per gram, would be:

(53) Base KG-GS(Market Price) = Base KG-GS(User Price) * (1 + %ΔQuantity-GS)

This equation captures the operation of the price elasticity, after a base adjustment for the different type of cannabis strains that will be supplied in the LP market. The operation of the price elasticity means that the quantity amount of marihuana has decreased as price rises. There are three ways in which, using a simple formula, this quantity reduction could be determined. The formula for the base quantity is:

Base KG-GS = User-GS * Days of Use * Quantity Per Day

The price elasticity effect could come about via some combination of changes in: a) the number of users; b) the number of days of use per year; and/or c) the mean quantity per day of use. For simplicity, the analysis assumed that there is no change in the number of days of use per year, so the above equation reduces to:

%ΔQuantity-GS = %ΔUser-GS + %ΔQuantity Per Day-GS

In order to assess the affordability of the quantity per day at the LP market price, the Proportion of Mean Annual Income (pre-tax) that would be comprised of marihuana purchases was computed. This proportion is:

%Annual Income = [Days-of-Use * Quantity-per-Day * Market Price] / Mean Income

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[20] Lucas (2009) reports an income distribution for a sample of MMAP users that implies a mean annual income of about $30,000, although 30% report earning less than $20,000 per year. At $5.00/gram, the expenditure of $2,800 per year would account for about 9% of pre-tax individual income.

[21] The reasonableness of this estimate was assessed in terms of an equilibrium model of Supply and Demand in the LP market for marihuana (see below). Effectively, the study assumed that ATP persons in the Transition face an *ex ante* expected user price of $7.50/gram which may be slightly more or less than the *ex post* realized price in LP market equilibrium when supply and demand interact.

In the CBA model, if the annual cost per user did not exceed $4,500 (i.e., 15% of mean annual income of $30,000), all of the price elasticity effect was ascribed to a reduction in the number of users. Conversely, if the annual cost per user did exceed $4,500, some proportion of the price elasticity was allowed to reduce the quantity per day so that the percentage of mean annual income required did not exceed 15%.

Various studies have shown that, with co-payment (usually 20% of private prescription drug costs), the annual amount spent on certain prescription drugs or treatment can be up to 17% of annual family income [Canadian Cancer Society (2009), Canadian Diabetes Association (2010)]. The out-of-pocket costs of new cancer drugs can be up to $13,000 per year and for Type I diabetes drugs and insulin pump up to $4,700 per year.

The Quantity per Day in the Policy scenario, for persons on Government Supply (as of April 2014), is calculated as:

(54) Quantity/Day-GS = MIN{1.6, [Mean Annual Income * Max % of Income / 350 / $7.50]}

In the Reference case, the effective minimum of the right-hand side was 1.6 grams per day. This equation allows, in the sensitivity analysis for a lower assumption as to maximum percentage of income, for the amount to be less than 1.6 grams per day.

The %ΔQuantity Per Day can therefore be calculated as:

(55) %ΔQuantity/Day-GS = [Quantity/Day-GS - 1.6] / 1.6

The %ΔUser-GS can therefore be calculated as:

(56) %ΔUser-GS = %ΔQuantity-GS - %ΔQuantity/Day-GS

The number of users in the Policy scenario, for persons formerly on Government Supply (as of April 2014), is calculated as:

(57) Users-GS(Market Price) = ATP-GS(April 2014) * (1 + %ΔUsers-GS)

Equations 53 and 57, therefore, represent the KG-Demand and the number of users in the Policy scenario that would result from the transition from the Status Quo for persons formerly on the Government Supply.

4.7.2 Policy Transition – Other (Government Supply)

There was the same number of persons with ATP-G who did not access the Government Supply (i.e., ATP-O) as those who accessed the Government Supply (ATP-GS) in the Status Quo as of April 2014. The analysis did not count their consumption for the Consumer Surplus measure, as there was no indication as to where the marihuana was obtained.

In the Policy scenario, such persons might start to obtain marihuana from the LP supply, provided that the LP market price was at or below the price prevailing in the illicit market. The

rationale for this switch is that the cannabis strains and quality are likely to be diverse in the LP market and should be comparable to those currently available in the illicit market.

The analysis assumed that these persons would generally consume at the same level of daily usage, at the LP market price, as the persons formerly reliant on the Government Supply, provided that the LP market price was below that of the illicit market price. However, as they would likely experience a decrease in their supply price, they might be able to afford an increased amount per day.

The logic flow for this component of the transition is reversed from that for the above component. Provided that the LP market price is less than the illicit market price, it is possible to calculate the %ΔPrice experienced by these users as:

(58) %ΔPrice-O = [LP-Price – Illicit Price] / Illicit Price

The associated %ΔQuantity can therefore be calculated as:

(59) %ΔQuantity-O = ε_p * %ΔPrice-O

The additional quantity consumed is reflected in a higher Quantity/Day, while the number of users is kept constant:

(60) %ΔQuantity/Day-O = 1.60 + (1 + %ΔQuantity-O)

Therefore, the base annual quantity of marihuana (in KG) that would be consumed in the Policy scenario, for the expected number of persons with ATP-O who will transition to the LP market at the lower LP market price of $7.50 per gram, is expected to be:

(61) Base KG-O(Market Price) = ATP-O(April 2014) * * 350 * (1 + %ΔQuantity/Day-O).

The Number of Users in the Policy scenario, for persons formerly in Other Supply (as of April 2014) is calculated as:

(62) Users-O(Market Price) = ATP-O(April 2014)

Therefore, equations 61 and 62 represent the KG-Demand and Number of Users in the Policy scenario that result from the transition from the Status Quo for persons formerly on Other Supply.

4.7.3 Policy Transition – Personal Use

Persons with PUPL who are ATP-P in April 2014 must decide whether to switch their use to the legal supply from the LP market. This is the only option for these persons to access a legal supply of marihuana for medical purposes.

There are two aspects to the transition of persons who formerly held PUPLs (and DPPLs) that make this process more complicated:

- Some proportion (36%) of these persons is likely engaged in some form of misuse (based on police data) and may want to continue that activity in the future; and

- Some other proportion of these persons may feel 'entitled' to continue to cultivate own-use marihuana, even if not involved in misuse in terms of otherwise supplying the illicit market – such entitlement may arise from civil disobedience in reaction to a change in their previous legal authorization to produce.

In the first case, the 'economics of crime' must be considered in terms of the relative, risk-adjusted rewards and penalties associated with illicit behaviour. It is still necessary to differentiate between the scale of operation involved in this form of marihuana cultivation from the normal 'grow-op' because the locus of production is the family residence in the presence of family members.

In the second case, allowance is made for some proportion that may opt out, based on their perceived right to grow marihuana for their own use.

Economics of Residential Misuse

The analysis applied a model of rational criminal activity based on Canadian studies [Desroches (2005), Dandurand et al (2002), Bouchard (2007), Easton (2004)]. It is important to distinguish between residential misuse marihuana cultivation and 'grow-op' activity. While these share some similarities, what is different about residential misuse is the presence of family members. Grow-op houses are usually dedicated to marihuana cultivation and operated by paid employees or persons who share the criminal proceeds of the operation.

One study [Dandurand et al (2002)] of British Columbia marihuana trafficking over a four-year period found that there was a very low (5%) risk of a grow operation coming to the attention of police. In terms of the consequence of police detection, the biggest risk was seizure of plants and other assets for evidence (pr=100%), followed by charges laid (pr=85%), conviction of at least one suspect in the case (pr=63%), the payment of a fine (pr=25%) and prison sentence (pr=17%). The average prison term upon conviction was 2.5 months and the average fine was $1,000[22].

One study [Bouchard (2007)] of Quebec marihuana cultivation over a seven-year period found that there was a very low (2.5%) risk of arrest per offender at risk (for indoor hydroponic cultivation). The study estimated the number of marihuana cultivation operations in Quebec, which was extrapolated using a growth rate per year of 16% to derive an estimate of about 60,000 grow operations in 2012. There are probably less than 1,000 PUPLs/DPPLs in Quebec, so the contribution of MMAR 'misuse' to the overall marihuana cultivation activity level is minimal (less than 1%, assuming that perhaps 36% of PUPL/DPPL activity involves 'misuse').

There could be several reasons why marihuana cultivation under the MMAR is such a small share of overall activity:

a) It requires identifying a residence and producer to Health Canada (which police can access under certain conditions); and

[22] Note that probabilities and magnitude of both fines and prison sentences likely have changed as a result of recent amendments to the law. The magnitude of any such changes could not be assessed at this time and therefore historical values were used for the purposes of the analysis.